13001 GARDEN GROVE BOULEVARD
GARDEN GROVE, CA 92843-2102
PHONES: (714) 971-2421
(949) 654-2421
FAX: (714) 971-3940
ocvcd@ocvcd.org
ocvcd.org
facebook.com/ocvectorcontrol
twitter.com/ocvector

April 29, 2016

Mr. Gil Vazquez
State Water Resources Control Board
NPDES Wastewater Unit, 15th Floor
1001 I Street
Sacramento, CA 95814

RE: TRANSMITTAL OF NOTICE OF INTENT TO COMPLY WITH THE TERMS OF WATER QUALITY ORDER NO. 2016-0039-DWQ STATEWIDE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR BIOLOGICAL AND RESIDUAL PESTICIDE DISCHARGES TO WATERS OF THE OF THE UNITED STATES FROM VECTOR CONTROL APPLICATIONS (GENERAL PERMIT) NO. CAG990004

Dear Mr. Vazquez:

Please find attached a Notice of Intent to comply with the terms of the above-listed Statewide General Permit for Vector Control Applications. Additionally, you will find enclosed the required Pesticide Application Plan. We have also attached a check warrant no. #18958 payment of the application fee each in the amount of $241.00 for enrollment. Copies of the NOI package have been emailed to both the Santa Ana and San Diego Regional Water Quality Control Boards under whose jurisdiction we operate.

If you have any questions or require further information please contact me at (714) 971-2421 ext.140.

Sincerely,

Amber Semrow
Biologist, OCMVCD

CC: Richard Howard, District Manager
Enc. (1) *NOI Application Package including check and Pesticide Application Plan*

Notice of Intent

TO COMPLY WITH THE TERMS OF WATER QUALITY ORDER NO. 2016-0039-DWQ STATEWIDE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR BIOLOGICAL AND RESIDUAL PESTICIDE DISCHARGES TO WATERS OF THE OF THE UNITED STATES FROM VECTOR CONTROL APPLICATIONS (GENERAL PERMIT) NO. CAG990004

Submitted by

The Orange County Mosquito and Vector Control District

April 29, 2016

Prepared for:

State Water Resources Control Board
Santa Ana Regional Water Quality Control Board (Region 8)
San Diego Regional Water Quality Control Board (Region 9)

Prepared by:

Orange County Vector Control District
13001 Garden Grove Blvd.
Garden Grove, CA 92843
Contact: Larry Shaw, Director of Operations
Telephone: (714) 971-2421
Fax: (714) 971-3940

ATTACHMENT E – NOTICE OF INTENT

WATER QUALITY ORDER 2016-0039-DWQ
GENERAL PERMIT CAG990004

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# _____

☒ D. Enrolled under Order 2011-0002-DWQ: WDID# 830346001

II. DISCHARGER INFORMATION

A. Name			
Orange County Mosquito and Vector Control District			
B. Mailing Address			
13001 Garden Grove Blvd.			
C. City	D. County	E. State	F. Zip Code
Garden Grove	Orange	CA	92843
G. Contact Person	H. Email address	I. Title	J. Phone
Richard Howard	rhoward@ocvcd.org	District Manager	714-740-4150

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. 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: various - see Attachment A
Name of the conveyance system: Applications may be made to various Conveyance systems in Orange County

☒ 3. Directly to river, lake, creek, stream, bay, ocean, etc.
Name of water body: various - see Attachment A

* 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 8 and 9
(List all regions where pesticide application is proposed.)

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

V. PESTICIDE APPLICATION INFORMATION

A. Target Organisms: ☒ Vector Larvae ☒ Adult Vector

B. Pesticides Used: List name, 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 Pesticides Application Plan 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. See Attachment C

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 Order, including developing and implementing a monitoring program, will be complied with."

A. Printed Name: Richard Howard

B. Signature: _____ **Date:** 4-27-16

C. Title: District Manager

X. FOR STATE WATER BOARD USE ONLY

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

ATTACHMENT – A

IV. RECEIVING WATER INFORMATION

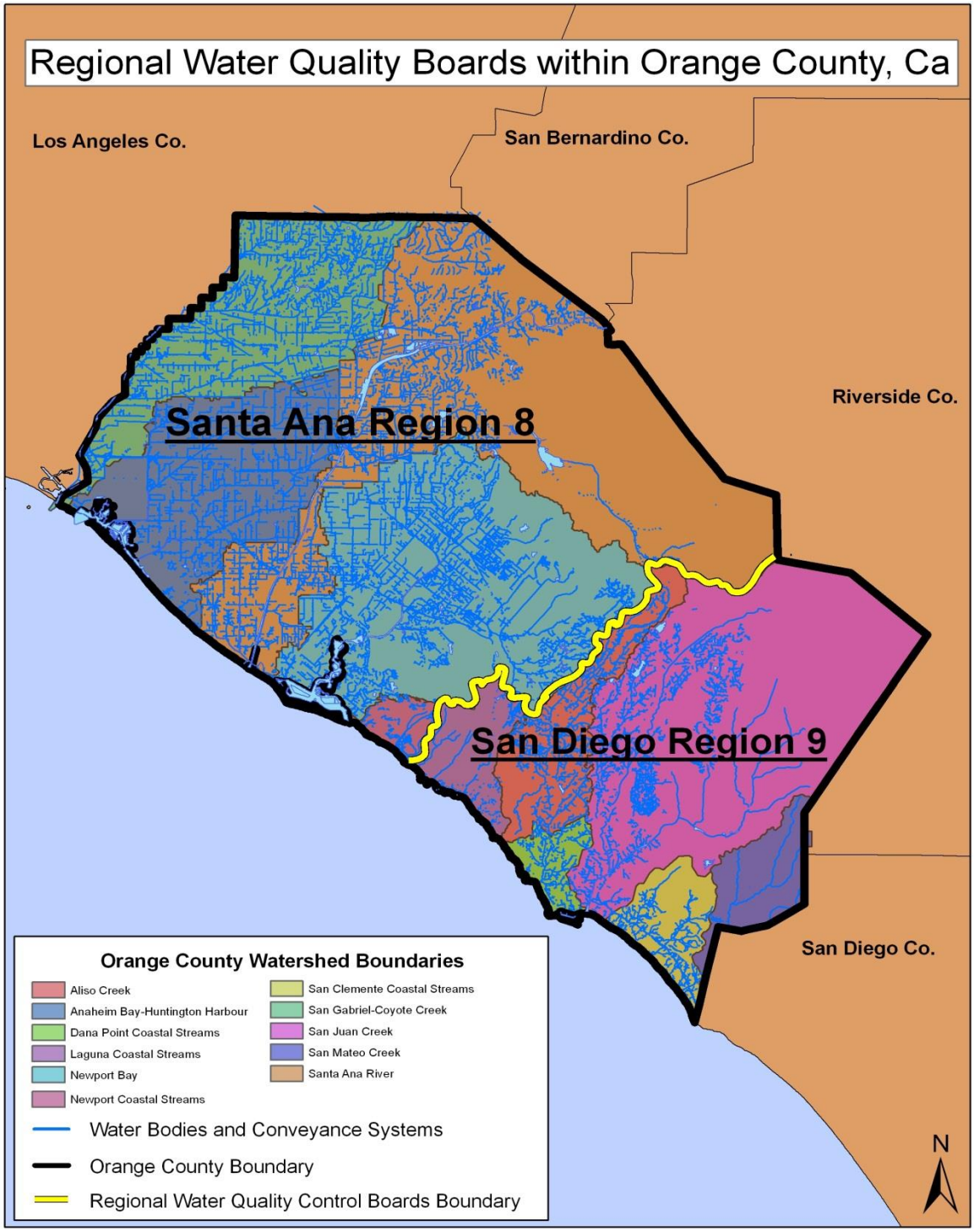
A. 2. and 3. – Below is a list of receiving waters in Orange County. These features, their tributaries, lakes, reservoirs, marshes, unnamed drainages, ditches, and water conveyances and infrastructure throughout the county can be subject to mosquito control applications by the Orange County Mosquito and Vector Control District.

List of Orange County Receiving Waters by Water Quality Control Board Regions

Santa Ana Region 8	**San Diego Region 9**
Anaheim Bay-Huntington Harbor	***Aliso Creek***
Bolsa Chica Channel	Wood Canyon
Bolsa Chica Wetlands	Sulphur Creek
East-Garden Grove Wintersburg Channel	Aliso Hills Channel
Westminster Channel	English Channel
Newport Bay	***Dana Point Harbor***
Big Canyon Wash	***Salt Creek***
Costa Mesa Channel	***Laguna Canyon Creek***
Santa Isabella Channel	Boat Canyon Drainage
Santa Ana Delhi	Blue Bird Canyon Drainage
San Diego Creek	Rim Rock Canyon Drainage
Peters Canyon Wash	Hobo Canyon Drainage
Newport Coast	Emerald Canyon Drainage
Muddy Creek	***Prima Deshecha Canada***
San Gabriel River	***Prima Deshecha***
Coyote Creek	***Segunda Deshecha Canada***
Carbon Creek	***San Juan Creek***
Santa Ana River	Arroyo Trabuco
Santiago Creek	Oso Creek
	San Mateo Creek
Numerous unnamed drainages and tributaries	**Numerous unnamed drainages and tributaries**

IV. RECEIVING WATER INFORMATION

B. Map of locations A. 2.-3.



ATTACHMENT – B

V. PESTICIDE APPLICATION INFORMATION (B.)

List of Active Ingredients that may be used under NPDES Permit.

Active Ingredients
Larvicides:
Bacillus thruingiensis subp. *israelensis* (*Bti*)
Lysinibacillus sphaericus (*Ls*) formerly *Bacillus sphaericus* (*Bs*)
Methoprene
Monomolecular Films
Petroleum Distillates
Spinosad
Temephos
Adulticides:
Deltamethrin
Etofenprox
Lambda-Cyhalothrin
Malathion
Naled
N-octyl bicycloheptene dicarboximide (MGK-264)
Piperonyl butoxide (PBO)
Permethrin
Prallethrin
Pyrethrin
Resmethrin
Sumithrin
In addition: Any “minimum risk category” pesticides that are FIFRA exempt and registered for use in California and used in a manner specified in 40 C.F.R. section 152.25.

ATTACHMENT C - NPDES GOVERNMENT CONTACT LIST

ID	Agency / Org	Name	Phone Number	Email	Website
City Manager or City Clerk	Aliso Viejo	David Doyle	(949) 425-2510	city-manager@cityofalisoviejo.com	http://www.cityofalisoviejo.com/
City Manager or City Clerk	Anaheim	Paul Emery	(714) 765-5165	pemery@anaheim.net	http://www.anaheim.net/
City Manager or City Clerk	Brea	Tim O'Donnell	(714) 990-7725	timo@cityofbrea.net	http://www.ci.brea.ca.us/
City Manager or City Clerk	Buena Park	James B. Vanderpool	(714) 562-3500	jvanderpool@buenapark.com	https://www.buenapark.com/
City Manager or City Clerk	Costa Mesa	Tom Hatch	(714) 754-5223	tom.hatch@costamesaca.gov	http://www.costamesaca.gov/
City Manager or City Clerk	Cypress	Peter Grant	(714) 229-6699	adm@ci.cypress.ca.us	http://www.ci.cypress.ca.us/
City Manager or City Clerk	Dana Point	Doug Chotkevys	(949) 248-3513	dchotkevys@danapoint.org	http://www.danapoint.org/index.aspx
City Manager or City Clerk	Fountain Valley	Bob Hall	(714) 593-4410	bob.hall@fountainvalley.org	http://www.fountainvalley.org/
City Manager or City Clerk	Fullerton	Joe Felz	(714) 738-6310	CityManager@ci.fullerton.ca.us	http://www.ci.fullerton.ca.us/
City Manager or City Clerk	Garden Grove	Scott Stiles	(714) 741-5000	sstiles@ci.gardengrove.ca.us	http://www.ci.garden-grove.ca.us/
City Manager or City Clerk	Huntington Beach	Fred Wilson	(714) 536-5202	fred.wilson@surfcity-hb.org	http://www.huntingtonbeachca.gov/
City Manager or City Clerk	Irvine	Sean Joyce	(949) 724-6000	cm@cityofirvine.org	http://www.cityofirvine.org/
City Manager or City Clerk	La Habra	Jim Sadro	(562) 383-4010	jsadro@lahabraca.gov	http://www.lahabracity.com/

ID	Agency / Org	Name	Phone Number	Email	Website
City Manager or City Clerk	La Palma	Ellen Volmert	(714) 690-3333	administration@cityoflapalma.org	http://www.cityoflapalma.org/
City Manager or City Clerk	Laguna Beach	John Pietig	(949) 497-0704	lhall@lagunabeachcity.net	http://www.lagunabeachcity.net/
City Manager or City Clerk	Laguna Hills	Bruce E. Channing	(949) 707-2610	bchanning@ci.laguna-hills.ca.us	http://www.ci.laguna-hills.ca.us/
City Manager or City Clerk	Laguna Niguel	Rod Foster	(949) 362-4300	rfoster@cityoflagunaniguel.org	http://www.cityoflagunaniguel.org/
City Manager or City Clerk	Laguna Woods	Christopher Macon	(949) 639-0500	cmacon@lagunawoodscity.org	http://www.lagunawoodscity.org/
City Manager or City Clerk	Lake Forest	Robert Dunek	(949) 461-3412	rdunek@lakeforestca.gov	http://www.lakeforestca.gov/
City Manager or City Clerk	Los Alamitos	Bret M. Plumlee	(562) 431-3538	bplumlee@cityoflosalamitos.org	http://cityoflosalamitos.org/
City Manager or City Clerk	Mission Viejo	Dennis Wilberg	(949) 470-3000	dwilberg@cityofmissionviejo.org	http://cityofmissionviejo.org/
City Manager or City Clerk	Newport Beach	Dave Kiff	(949) 644-3001	dkiff@newportbeachca.gov	http://www.newportbeachca.gov/
City Manager or City Clerk	Orange	John Sibley	(949) 744-2222	jsibley@cityoforange.org	http://www.cityoforange.org/
City Manager or City Clerk	Placentia	Damien Arrula	(714) 993-8117	administration@placentia.org	http://www.placentia.org/
City Manager or City Clerk	RSM	Jennifer Cervantez	(949) 635-1800	jcervantez@cityofrsm.org	http://www.cityofrsm.org/
City Manager or City Clerk	San Clemente	James Makshanoff	(949) 361-8322	CityManager@San-Clemente.org	http://san-clemente.org
City Manager or City Clerk	San Juan Capistrano	Karen Brust	(949) 443-6315	kburst@sanjuancapistrano	http://www.sanjuancapistrano.org/

ID	Agency / Org	Name	Phone Number	Email	Website
City Manager or City Clerk	Santa Ana	David Cavazos	(714) 647-5400	dcavazos@santa-ana.org	http://www.santa-ana.org/
City Manager or City Clerk	Seal Beach	Jill R. Ingram	(562) 431-2527	jingram@sealbeachca.gov	http://www.sealbeachca.gov/
City Manager or City Clerk	Stanton	James A. Box	(714) 379-9222	jbox@ci.stanton.ca.us	http://www.ci.stanton.ca.us/
City Manager or City Clerk	Tustin	Jeffrey Parker	(714) 573-3000	jparker@tustinca.org	https://www.tustinca.org/
City Manager or City Clerk	Villa Park	Jarad Hildenbrand	(714) 998-1500	jhildenbrand@villapark.org	http://www.villapark.org/
City Manager or City Clerk	Westminster	Eddie Manfro	(714) 548-3172	emanfro@westminster-ca.gov	http://www.westminster-ca.gov/
City Manager or City Clerk	Yorba Linda	Mark Pulone	714-961-7110	mpulone@yorba-linda.org	http://www.ci.yorba-linda.ca.us/
Water Districts	East Orange County Water District	Lisa Ohlund	(714) 538-5815	lohlund@eocwd.com	http://www.eocwd.com/contact
Water Districts	El Toro Water District	Robert R. Hill	(949) 837-0660	district@etwd.com	http://www.etwd.com/
Water Districts	Emerald Bay Service District	Michael Dunbar	(949) 494-8571	mdunbar@ebservicedistrict.com	http://www.ebca.net/
Water Districts	Golden State Water Company	Ken Vecchiarelli	(714)535-7711	k.vec@gswater.com	www.gswater.com
Water Districts	Irvine Ranch Water District	Paul Cook	(949) 453-5300	cook@irwd.com	http://www.irwd.com/
Water Districts	Laguna Beach County Water District	Renae Hinchey	(949) 494-1041	rhinchy@lbcwd.org	http://www.lbcwd.org/
Water Districts	Mesa Water District	Paul E. Schoenberger	(949) 631-1206	pauls@mesawater.org	http://www.mesawater.org/

ID	Agency / Org	Name	Phone Number	Email	Website
Water Districts	Metropolitan Water District of Southern California	Jeffrey Kightlinger	(213) 217- 6139	officeofthegeneralmanager2@mwdh2o.com	http://www.mwdh2o.com/
Water Districts	Moulton Niguel Water District	Joone Lopez	(949) 831-2500	jlopez@mnwd.com	http://mnwd.com/
Water Districts	Municipal Water District of Orange County	Rob Hunter and Karl Seckel (Assistant GM)	(714) 593-5026	kseckel@mwdoc.com	http://www.mwdoc.com/
Water Districts	Orange County Water District	Michael R. Markus, PE	(714) 378-3200	mmarkus@ocwd.com	http://www.ocwd.com/
Water Districts	Santa Ana Watershed Association	Hugh Wood	(951) 780-1012 (Ext. 23)	hwood@sawatershed.org	http://www.sawatershed.org/
Water Districts	Santa Ana Watershed Project Authority	Celeste Cantu	(951) 354-4229	ccantu@sawpa.org	http://www.sawpa.org/
Water Districts	Santa Margarita Water District	Daniel R. Ferons	(949) 459-6576	danf@smwd.com	http://www.smwd.com/
Water Districts	Serrano Water District	Jerry Vilander	(714) 538-0079	jerryvilander@gmail.com	http://www.serranowater.org/
Water Districts	South Coast Water District	Andrew Brunhart	(949) 499-4555 (Ext. 3160)	abrunhart@scwd.org	http://www.scwd.org/
Water Districts	Trabuco Canyon Water District	Hector Ruiz	(949) 858-0277	hruiz@tcwd.ca.gov	http://www.tcwd.ca.gov/index.html
Water Districts	West Orange County Water Board	Brian Ragland	(714) 536-5503	Brian.Ragland@surfcity-hb.org	
Water Districts	Yorba Linda Water District	Marc Marcantonio	(714) 701-3020	mmarcantonio@ylwd.com	http://www.ylwd.com/
Local Agencies	County of Orange: Agricultural Commissioner	Jeff Croy	(714) 955-0100	jeff.croy@ocpw.ocgov.com	http://ocagcomm.com/contact/
Local Agencies	County of Orange: Division of Environmental Health		(714) 433-6000	ehealth@ochca.com	http://www.ochealthinfo.com/eh/contact

ID	Agency / Org	Name	Phone Number	Email	Website
Local Agencies	County of Orange: OC Parks	Robin M. Lamont	949-585-6441	robin.lamont@occr.ocgov.com	http://ocgov.com/gov/occr/ocparks/
Local Agencies	County of Orange: OC Parks	Stacy Blackwood	(949) 923-3743	Stacy.Blackwood@occr.ocgov.com	http://ocgov.com/gov/occr/ocparks/
Local Agencies	County of Orange: OC Stormwater Program	Mary Anne Skorpanich	(714) 955-0601	maryanne.skorpanich@ocpw.ocgov.com	http://ocwatersheds.com/programs/waterways/stormwater
Local Agencies	Orange County Department of Education	Al Mijares	(714) 966-4000	amijares@ocde.us	http://www.ocde.us/Pages/default.aspx
Local Agencies	County of Orange	Mike Giancola	(714) 834-6201	Mike.Giancola@ocgov.com	www.ocgov.com
Local Agencies	County of Orange - Dept. of Public Works	Shane L. Silsby	(714) 667-9700	shane.silsby@ocpw.ocgov.com	www.ocgov.com
Local Agencies	County of Orange - Health Care Agency	Mark Refowitz	(714) 834-6021	mrefowitz@ochca.com	www.ocgov.com
Local Agencies	Board of Supervisors	Andrew Do	(714) 834-3110	First.District@ocgov.com	www.ocgov.com
Local Agencies	Board of Supervisors	Michelle Steel	(714) 834-3220	Michelle.Steel@ocgov.com	www.ocgov.com
Local Agencies	Board of Supervisors	Todd Spitzer	(714) 834-3330	Todd.Spitzer@ocgov.com	www.ocgov.com
Local Agencies	Board of Supervisors	Shawn Nelson	(714) 834-3440	Shawn.Nelson@ocgov.com	www.ocgov.com
Local Agencies	Board of Supervisors	Lisa A. Bartlett	(714) 834-3550	Lisa.Bartlett@ocgov.com	www.ocgov.com
Local Agencies	Irvine Ranch Conservancy	Jutta Burger	714-508-4757	jburger@irconservancy.org	http://irconservancy.org/keeping/contactus.aspx
Local Agencies	Orange County Fire Authority	Jeff Bowman	(714) 573-6010	capa@ocfa.org	http://www.ocfa.org/

ID	Agency / Org	Name	Phone Number	Email	Website
Local Agencies	Southern California Association of Governments	Kevin Gilhooley	(213) 236-1878	gilhooley@scag.ca.gov	https://www.scag.ca.gov/pages/default.aspx
Local Agencies	Nature Reserve of Orange County	James M. Sulentich	949-453-3324	jsulentich@occonservation.org	http://occonservation.org/
Local Agencies	Orange County Sheriff's Department- Orange County Operational Area	Donna Boston	(714) 628-7054	dboston@ocsd.org	http://ocsd.org/divisions/fieldops/emb
Local Agencies	Orange County Sheriff's Department	Brain Wayt	(714)647-7000	bwayt@ocsd.org	http://ocsd.org/
State & Federal	California Coastal Commission	Sherilyn Sarb	(562) 590-5071	ssarb@coastal.ca.gov	http://www.coastal.ca.gov/
State & Federal	California Department of Fish and Wildlife (Region 5: South Coast Region)	Ed Pert	(858) 467-4201	Ed.Pert@wildlife.ca.gov	http://www.dfg.ca.gov/
State & Federal	California Department of Fish and Wildlife - Bolsa Chica	Kelly O'Reilly	(714) 840-1959	Kelly.O'Reilly@wildlife.ca.gov	http://www.dfg.ca.gov/
State & Federal	California Department of Fish and Wildlife - Upper Newport Back Bay	Carla Navaro	(949) 640-9961	Carla.Navarro@wildlife.ca.gov	http://www.dfg.ca.gov/
State & Federal	Santa Ana Regional Water Quality Control Board (Region 8)	Kurt Berchtold	(951) 782-3286	kberchtold@waterboards.ca.gov	http://www.waterboards.ca.gov/santaana/
State & Federal	Santa Ana Regional Water Quality Control Board (Region 8)	Gary Stewart	(951) 782-4379	Gary.Stewart@waterboards.ca.gov	http://www.waterboards.ca.gov/santaana/
State & Federal	San Diego Regional Water Quality Control Board (Region 9)	David Gibson	(619) 521-3005	dgibson@waterboards.ca.gov	http://www.waterboards.ca.gov/sandiego/
State & Federal	San Diego Regional Water Quality Control Board (Region 9)	David Barker	(619) 521-3007	David.Barker@waterboards.ca.gov	http://www.waterboards.ca.gov/sandiego/
State & Federal	California Department of Transporatation (CalTrans): District 12	Ryan Chamberlain	(949) 724-2000	Ryan.Chamberlain@dot.ca.gov	http://www.dot.ca.gov/

ID	Agency / Org	Name	Phone Number	Email	Website
State & Federal	Bureau of Land Management (South Coast Field Office: Palm Springs)	John Kalish	(760) 833-7100	jkalish@blm.gov	http://www.blm.gov/wo/st/en.html
State & Federal	U.S. Army Corps of Engineers (Riverside and Orange Counties Section)	David Castanon	(213) 452-3406	david.j.castanon@usace.army.mil	http://www.usace.army.mil/About.aspx
State & Federal	U.S. Fish and Wildlife Service	Nancy Ferguson	(760) 431-9440	nancy_ferguson@fws.gov	http://www.fws.gov/carlsbad/
State & Federal	Environmental Protection Agency (Region 9: The Pacific Southwest)	Glenda Dugan	(415) 947-4204	dugan.glenda@epa.gov	http://www.epa.gov/
State & Federal	California Department of Water Resources	Mark Stuart	(818) 500-1645	marks@water.ca.gov	http://www.water.ca.gov/
State & Federal	California Environmental Protection Agency (Drinking Water Division)	Jeff O'Keefe	(714) 558-4480	jeff.okeefe@cdph.ca.gov	http://www.cdph.ca.gov/programs/pages/ddwem.aspx
State & Federal	US Fish and Wildlife Service - Seal Beach National Wildlife Refuge	Kirk Gilligan	562-598-1024	kirk_gilligan@fws.gov	http://www.fws.gov/refuge/Seal_Beach/
State & Federal	Department of the Navy - Seal Beach Naval Weapons Station	Michael Medina	(619) 532-1157	michael.j.medina1@navy.mil	
State & Federal	California Department of Public Health	Vicki Kramer	(916)552-9730	vicki.kramer@cdph.ca.gov	https://www.cdph.ca.gov/programs/vbds/Pages/default.aspx
State & Federal	California Department of Public Health	Renji Hu	(909)937-3448	Renjie.Hu@cdph.ca.gov	https://www.cdph.ca.gov/programs/vbds/Pages/default.aspx
State & Federal	U.S. Fish and Wildlife Service	Will Miller	(760) 431-9440	william_b_miller@fws.gov	http://www.fws.gov/carlsbad/
State & Federal	U.S. Fish and Wildlife Service	Katie Zeeman	(760) 431-9440	katie_zeeman@fws.gov	http://www.fws.gov/carlsbad/
State & Federal	California Department of Pesticide Regulation - So. Region Office	Jahan Motakef	(714)279-7690	Jahan.Motakef@cdpr.ca.gov	www.cdpr.ca.gov
State & Federal	State Water Resources Control Board	Phil Isorena	(916)341-5544	phillip.Isorena@waterboards.ca.gov	http://www.swrcb.ca.gov/

ID	Agency / Org	Name	Phone Number	Email	Website
State & Federal	State Water Resources Control Board	Gil Vazquez	(916)322-1400	gvazquez@waterboards.ca.gov	http://www.swrcb.ca.gov/
State & Federal	South Coast Air Quality Management District	Barry Wallerstein	(909) 396-2000	webinquiry@aqmd.gov	http://www.aqmd.gov/
State & Federal	State of California Air Resources Board	Mary Nichols	(916) 322-5594	cotb@arb.ca.gov	http://www.arb.ca.gov/homepage.htm
State & Federal	Assembly District 69	Tom F. Daly - Asm.	(714) 939-8469	assemblymember.daly@assembly.ca.gov	http://assembly.ca.gov/
State & Federal	Assembly District 72	Travis Allen - Asm.	(714) 843-4966	assemblymember.allen@assembly.ca.gov	http://assembly.ca.gov/
State & Federal	Assembly District 68	Donald P. Wagner - Asm.	(714) 665-6868	assemblymember.wagner@assembly.ca.gov	http://assembly.ca.gov/
State & Federal	Assembly District 74	Matthew Harper - Asm.	(714) 668-2100	assemblymember.harper@assembly.ca.gov	http://assembly.ca.gov/
State & Federal	Assembly District 55	Ling-Ling Chang - Asm.	(714) 529-5502	assemblymember.chang@assembly.ca.gov	http://assembly.ca.gov/
State & Federal	Assembly District 65	Young O. Kim - Asm.	(714) 521-6505	assemblymember.kim@assembly.ca.gov	http://assembly.ca.gov/
State & Federal	Assembly District 73	William P. Brough - Asm.	(949) 347-7301	assemblymember.brough@assembly.ca.gov	http://assembly.ca.gov/
State & Federal	Senate District 32	Tony Mendoza - Sen. (2014)	(562) 860-3202	senator.mendoza@senate.ca.gov	http://senate.ca.gov/
State & Federal	Senate District 34	Janet Nguyen - Sen. (2014)	(714) 741-1034	senator.nguyen@senate.ca.gov	http://senate.ca.gov/
State & Federal	Senate District 29	Bob Huff - Sen. (2008)	(714) 671-9474	senator.huff@senate.ca.gov	http://senate.ca.gov/
State & Federal	Senate District 36	Patricia C. Bates - Sen. (2014)	(949) 598-5850	senator.bates@senate.ca.gov	http://senate.ca.gov/

ID	Agency / Org	Name	Phone Number	Email	Website
State & Federal	Senate District 37	John Moorlach - Sen. (2015)	(714) 662-6050	senator.moorlach@senate.ca.gov	http://senate.ca.gov/
State & Federal	Congressional District 39	Ed Royce	(714) 255-0101	Fax 714-255-0109	http://royce.house.gov/
State & Federal	Congressional District 46	Loretta Sanchez	(714) 621-0102	Fax 621-0401	http://lorettasanchez.house.gov/
State & Federal	Congressional District 45	Mimi Walters	(949)263-8703	Fax 949-263-8704	https://walters.house.gov/
State & Federal	Congressional District 48	Dana Rohrabacher	(714)960-6483		https://rohrabacher.house.gov/
State & Federal	Congressional District 47	Alan Lowenthal	(562) 436-3828	Fax 562-437-6434	http://lowenthal.house.gov/
State & Federal	US Senate	Barbara Boxer	(213) 894-5000	Fax 202-224-0357	https://www.boxer.senate.gov/?p=home
State & Federal	US Senate	Diane Feinstein	(310) 914-7300	Fax (310) 914-7318	http://www.feinstein.senate.gov/public/
School Districts	Anaheim City School District Anaheim	Mary Grace	714-517-7517	mgrace@acsd.us	
School Districts	Union School District	Rick Martens	714-999-5654	martens_r@auhsd.us	
School Districts	Brea-Olinda Unified School District	David Giordano	714-990-7827	dgiordano@bousd.k12.ca.us	
School Districts	Buena Park School District	Mike Anderson	714-736-4294	manderson@bpsd.k12.ca.us	
School Districts	Capistrano Unified School District	Mike Beekman	949-234-9267	mbeekman@capousd.org	
School Districts	Centralia School District	Carla Nossett	714-228-3104	carla_nossett@cesd.us	

ID	Agency / Org	Name	Phone Number	Email	Website
School Districts	Cypress School District	Robert Daley	714-220-6952	rdaley@cypsd.k12.ca.us	
School Districts	Fountain Valley School District	Marc Ecker	714-843-3255	eckerm@fvsd.k12.ca.us	
School Districts	Fullerton Joint High School District	Carl Erickson	714-870-2907	cerickson@fjuhsd.net	
School Districts	Fullerton School District	Kathy (Kathryn) Ikola	714-447-7465	kathy_Ikola@fullertonsd.org	
School Districts	Garden Grove Unified School District	Alan Trudell	714-663-6503	atrudell@ggusd.us	
School Districts	Huntington Beach City School District	Jon Archibald	714-378-2050	jarchibald@hbcsd.k12.ca.us	
School Districts	Huntington Beach Union H.S. District	Brad Ennis	714-536-7521	bennis@hbuhsd.org	
School Districts	Irvine Unified School District	Stephen Bayne	949-936-5021	stephenbayne@iusd.org	
School Districts	La Habra City School District	Susan Belenardo	562-690-2302	sbelenardo@LHCSD.K12.ca.us	
School Districts	Laguna Beach Unified School District	Eric Jetta	949-497-7700	ejetta@lbusd.org	
School Districts	Los Alamitos Unified School District	Don Farrell	562-799-4700	dfarrell@losal.org	
School Districts	Lowell Joint School District	Andrea Reynolds	562-902-4280	areynolds@ljsd.org	
School Districts	Magnolia School District	Alejandro Flores	714-761-5533	aflores@magnoliasd.org	
School Districts	Newport-Mesa Unified School	Laura Boss	714-424-5070	lboss@nmusd.us	

ID	Agency / Org	Name	Phone Number	Email	Website
School Districts	North Orange County ROP	Jim Williamson	714-502-5821	jwilliamson@nocrop.us	
School Districts	Ocean View School District	Mark Schiel	714-847-2551	mschiel@ovsd.org	
School Districts	Orange Unified School District	Mike Pollock	714-628-5424	mikep@orangeusd.org	
School Districts	Placentia-Yorba Linda Unified	Doug Domene	714-985-8419	Ddomene@pylusd.org	
School Districts	Saddleback Valley Unified School District	Frank Manzo	949-580-3219	manzo@svusd.org	
School Districts	Santa Ana Unified School District	Kevin Phillips	714-558-5889	kevin.phillips@sausd.ous	
School Districts	Savanna School District	Dr. Sue Johnson	714-236-3805	sue.johnson@savsd.org	
School Districts	Tustin Unified School District	Michael Barker	714-730-7301	mbarker@tustin.k12.ca.us	
School Districts	Westminster School District	Debra Hill	714-894-7311	dhill@wds.k12.ca.us	
Colleges	California State University Fullerton	Sue Fisher	657-278-3572	sfisher@fullerton.edu	
Colleges	Chapman University	Randy Burba	714-744-7667	burba@chapman.edu	
Colleges	Coast Community College District	Linda Morin	714-438-4753	lmorin@mail.cccd.edu	
Colleges	North O.C. Community College District	Tammy Oh	714-808-4779	toh@nocccd.edu	
Colleges	Rancho Santiago Community College District	Alistair Winter	714-628-4989	winter_alistair@rsccd.edu	

ID	Agency / Org	Name	Phone Number	Email	Website
Colleges	Saddleback College	Pat Higa	949-582-4390	phiga@saddleback.edu	
Colleges	South O.C. Community College District	Jim Pyle	949-582-4585	jpyle@saddleback.edu	
Colleges	University of California, Irvine	Anne Widney	949-824-7147	awidney@uci.edu	

Public Notice

April 29, 2016

Re: Notification to Potentially Affected Governmental Agencies Regarding
Application of Pesticides by the Orange County Vector Control District (April - December 2016)

The Orange County Mosquito and Vector Control District (District) is hereby notifying potentially affected governmental agencies of our continued application of mosquito control pesticides within Orange County pursuant to the National Pollutant Discharge Elimination System (NPDES) Permit (Order No. 2011-0002-DWQ) [General Permit No. CAG 990004] adopted on March 1, 2011, and revised on April 3, 2012, (Order No. 2012-0003-DWQ); March 12, 2014 (Order No. 2014-0038-EXE); and July 2, 2014 (Order No. 2014-0106-DWQ). The District has applied to extend coverage under the new order adopted March 1, 2016 (Order No. 2016-0039-DWQ) and is thus redistributing this notice as required. This permit is for discharges of biological and residual pesticides to waters of the United States, per those pesticide active ingredients approved for application within the provisions of the approved Pesticide Application Plan and the Notice of Applicability, as adopted by the State Water Resources Control Board on March 1, 2016, effective July 1, 2016 through June 30, 2021. This notification is for applications made from April 29 – December 31, 2016 for the suppression of vector populations and arbovirus transmission when non-chemical strategies are not feasible or effective. Each year the District will update interested agencies regarding the control products being used within the District's boundaries (see enclosed service area map).

The District is a public health agency charged with protecting the citizens of Orange County under Division 3 of the California Health and Safety Code (CAL. HSC. §2000-2910). The District carries out its mission with a balanced approach focused on protecting public health and the environment through an effective, county-wide Integrated Vector Management (IVM) Program. As part of the IVM Program the District applies mosquito control pesticides that primarily target aquatic, immature (larval) stages of mosquitoes to prevent the emergence of adult mosquitoes, which inflict painful bites and may transmit diseases such as West Nile virus. District personnel conduct larval mosquito control year-round in a variety of urban and natural habitats, such as unmaintained swimming pools, ornamental ponds, small containers, stormwater treatment systems, riparian corridors, tidal marshes, and seasonal and permanent wetlands. Adult mosquito control, if necessary, occurs typically in the warmer months near mosquito producing habitats, like seasonal and permanent wetlands, tidal marshes, and urban areas.

All mosquito control pesticides are applied only when necessary by licensed, District personnel according to product label instructions and in compliance with all local, state, and federal regulations. Proper applications maximize a product's effectiveness while avoiding or minimizing any adverse impacts to the public and environment. No special precautions need to be taken by your representative agencies as the District performs these ongoing activities. There are no known water use restrictions or precautions during treatment. Please refer to the District's website for all product labels and Safety Data Sheets.

The NPDES Permit requirements for listing of the Public Health Pesticides anticipated to be used were modified from the previous permit, to the new permit which will take effect July 1, 2016. The newer

requirements specify that any pesticide product can be used that contain approved active ingredients, provided all pesticide label restrictions and instructions are followed. In addition, pesticides which fall under the "minimum" risk pesticides have been exempted from FIFRA requirements, and a list of these can be found at http://www.epa.gov/minimum-risk-pesticides/inert-ingredients-approved-use-minimum-risk-pesticide-products. The following tables list the active ingredients approved for the FIFRA regulated pesticides.

Active Ingredients for Larval Mosquito Control:

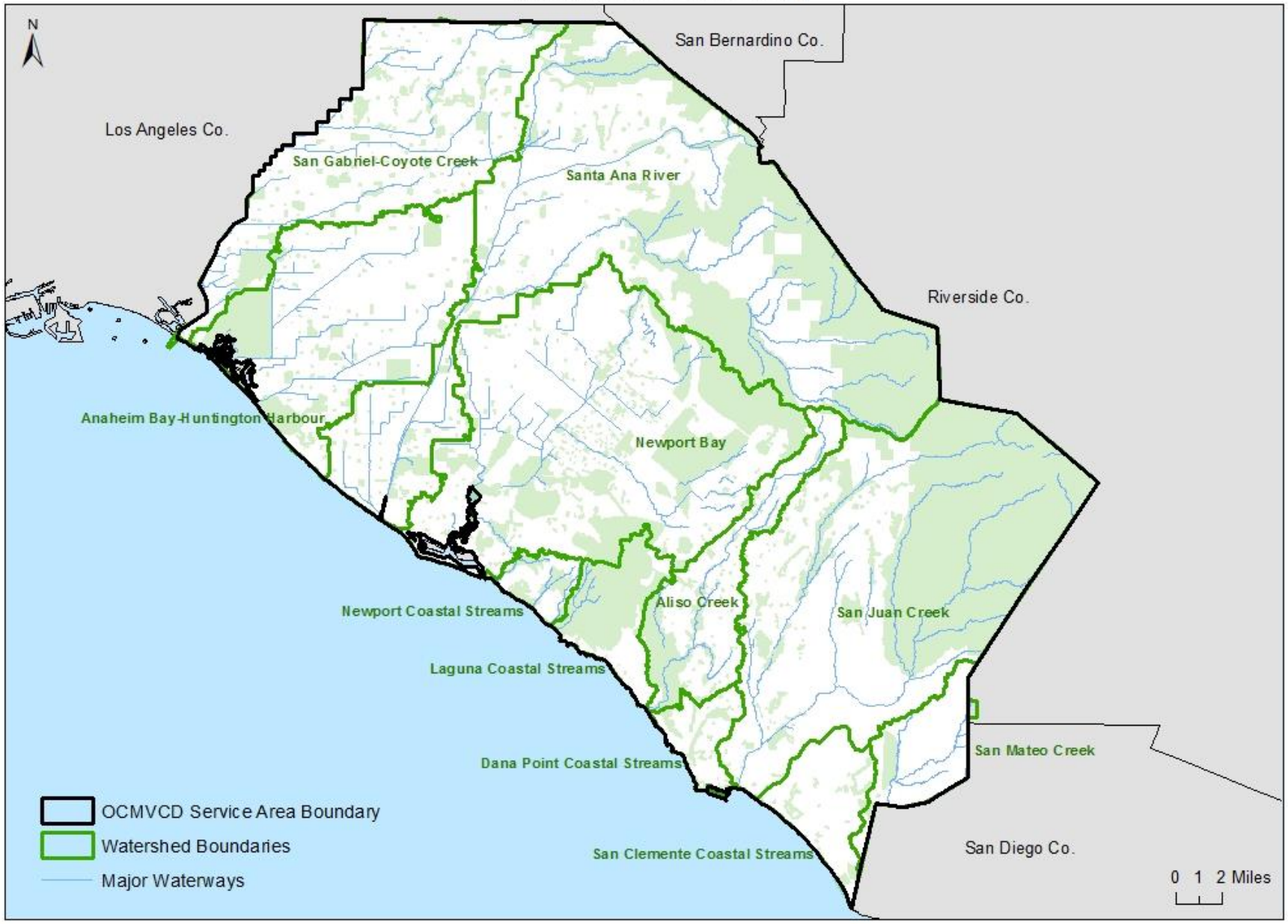
Bacillus thruingiensis subp. *israelensis* (*Bti*)
Lysinibacillus sphaericus (*Ls*) formerly *Bacillus sphaericus* (*Bs*)
Methoprene
Monomolecular Films
Petroleum Distillates
Spinosad
Temephos

Active Ingredients for Adult Mosquito Control:

Deltamethrin
Etofenprox
Lambda-Cyhalothrin
Malathion
Naled
N-octyl bicycloheptene dicarboximide (MGK-264)
Piperonyl butoxide (PBO)
Permethrin
Prallethrin
Pyrethrin
Resmethrin
Sumithrin

For more information, please call (714) 971-2421 or visit the District's website (www.ocvcd.org).

Orange County Mosquito and Vector Control District (OCMVCD)
Service Area Boundary



PESTICIDE APPLICATION PLAN

For the Biological and Residual Pesticide Discharges to Surface Waters of the US by the Orange County Mosquito and Vector Control District

FOR WATER QUALITY ORDER NO. 2016-0039-DWQ STATEWIDE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR BIOLOGICAL AND RESIDUAL PESTICIDE DISCHARGES TO WATERS OF THE UNITED STATES FROM VECTOR CONTROL APPLICATIONS (GENERAL PERMIT) NO. CAG 990004

April 29, 2016

Prepared for:

State Water Resources Control Board

Santa Ana Regional Water Quality Control Board (Region 8)

San Diego Regional Water Quality Control Board (Region 9)

Prepared by:

Orange County Vector Control District

13001 Garden Grove Blvd.

Garden Grove, CA 92843

Contact: Larry Shaw, Director of Operations

Telephone: (714) 971-2421

Fax: (714) 971-3940

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List of Acronyms and Abbreviations

The District	Orange County Mosquito and Vector Control District
The County	Orange County
RWQCB	Regional Water Quality Control Board
SWRCB	State Water Resource Control Board
MVCAC	Mosquito and Vector Control Association of California
BMP	Best Management Practice
IVM	Integrated Vector Management
NPDES	National Pollutant Discharge Elimination System
CDPH	California Department of Public Health
DPR	Department of Pesticide Regulation
CDPH	California Department of Public Health
General Permit	General Permit No. CAG 990004, Permit for Vector Control

Introduction

The Orange County Mosquito and Vector Control District (the District) is a public health agency charged with protecting the citizens of Orange County from vectors and vector-borne disease under Division 3 (Pest Abatement) of the California Health and Safety Code (CAL. HSC. § 2000-2910). The District is an Independent Special District that carries out its mission with a balanced approach focused on protecting public health and the environment. The District's operations are based out of the city of Garden Grove, California, and service all 789 square miles of Orange County, home to more than three million residents. Service is provided to all 34 cities within Orange County as well as unincorporated areas, federal and state lands. The District operates year-round to control mosquitoes, other flies, red imported fire ants (RIFA), and rats.

The District is within the jurisdiction of the Santa Ana Regional Water Quality Control Board (Region 8) and the San Diego Regional Water Quality Control Board (Region 9), and is seeking coverage under the General Permit No. CAG 990004 as "a public entity" that applies biological and residual pesticides for vector control in or near waters of the United States (Exhibit 1). The District has previously obtained coverage under General Permit Order No. 2011-0002-DWQ: WDID # 830346400. The new Order No. 2016-0039-DWQ replaces the previous one and covers application of larvicides (pesticides used to control aquatic larval stages of immature mosquitoes) and adulticides (pesticides used to control adult mosquitoes). Order No. 2016-0039-DWQ covers the point source discharge of biological and residual pesticides resulting from direct larvicide and indirect adulticide aerosol applications for vector control using: 1) larvicides containing monomolecular films, methoprene, *Bacillus thuringiensis* subspecies *israelensis* (or *Bti*), *Lysinibacillus sphaericus* (or *L. sphaericus*), temephos, petroleum distillates, or spinosad; and 2) adulticides containing malathion, naled, pyrethrin, deltamethrin, etofenprox, lambda-cyhalothrin, permethrin, prallethrin, resmethrin, sumithrin, piperonyl butoxide (PBO), or N-octyl bicycloheptene dicarboximide (or MGK-264). Additionally,coverage extends to any minimum risk category pesticides that are FIFRA exempt and registered for use in California and used in a manner specified in 40 C.F.R. section 152.25.

The District utilizes an Integrated Vector Management (IVM) Program strategy to control the production of mosquitoes, filth flies and black flies, red imported fire ants (RIFA), and rats. The IVM Program consists of the following activities: 1) Surveillance for vectors, vector habitats, and associated pathogens/diseases-this includes field and laboratory analysis of vectors in order to evaluate populations and emerging disease threats; 2) Source reduction to limit breeding by vectors-this includes management of vegetation, land, and water with appropriate landowners to minimize vector production; 3) Education and outreach efforts targeted toward the public and private landowners in ways to facilitate source reduction and minimize disease-carrying vectors; 4) Distribution of mosquito fish (*Gambusia affinis*), a biological control measure used to reduce mosquito production in isolated aquatic features, such as neglected residential swimming pools; and 5) Application of pesticides to minimize vector populations and reduce the threat of potential vector-borne disease transmission to humans.

The District is a member of the Mosquito and Vector Control Association of California (MVCAC), a statewide association of over 60 mosquito and vector control agencies. The District is a member of the MVCAC NPDES Coalition Monitoring Program. As required under Section VIII. Pesticide Use Requirements. C., of the General Permit, the District is submitting this document as its Pesticide Application Plan for review and approval by the State Water Resources Control Board (SWRCB).

1 Description of Target Areas

Description of ALL target areas and adjacent areas, if different from the water body of the target area, in to which larvicides and adulticides pesticides 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.

Orange County (the County) is a coastal county comprised of approximately 789 square miles. It is bordered on the southwest by the Pacific Ocean, on the north by Los Angeles County, on the northeast by San Bernardino County and Riverside County, and on the southeast by San Diego County. The northwestern part of the county includes part ofon the coastal plain of the Los Angeles Basin, while the southeastern end rises into the foothills of the Santa Ana Mountains. With a Mediterranean climate, Orange County has a diversity of land uses ranging from urban/metropolitan centers, agricultural croplands, and residential communities as well as regional parks and national forests. The County also has nearly 40 miles of the Pacific Ocean coastline.

The District applies pesticides for the purpose of vector control to locations within the jurisdiction of two different Regional Water Quality Control Boards (RWQCBs): Santa Ana, Region 8 and San Diego, Region 9 (Exhibit 1). Watersheds of Orange County include the larger Santa Ana River, San Gabriel-Coyote Creek, Anaheim Bay-Huntington Harbor, Newport Bay, Aliso Creek, San Juan Creek, San Mateo Creek, and the smaller San Clemente Coastal Streams, Dana Point Coastal Streams, Laguna Coastal Streams, and Newport Coastal Streams watersheds (County of Orange, 2008) (Figure 1and Table 1 below). All watersheds in Orange County are potentially subject to treatment applications if threshold levels of target vectors are present and all other control alternatives have been considered and determined to be unsuitable.

The receiving water systems in Orange County which are potentially subject to pesticide applications by the District, include any and all navigable waters and their tributaries, waters of the State, and waters of the US, and any waters adjacent to District boundaries that breed mosquitoes, black flies, or midges (Table 1). This includes water features like the Santa Ana River and its tributaries, any and all flood control channels, basins, storm drains, gutters, roadside low spots, backyard pools, ponds, wetlands and any stagnant water feature found to be breeding mosquitoes exceeding threshold numbers.

Below is a list of the receiving waters in Orange County (Table 1). These features, their tributaries, lakes, reservoirs, marshes, unnamed drainages, ditches and the water conveyances and infrastructure throughout the county can be subject to mosquito control applications by the Orange County Mosquito and Vector Control District (Figure 1).

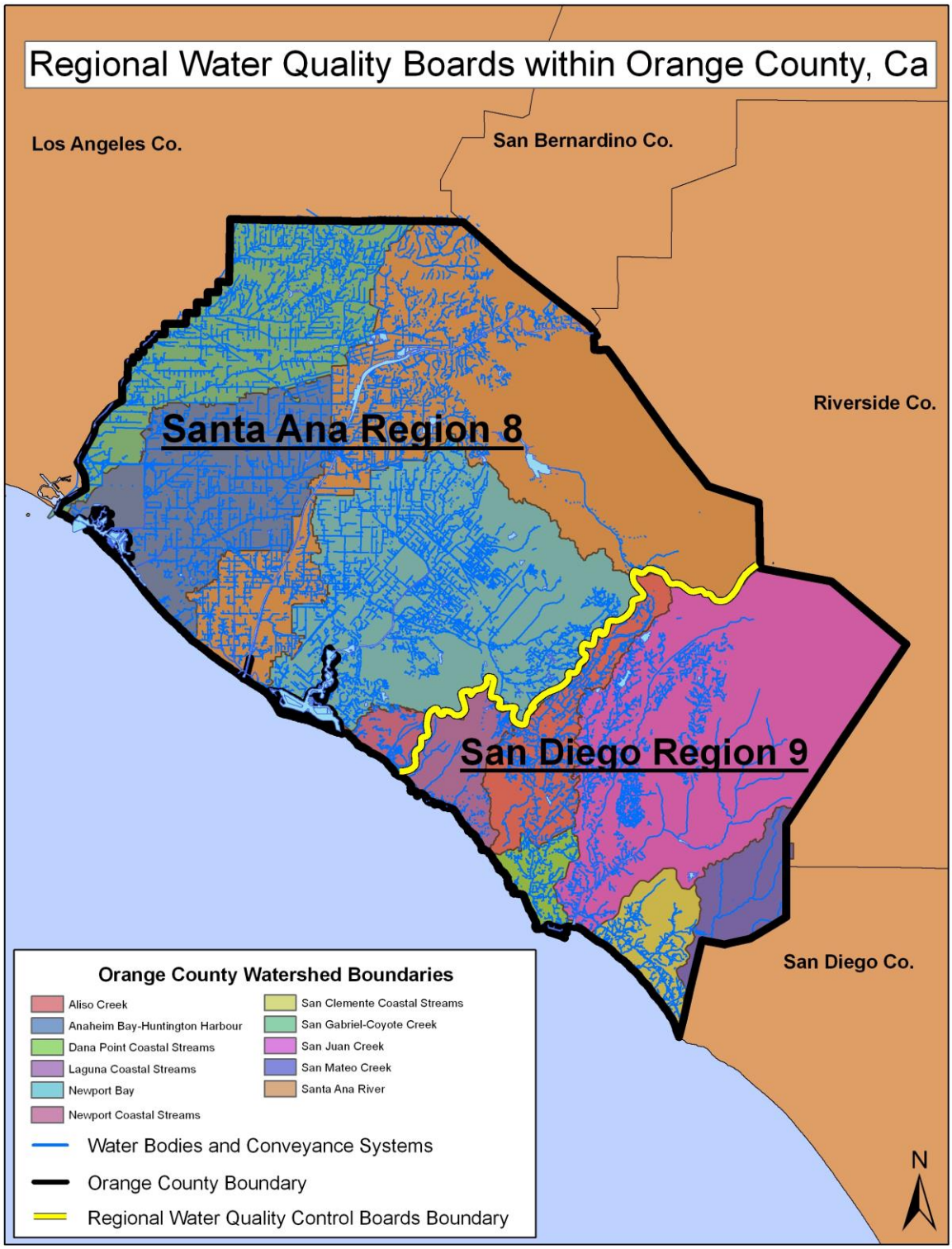


Figure 1. Regional Water Quality Control Board Boundaries, Watershed Boundaries, Water Bodies, and Conveyance Systems in Orange County.

Table 1. List of Orange County Receiving Waters by Water Quality Control Board Regions.

Santa Ana Region 8	**San Diego Region 9**
Anaheim Bay-Huntington Harbor	***Aliso Creek***
Bolsa Chica Channel	Wood Canyon
Bolsa Chica Wetlands	Sulphur Creek
East-Garden Grove Wintersburg Channel	Aliso Hills Channel
Westminster Channel	English Channel
Newport Bay	***Dana Point Harbor***
Big Canyon Wash	***Salt Creek***
Costa Mesa Channel	***Laguna Canyon Creek***
Santa Isabella Channel	Boat Canyon Drainage
Santa Ana Delhi	Blue Bird Canyon Drainage
San Diego Creek	Rim Rock Canyon Drainage
Peters Canyon Wash	Hobo Canyon Drainage
Newport Coast	Emerald Canyon Drainage
Muddy Creek	***Prima Deshecha Canada***
San Gabriel River	***Prima Deshecha***
Coyote Creek	***Segunda Deshecha Canada***
Carbon Creek	***San Juan Creek***
Santa Ana River	Arroyo Trabuco
Santiago Creek	Oso Creek
	San Mateo Creek
Numerous unnamed drainages and tributaries	**Numerous unnamed drainages and tributaries**

For more specific application areas/sites, see Section 4 of this document.

2 Pesticide Selection Factors

Discussion of the factors influencing the decision to select pesticide applications for mosquito vector control.

The District's Board of Trustees adopted an Integrated Vector Management & Response Plan (the IVM Plan) in May of 2010 (Appendix 1). To better address recent epidemics of West Nile virus, a supplement to the IVM Plan called the West Nile Virus Emergency Response Plan was adopted in August of 2015 (Appendix 2). The District's IVM Plan outlines surveillance and control measures for vectors in Orange County. The purpose of the IVM Plan is to provide guidelines to the District's staff and information to stakeholders regarding the various responses made to prevent and control disease vectors as well as introduced diseases and vectors in Orange County. This document details the roles and responsibilities of Management, Administration, Communications, Scientific/Technical, and Operations staff in responding to vector-borne disease threats. The responses are organized by vector species that cause illnesses in humans, domestic animals, and wildlife. The IVM Plan includes guidelines for surveillance for vectors and disease, site assessment, source reduction, biorational and chemical control methods, and public education. The IVM Plan establishes specific thresholds for the initiation of physical and chemical control based on vectors species and their abundance and the presence or absence of infective agents. Treatment thresholds are established for mosquito developmental sites in the IVM Plan where potential disease vector and/or nuisance risks are evident. Only those sources that represent imminent threats to public health or quality of life are treated.

Treatment thresholds are based on the following criteria: mosquito species present, mosquito stage of development, nuisance or disease potential, mosquito abundance, flight range, proximity to populated areas, size of source, presence/absence of natural enemies or predators, and presence of sensitive/endangered species IVM Plan (Appendix 1, pages 23-31 for larval mosquito control and pages 32-41 for adult mosquito control).

When thresholds are exceeded, an appropriate control strategy is implemented. Control strategies are selected to minimize potential environmental impacts while maximizing efficacy. The method of control is based on the above threshold criteria but also habitat type, water conditions and quality, weather conditions, cost, site accessibility, size of site and a number of other factors as specified in the IVM Plan (Appendix 1, pages 23-31 for larval mosquito control and pages 32-41 for adult mosquito control).

In following the principles of Integrated Vector Management, it is always the District's focus to first prevent mosquito and vector breeding/harborage through public education-this is also known as Cultural Control, which aims to influence or change the behavior of people so that their actions prevent the development of vector populations or the transmission of vector-borne disease. The next best option can be Physical Control (or Source Reduction)-this practice involves environmental manipulation that results in a reduction of vector development sites. Physical control is not always possible or feasible due to environmental regulations on some habitats and/or access restrictions. Another strategy is Biological Control, involving the use of a biological agent like mosquitofish which the District plants in neglected swimming pools that consume mosquito larvae as an alternative to pesticide use. Some conditions are not favorable or appropriate for mosquitofish use. Finally, after many factors have been considered, the District may need to use Chemical Control as a last resort treatment option.

Additional considerations are also drawn from and in accordance with the California Mosquito-Borne Virus and Surveillance & Response Plan (Appendix 3, pages 8-17). Additionally, each of the control methods and specific vector reduction guidelines (or best management practices) can be found in the District's Vector Reduction Manual: Procedures and Guidelines (Appendix 4, pages 11-35).

3 Types of Pesticide Products

The NPDES Permit for Biological and Residual Pesticide Discharges to Waters of the U.S. from Vector Control Applications was amended to list the approved active ingredients rather than having specific products named (Table 2). All pesticide label restrictions and instructions will be followed for pesticides, which fall under the "minimum risk" category. The minimum risk pesticides have been exempted from FIFRA requirements. Products will be applied by hand can, spray bottle, backpack, truck, all-terrain vehicle (ATV), and aircraft.

The types of pesticides used in mosquito control and the methods of applications are also discussed in detail and listed in the Best Management Practices for Mosquito Control in California (Appendix 5, Appendix A- Mosquito Control and Arbovirus Surveillance, pages 26-34 and Appendix B, Compounds Approved for Mosquito Control in California, pages 35-39).

Table 2 . List of Active Ingredients That May Be Used Under NPDES Permit.

Active Ingredients
Larvicides:
Bacillus thruingiensis subp. *israelensis* (*Bti*)
Lysinibacillus sphaericus (*Ls*) formerly *Bacillus sphaericus* (*Ls*)
Methoprene
Monomolecular Films
Petroleum Distillates
Spinosad
Temophos
Adulticides:
Deltamethrin
Etofenprox
Lambda-Cyhalothrin
Malathion
Naled
N-octyl bicycloheptene dicarboximide (MGK0264)
Piperonyl butoxide (PBO)
Permethrin
Prallethrin
Pyrethrin
Resmethrin
Sumithrin
In addition:
Any "minimum risk category" pesticides that are FIFRA exempt and registered for use in California and used in a manner specified in 40 C.F.R. section 152.25.

4 Description of Application Areas

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 affect long-term solutions to reduce or eliminate the need for continued applications as described in Section 2 above and in detail in the District's Vector Reduction Manual (Appendix 4, for policies see pages 1-7, for specific guidelines to reduce mosquitoes see pages 8-25). Mosquito breeding sources and areas that require adult mosquito control are difficult to predict from year to year based on the weather and variations in local environmental conditions. However, the typical sources treated by OCMVCD are listed in Table 3 below.

The targets for application projects are primarily the immature aquatic stages of insect vectors, including mosquitoes, midges, and black flies, which predominantly breed in standing or slow-moving water. These insect disease vectors may pose a threat to human public heath, especially due to the risk they may spread West Nile virus, and require treatment to eliminate or minimize the health risks. Using the District's IVM Plan (Appendix 1, pages 25-31 for larval mosquito control and pages 34-44 for adult mosquito control) decision matrix, District personnel use pesticides as a last resort to treat water features that have undesirable insect pest vectors exceeding threshold levels. Larvicides are applied at larval mosquito development sites which can include drainage channels, riparian areas, wetlands, roadside ditches, neglected swimming pools, ornamental ponds, catch basins, detention/retention basins, and potentially, any aquatic site or low lying area that has standing water for longer than 96 hours (Table 3). Many of these applications take place in urban watershed storm water conveyance systems. Exhibit 2 depicts the anticipated larviciding application areas within water conveyance systems throughout the County based on historical treatment application data. Additional application areas include breeding locations within the coastal wetlands, and intermittent or ephemeral streams.

Areas requiring larvicide applications are treated, as necessary, primarily from spring to late fall during the warmest months (approximately March – November). However, if vectors are a persistent problem at some locations, applications may be made year-round. Pesticides are applied only to water that will persist for at least 96 hours when a vector is present at threshold levels and when alternative measures are infeasible and/or unsuitable for the given conditions.

Directing our main efforts at controlling mosquito larvae allows the District to localize treatments and use the least toxic alternatives. Adult mosquitoes may occasionally be targeted for control. However, since pesticides must be applied over a greater area and are less selective, the District minimizes there use whenever possible. Currently, there are three sites in the County that are receive adulticide treatment when they exceed threshold levels due to persistent mosquito breeding conditions and their proximity to human populations (Exhibit 3). Those sites include the University of California, Irvine Regents Freshwater Marsh and Big Canyon Lake/Pond at the Upper Newport Bay Ecological Reserve, and Ladera Ranch Marsh near Arroyo Trabuco Creek adjacent to the Ladera Ranch Community in South Orange County.

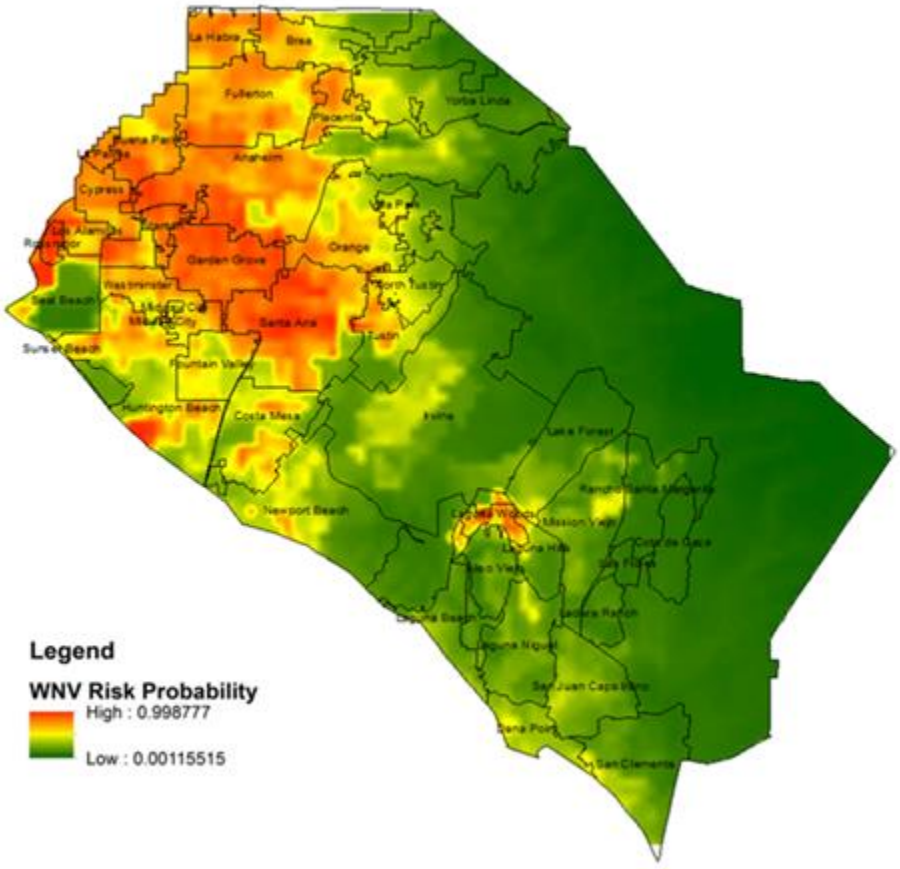
Table 3. List of Typical Sites That May be Targeted for Mosquito Control Applications in Orange County.

Source Type
Above Ground Spas
Agricultural Crop Ditches
Catch Basins
Cemetery Flower Containers
Cemetery Grounds
Containers
Creeks
Dams
Ditches
Drainages
Fish Ponds
Flood Control Channels
Fountains
Freeway Drainages
Freshwater Marshes
Gutters
Holes
Knot Holes
Lakes or Ponds
Misc. Standing Water
Mitigation Sites
Off Street Drains
Ornamental Ponds
Ornamental Streams
Pool and Spa Heaters
Rainwater Depressions
Rain Barrels
Reservoirs
Retarding Basins
Saltwater Marshes
Sewage/Settling Ponds
Sumps
Swimming Pools
Underground Storm Drains
Water Spreading

In 2014 and 2015 Orange County experienced consecutive epidemics of WNV resulting in 377 human infections resulting in 17 deaths. The area in Orange County with the highest risk of human WNV infection is seen in Figure 2 below. The area from where most human infections are reported is a highly urbanized, densely populated, flat landscape with aging stormwater infrastructure. In response to the back-to-back epidemics of WNV in 2014 and 2015, the District

expanded the adult mosquito control program to include the option to make aerial adulticide applications over high risk urban areas to mitigate a mosquito-borne disease outbreak. The triggers for this response option are detailed in the District's West Nile Virus Emergency Response Plan (Appendix 2).

Figure 2. West Nile virus High Risk Area Based on Environmental and Historical Surveillance Factors, 2004-2013.



5 Other Control Methods Used

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 Best Management Practices for Mosquito Control in California (Appendix 5, pages 4-19). The following is an excerpt from Appendix A of the Best Management Practices for Mosquito Control in California (Appendix 3, [Appendix A- Mosquito Control and Arbovirus Surveillance, pages 26-27]) called Mosquito Control and Arbovirus Surveillance:

Environmental Management

Manipulating or eliminating potential mosquito breeding sources can provide dramatic reductions in mosquito populations. There are three levels of environmental management.

1. *Source elimination: This approach completely eliminates potential habitats for mosquitoes. This strategy is generally limited to artificial habitats created by urbanization. Examples of source elimination include emptying or turning over containers holding water, filling in holes containing water with sand or gravel, cleaning drainage ditches of debris, and covering or inverting structures and vessels that could hold water.*
2. *Source reduction: This strategy aims to alter and sometimes eliminate available habitat for larvae which substantially reduces mosquito breeding and the need for repeatedly applying pesticides. Unlike source elimination, standing water may exist but the total amount of water, or the time the water is left standing, is greatly reduced. Source reduction may require some maintenance (see below) to prevent further mosquito breeding. Examples of source reduction include limiting the growth of emergent vegetation in wetlands and ponds, constructing drainage ditches to remove water from areas prone to flooding, and clearing stormwater channels of silt and debris. Routine larval monitoring can indicate whether these efforts are effective or need further action.*
3. *Source maintenance: When eliminating or significantly altering mosquito breeding sources is prohibited and/or inappropriate, reducing the number of sheltered, predator-free habitats while having minimal impact on the surrounding environment can make an area unsuitable for mosquitoes. Source maintenance can include water management, vegetation management, wetland infrastructure maintenance, and wetland restoration. Strategic, focused plans must be developed for each site.*

Biological Control

Biological control uses predators, parasites, or pathogens to reduce populations of mosquito larvae and is often combined with environmental management to enhance results. The mosquitofish (Gambusia affinis) has been used to control mosquitoes in California since 1921 and is the most widely used biological control agent in the world. These small fish are effective against mosquito larvae because they grow and reproduce rapidly, feed at the water surface where mosquito larvae are found, and tolerate a wide range of temperature and water quality. Other fish are occasionally used with mixed success. Fish are most effective in permanent ponds and wetlands, but are also used in rice fields and stormwater canals with permanent water.

Many local mosquito control agencies propagate mosquito eating fish. Although many other animals have been tested for mosquito control, and in natural wetlands predation is an important factor in reducing mosquito production, biological control by the intentional addition of mosquito predators other than mosquitofish is largely experimental rather than operational.

There are inherent limitations to these alternative control measures. The limiting factors with Environmental Management (also referred to as physical control and/or source reduction) can be complex. In cases where appropriate and feasible, the District conducts or advises on environmental management control strategies like source elimination, source reduction and source maintenance with the cooperation of property owners and land managers, and under appropriate regulatory guidelines. The District's Vector Reduction Program is outlined in the Vector Reduction Manual: Procedures & Guidelines (VRM) (Appendix). This document describes how the District aims to work with property owners to reduce or eliminate vector-favorable conditions by encouraging the implementation of Vector Reduction Guidelines (for specific guidelines to reduce mosquitoes see pages 8-25), which are based on IVM techniques and strategies. Some specific methods used by the District include educating residents that mosquitoes develop in standing water and encouraging them to remove sources of standing water on their property, working with property owners to find long-term water/environmental management strategies that meet their needs while minimizing the need for public health pesticide applications.

The District's Biological Control practices include the use of mosquitofish, *Gambusia affinis*, primarily in neglected swimming pools and other impoundments. The limiting factors to the use of mosquitofish include considerations about appropriate habitat, water quality, persistence of water source, and availability.

6 Anticipated Product Amounts

Approximately how much product is needed/anticipated to be used and how this amount was determined.

The need to apply product is determined by surveillance. Actual use varies annually depending on mosquito abundance. The total amounts of mosquito control pesticides applied to or near waters of the US by the District from January 2015 – December 2015 are shown in Table 4 below. These amounts serve as an approximation of the amount of product anticipated for use in 2016 and subsequent years. Several factors influence the amounts of pesticides applied, which can include rainfall, weather patterns, disease outbreak, and availability of products. Other public health pesticides in addition to those listed below may be used as part of the District's best management practices.

Table 4. Pesticide Usage for Mosquito Control by OCMVCD (January 2015 – December 2015) to or Near Waters of the US.

ACTIVE INGREDIENT	UNITS	AMOUNT USED	No. of Applications
Petroleum Distillate	GAL	8484	902
(S)-Methoprene Liquid	OZ	15	2
(S)-Methoprene Pellets	LBS	12.4	14
(S)-Methoprene XR	BRIQ	469	28
(S)-Methoprene Briquettes	BRIQ	61	3
Monomolecular Films	OZ	205.2	4
Spinosad Liquid	OZ	64.2	14
Spinosad 30 Day Tablet	TAB	143	30
Spinosad XRT	TAB	767	207
Bti Liquid	OZ	2776.1	58
Bti Granules	LBS	4919	441
Bti/Ls Granules	LBS	10196.2	1226
Bti/Ls 180 Dday Briquettes	BRIQ	849	26
Sumithrin	GAL	21.3	72

7 Monitoring Locations

Representative monitoring locations and the justification for selecting these monitoring locations.

Please see the MVCAC NPDES Coalition Monitoring Plan.

8 Evaluation of Available BMPs

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

The District uses BMPs described in its own IVM Plan (Appendix 1, pages 3, 6, and 23-40) and Vector Reduction Manual (Appendix , pages 1-7 and 8-25), as well as practices in accordance with state guidelines from the Best Management Practices for Mosquito Control in California (Appendix 5, pages 4-19) and the California Mosquito-borne Virus and Surveillance & Response Plan (Appendix 3, pages 4-8).

The protocol for these evaluations is discussed in the aforementioned documents and in Sections 2 and 5 above. Best management practices are continually evaluated through ongoing inspection and surveillance methods, review or reassessment of alternative control options prior to each pesticide application, treatment effectiveness evaluations, pursuit of long-term or preventative source reduction, educational or biological solutions.

9 Description of BMPs

Description of the BMPs to be implemented. The BMPs shall include, at the minimum.
The District uses BMPs described in its own IVM Plan (Appendix 1, pages 3, 6, and 23-40) and Vector Reduction Manual (Appendix 4, pages 1-7 and 8-25), as well as practices in accordance with state guidelines from the Best Management Practices for Mosquito Control in California (Appendix 5, pages 4-19) and the California Mosquito-borne Virus and Surveillance & Response Plan (Appendix 3, pages 4-8).

Specific elements have been highlighted below under items 9.1-9.6:

9.1 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. All safety, handling, and use requirements and instructions are followed per pesticide product labels and Safety Data Sheets.

9.2 Measures to Ensure Minimum and Consistent Amount Used

Spray equipment is calibrated each year as stipulated inthe Cooperative Agreement, a Memorandum of Understanding with the California Department of Public Health. All safety, handling, and use requirements and instructions are followed per pesticide product labels and Safety Data Sheets.

9.3 Applicator Education on Adverse Effects of Pesticide Application

The California Vector Control Technician Certification and Continuing Education Guidelines (CPDH, 2007) describes all topics that vector control technicians are trained and certified in. Applicators are required to complete pesticide and safety training annually. Records are kept of these training sessions for review by the local Agricultural Commissioner and/or CDPH. Additionally, District technicians are given an annual Environmental Awareness Training per District CEQA compliance requirements which includes NPDES Permit training.

9.4 Descriptions of Specific BMPs for Each Application Mode

The District calibrates truck-mounted, backpack and handheld equipment each year to meet application specifications. Supervisors review application records daily to ensure appropriate amounts of material are used. Ground-based Ultra Low Volume (ULV) application 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 at a minimum of once per year (by the Contractor) and as needed based on the efficacy results and total amount of product used per event. Droplet size are monitored by the District to ensure droplets meet label requirements. Airplanes used in ULV applications are equipped with advanced guidance and drift management equipment to ensure the best available technology is being used to place product in the intended target area.

All safety, handling, and use requirements and instructions are followed per pesticide product labels and Safety Data Sheets.

9.5 BMPs for Pesticide Products Used

Please see the Best Management Practices for Mosquito Control in California (Appendix 5, [Appendix A- Mosquito Control and Arbovirus Surveillance, pages 26-34 and Appendix B, Compounds Approved for Mosquito Control in California, pages 35-39]) for general pesticide application BMPs, and the current approved pesticide labels for application BMPs for specific products.

9.6 BMPs for Environmental Setting

The District uses environmental setting, specific BMPs described in its own IVM Plan (Appendix 1, pages 25-44) and Vector Reduction Manual (Appendix 4, pages 8-25), as well as practices in accordance with state guidelines from Best Management Practices for Mosquito Control in California (Appendix 5, pages 4-19) and the California Mosquito-borne Virus and Surveillance & Response Plan (Appendix 3, pages 4-17).
The District has an agency-specific Vector Reduction Program which is outlined in its Vector Reduction Manual: Procedures & Guidelines (the VRM) (Appendix 4, pages 8-25). This document describes how the District aims to work with property owners to reduce or eliminate vector-favorable conditions by encouraging the implementation of Vector Reduction Guidelines, which are based on IVM techniques and strategies. This document includes specific vector reduction guidelines (or BMPs) for the following environmental settings:

Residential and Commercial Mosquito Sources
Low Impact Developments (LIDs)
Ornamental Ponds and Water Features
Tire Storage
Sprinkler and Irrigation Systems
Nurseries
Cemeteries
Golf Courses
Equestrian Facilities
Agriculture
Wetlands
Stormwater Systems and Urban Runoff
- Above Ground Structures
- Underground Structures
- Flood Channels
- Natural Watercourses
- Freeway Drains
- Wastewater Management

The District works extensively with property owners, land managers, cities, engineers, stormwater programs, regulatory agencies, and other interests to minimize vector production and harborage throughout Orange County and the region.

10 Identification of the Problem

Prior to first pesticide application covered under this General Permit that will result in a discharge of biological and residual pesticides to waters of the US, and at least once each calendar year thereafter prior to the first pesticide application for that calendar year, the Discharger must do the following for each vector management area:

10.1 Establishment of Vector Populations

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

Only those mosquito sources that District staff determines to represent imminent threats to public health or quality of life are treated. The presence of any mosquito may necessitate treatment, however higher thresholds may be applied depending on the District's resources, disease activity, or local needs. Treatment thresholds are based on a combination of one or more of the following criteria: mosquito species present, mosquito stage of development, pest, nuisance, or disease potential, disease activity, mosquito abundance, flight range, proximity to populated areas, size of source, presence/absence of natural enemies or predators, and presence of sensitive/endangered species or habitats. This is discussed in detail in the District's IVM Plan (Appendix 1, pages 25-44).

10.2 Identification of Target Vector Species

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

The District addresses this practice as discussed in its IVM Plan (Appendix 1, page 4-6) and Vector Reduction Manual (Appendix 4, pages 8-10), as well as practices in accordance with state guidelines from the Best Management Practices for Mosquito Control in California (Appendix53, pages 2-3 and [Appendix D-Mosquitoes of California, pages 42-45, and Appendix E-Typical Larval habitats of California Mosquitoes, page 46]) and the California Mosquito-borne Virus and Surveillance & Response Plan (Appendix32, pages 4-11) that are used by this agency.

Twenty-fourspecies of mosquitoes occur within Orange County, and their control is the primary focus of the District's activities.Certain species of mosquitoes found within Orange County can transmit West Nile virus (WNV), St. Louis encephalitis (SLE), western equine encephalitis (WEE), malaria, and potentially other viruses to humans. West Nile virus is also a threat to wildlife, primarily birds, and has contributed to thousands of bird deaths, including special status species, in Orange County since 2004. A few species of mosquitoes are also capable of transmitting dog heartworm and other viral diseases, including myxomatosis, to both domestic and wild animals. Although some species of mosquitoes have not been shown to transmit disease, most species can cause human discomfort from bites that are inflicted to obtain a blood meal. Reactions range from irritation in the area of the bite to severe allergic reactions to secondary infections resulting from scratching the irritated area. Additionally, an abundance of mosquitoes can cause economic losses, and loss of use or enjoyment of recreational, agricultural, or industrial areas.

In 2015, multiple introductions of two invasive mosquitoes were detected in Orange County. The Asian tiger mosquito (*Aedes albopicuts*) and the yellow fever mosquito (*Aedes aegypti*) are now known to infest several neighborhoods in nine Orange County cities. The likelihood of eradication of these species is low. With their introduction and establishment in the County, these aggressive day-biting mosquitoes bring the potential to spread viruses not currently endemic to the area such as yellow fever, dengue, chikungunya, and Zika. The District is working diligently to educate residents about their role in eliminating backyard sources to suppress these container breeding species.

In general, the District may coordinate (or advise) the flowing with the property owners or land managers based on species-specific vector management strategies:

Standing –Water Mosquitoes prefer water commonly found in ornamental ponds, unmaintained swimming pools, freeway drains, stormwater systems, natural waterways, and flood control channels.

Common Mosquito Reduction Guidelines:

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. mosquito fish).

Container Mosquitoes prefer contained areas of water, such as tree holes, buckets, tires, etc. Some standing water mosquitoes will also develop in containers.

Common Mosquito Reduction Guidelines:

a. Drain containers of standing water.
b. Cover, overturn, or create drainage holes that prevent standing water in the container.
c. Identify and prevent water from refilling containers.

Salt Water Mosquitoes lay their eggs on moist soil and vegetation. When they become submerged, due to tidal fluctuations or heavy rains, the eggs hatch.

Common Mosquito Reduction Guidelines:

a. Flood when air temperatures do not encourage rapid mosquito development (late fall rather than summer).
b. Reduce or eliminate emergent vegetation.
c. Flood quickly to encourage all eggs to hatch at once and minimize the need for multiple larvicide applications.

10.3 Identification of Known Breeding Areas

Identify known breeding areas for source reduction, larval control programs and habitat management;

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 Section 2 above. Further, the District address this practice as discussed in its IVM Plan (Appendix 1, pages 23-41) and Vector Reduction Manual (Appendix 4, pages 1-7), as well as practices in accordance with state guidelines from the Best Management Practices for Mosquito Control in California (Appendix 5 [Appendix A- Mosquito Control and Arbovirus Surveillance, pages 26-32]) and the California Mosquito-borne Virus and Surveillance & Response Plan (Appendix 3, pages 4-11).

10.4 Analysis of Surveillance Data

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

The District continually collects adult and larval mosquito surveillance data, dead bird reports, avian seroprevalence test results, and uses them to guide mosquito control activities. The District uses Geographic Information Systems (GIS) technology to analyze these data along with service requests and work records to monitor changes in abundance and distribution of mosquitoes and other target vector species. Also, annual aerial surveillance reveals possible neglected pools and other potential mosquito breeding sources. The District utilizes mosquito surveillance traps on a weekly basis to obtain appropriate mosquito abundance and disease activity data to guide control decisions.

This is further described in the District's IVM Plan (Appendix 1, pages 23-41) and in accordance with the California Mosquito-borne Virus and Surveillance & Response Plan (Appendix 3, pages 4-11).

11 Examination of Alternatives to Treatments

Dischargers shall continue to examine alternatives to pesticide use to reduce the need for applying larvicides that contain temephos and for spraying adulticides. Such methods include:

a. Evaluating the following management options, in which the impact to water quality, impact to non-target organisms, vector resistance, feasibility, and cost effectiveness should be considered:
• No action
• Prevention
• Mechanical or physical methods
• Cultural methods
• Biological control agents
• Pesticides

The District uses the principles and practices of Integrated Vector Management (IVM) as described in its agency specific Integrated Vector Management and Response Plan (Appendix 1, pages 2-3,6, and 23-41), its Vector Reduction Manual: Procedures and Guidelines (Appendix 4, pages 1-7 and pages 8-25) and discussed in Section2 above. As stated in Item 10 above, locations where vectors may exist are assessed, and the potential for using alternatives to pesticides is determined on a case-by-case basis. Commonly considered alternatives include: 1) Eliminate artificial sources of standing water; 2) Ensure temporary sources of surface water drain within four days (96 hours) to prevent adult mosquitoes from developing; 3) Control plant growth in ponds, ditches, and shallow wetlands; 4) Design facilities and water conveyance and/or holding structures to minimize the potential for producing mosquitoes; and 5) Use appropriate biological control methods that are available. Additional alternatives to using pesticides for managing mosquitoes are listed on pages 8-35 of the District's Vector Reduction Manual: Procedures and Guidelines (Appendix 4).

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

b. Applying pesticides only when vector are present at a level that will constitute a nuisance

c. Using the least intrusive method of pesticide application.

d. Public education efforts to reduce potential vector breeding habitat.

e. Applying a decision matrix concept to the choice of the most appropriate formulation.

The District uses the principles and practices of Integrated Vector Management (IVM) as described in its agency specific Integrated Vector Management and Response Plan (Appendix 1 pages 2-3, 6, and 23-41). Implementing preferred alternatives depends on a variety of factors including availability of agency resources, cooperation with stakeholders, coordination with

other regulatory agencies, and the anticipated efficacy of the alternative. If a pesticide-free alternative does not sufficiently reduce the risk to public health, pesticides are considered, beginning with the least amount necessary to effectively control the target vector.

A "nuisance" is specifically defined in California Health and Safety Code (HSC) §2002(j). This definition allows vector control agencies to address situations where even a low number of vectors may pose a substantial threat to public health and quality of life. In practice, the definition of a "nuisance" is generally only part of a decision to apply pesticides to areas covered under this permit. As summarized in the California Mosquito-borne Virus Surveillance and Response Plan, the overall risk to the public when vectors and/or vector-borne disease are present is used to select an available and appropriate material, rate, and application method to address that risk in the context of our IVM program.

12 Correct Use of Pesticides

Users 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 right 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. All errors in application and spills are reported to the proper authority.

13 Public Notices

Specify a website where public notices, required in Section VIII.B, may be found.

Public notices will be posted on the District website (www.ocvcd.org).

A distribution list of potentially affected government agencies was provided as part of the Notice of Intent Application.

14 References

Best Management Practices for Mosquito Control in California. 2010. Available by download from the California Department of Public Health—Vector-Borne Disease Section at http://www.westnile.ca.gov/resources.php under the heading *Mosquito Control and Repellent Information*. Copies may be also requested by calling the California Department of Public Health—Vector-Borne Disease Section at (916) 552-9730 or the Orange County Vector Control District at (714) 971-2421.

California Department of Public Health. 1989. The California Vector Control Technician Certification and Continuing Education Guidelines (2007 Revision). Accessed 3/03/2011 http://www.cdph.ca.gov/certlic/occupations/Documents/VCTCEGuide.pdf

California Mosquito-borne Virus Surveillance and Response Plan. 2010. [Note: this document is updated annually by CDPH]. . Available by download from the California Department of Public Health—Vector-Borne Disease Section at http://www.westnile.ca.gov/resources.php under the heading *Response Plans and Guidelines*. Copies may be also requested by calling the California Department of Public Health—Vector-Borne Disease Section at (916) 552-9730 or the Orange County Vector Control District at (714) 971-2421.

County of Orange. 2008. Orange County General Plan 2005 (2008 Revision). Accessed 3/03/2011 http://www.ocplanning.net/GeneralPlan2005.aspx

MVCAC NPDES Coalition Monitoring Plan. 2011. Posted on SWRCB website: http://www.waterboards.ca.gov/water_issues/programs/npdes/docs/aquatic/vectorcontrol/mvcac.pdf

Orange County Mosquito and Vector Control District's Integrated Vector Management and Response Plan. 2010. http://www.ocvcd.org/documents/CA_Integrated_VMRG_6-9-10.pdf

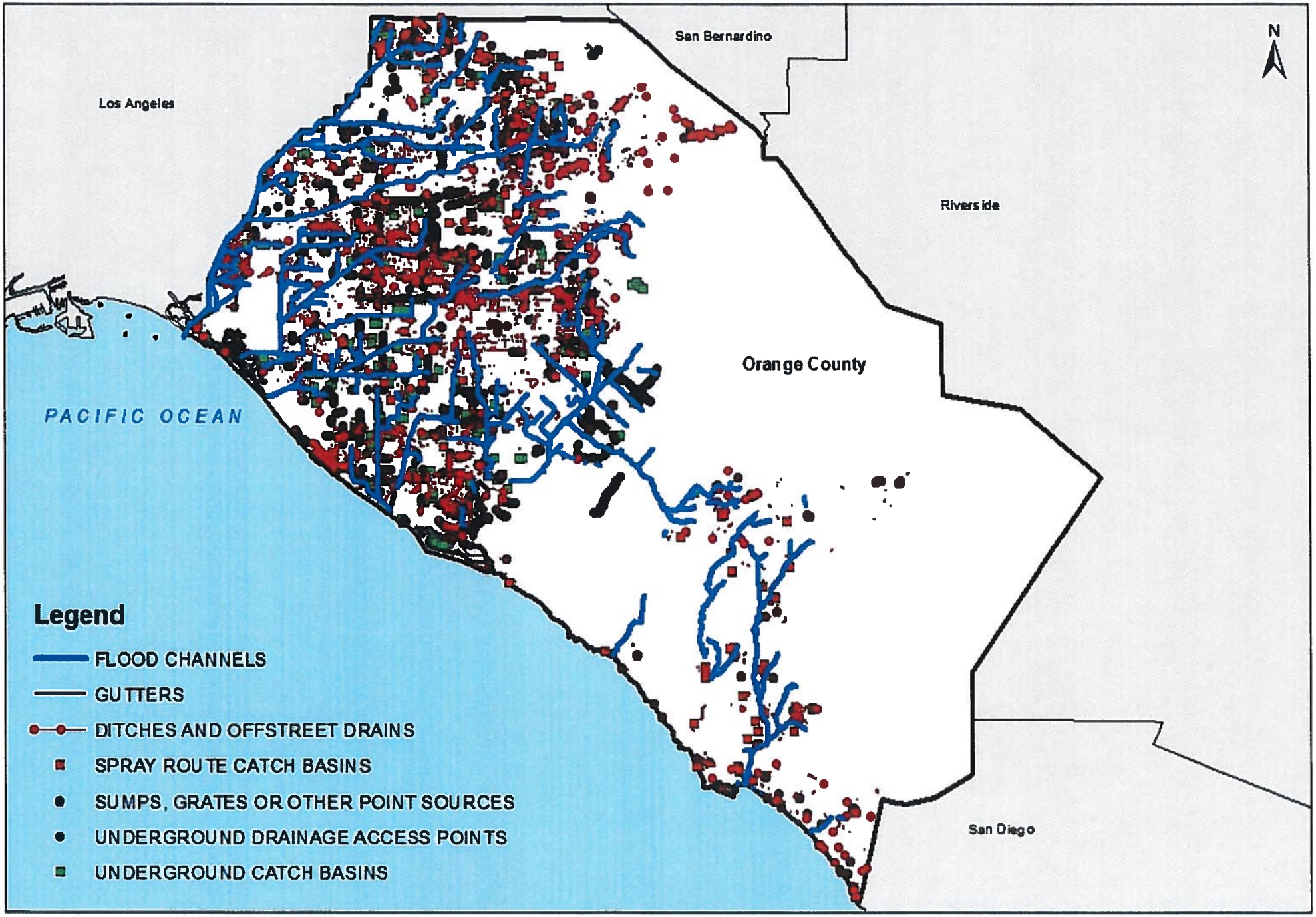
Orange County Mosquito and Vector Control District's West Nile Virus Emergency Response Plan. 2015. http://www.ocvcd.org/documents/OCMVCD_Emergency_FINAL.pdf.

Orange County Vector Control District Vector Reduction Manual: Procedures and Guidelines. 2010. http://www.ocvcd.org/documents/VectorReductionFinal.pdf

State Water Resources Control Board (SWRCB), 2011, Water Quality Order No. 2011-0002-DWQ, Statewide General National Pollutant Discharge Elimination System Permit For Biological and Residual Pesticide Discharges to Waters of Waters Of The United States From Vector Control Vector Control Applications (General Permit No. CAG 990004).

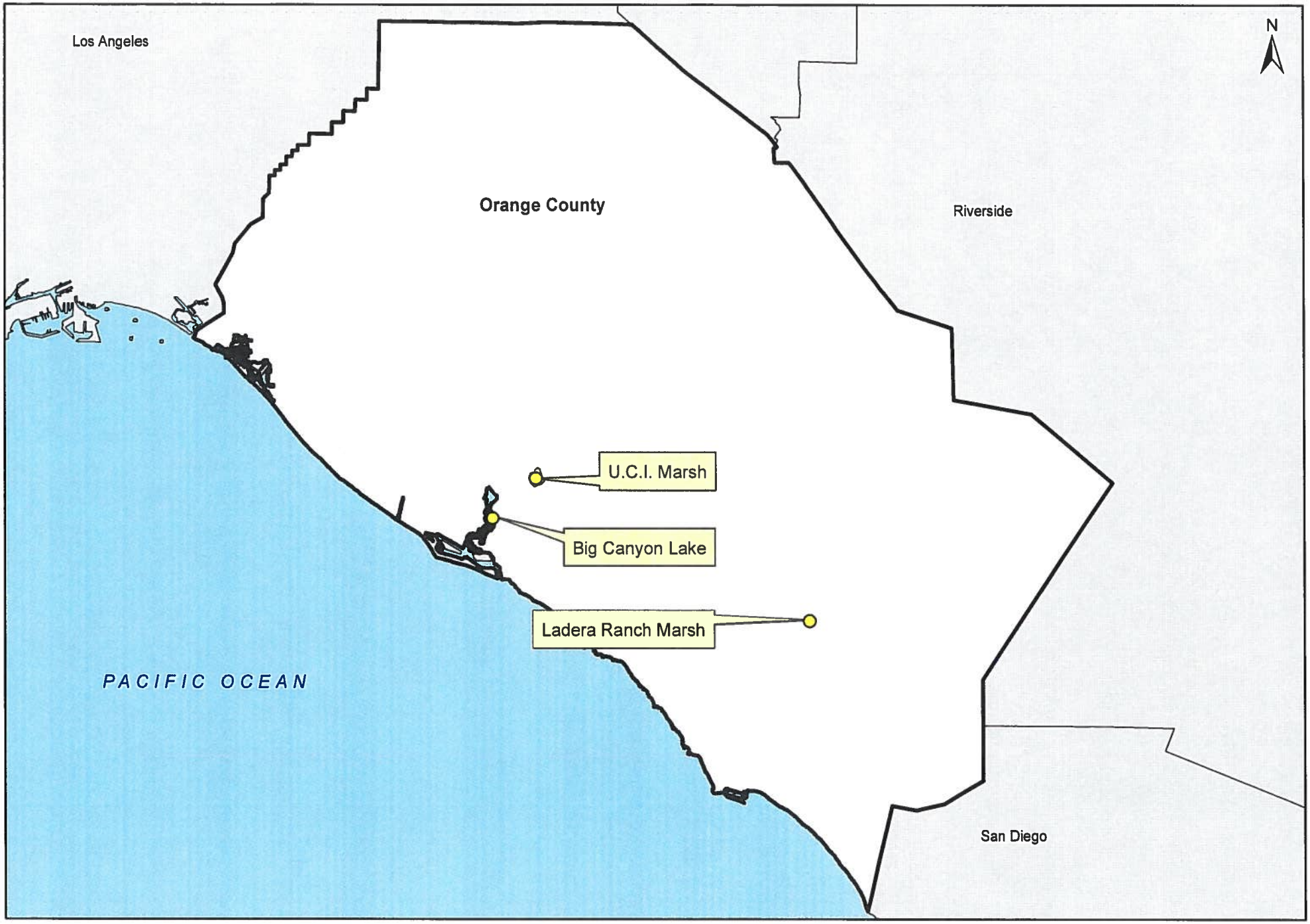

Orange County Vector Control District Jurisdictional Map
Los Angeles Co.
San Bernardino Co.
Riverside Co.
Santa Ana Region 8
San Diego Region 9
San Diego Co.
Orange County Boundary
Regional Water Quality Control Boards Boundary
Orange County Vector Control District Jurisdiction
N

ANTICIPATED LARVICIDING LOCATIONS WITHIN WATER CONVEYANCE SYSTEMS



ORANGE COUNTY VECTOR CONTROL

ANTICIPATED ADULTICIDING LOCATIONS



ORANGE COUNTY MOSQUITO AND VECTOR CONTROL DISTRICT

ORANGE COUNTY VECTOR CONTROL District

Integrated Vector Management & Response Plan

May 11, 2010

Integrated Vector Management & Response Plan
Preface

The purpose of the Integrated Vector Management and Response Plan is to provide guidelines to Orange County Vector Control District (District) staff and information to stakeholders regarding the various responses made to prevent and control disease vectors as well as introduced diseases and vectors in Orange County. A vector is any insect or arthropod, rodent or other animal of public health significance capable of harboring or transmitting the causative agents of human disease, or capable of causing human discomfort or injury. This document details the roles and responsibilities of Management, Administration, Public Information, Laboratory, and Operations staff in responding to vector-borne disease threats. The responses are organized by vector species that cause illnesses in humans, domestic animals, and wildlife. This Response Plan also includes contingencies for targeting control of newly introduced disease vectors that are nonnative in Orange County. The formation of this document is guided by the following principles: The application of professional knowledge and judgment for the protection of public health, the use of integrated vector management (IVM) concepts, partnerships with stakeholders, and continuous assessment and improvement.

Protection of Public Health

The mission of the Orange County Vector Control District is to provide the citizens of Orange County with the highest level of protection from vectors and vector-borne diseases. This mission is achieved by being proactive in response to current and future vector threats; responding effectively and courteously to the needs of the public; informing and educating the public about the shared responsibility of vector control; utilizing the most effective and safest methods available for the control of vectors; and providing vector control services in the most cost-effective manner.

Integrated Vector Management

The District's vector control activities are based solely on Integrated Vector Management principles. These principles serve as the foundation for developing vector control activities. Vector population and pathogen monitoring are integral to the control program and are used to generate criteria to implement mosquito management. The District recognizes that utilizing IVM principles will reduce the use of pesticides.

Professional Knowledge and Judgment

The District applies professional knowledge and judgment when necessary. Although this document represents the District's best efforts to delineate the District's response for reasonably foreseeable situations, it is recognized that management of vector populations and vector diseases is part of a natural process; and, therefore, very complex and not 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 knowledge and judgment in implementation of these policies and procedures. Deviation from these guidelines is, therefore, allowable when deemed necessary by District management or

authorized staff, based on available information and conditions, to meet the District's primary goal of protecting the public from vector-borne diseases.

Stakeholder Partnerships

The District works actively and cooperatively with stakeholder groups to help ensure that vector production is avoided or minimized; and, when necessary, controlled to protect both human and environmental health. The District aims to engage the public in the shared responsibility of vector control. The District identifies Federal Government agencies, State of California, Orange County, incorporated city and local government officials and agencies, agricultural producers, environmental groups, community groups and leaders, and citizens within the District's jurisdiction as stakeholders.

Continuous Improvement

The District regularly researches and tests new and innovative vector monitoring and management techniques. Staff is encouraged to investigate methods to improve vector and vector-borne disease management tools and incorporate them into activities as necessary. For this purpose, this document will be reviewed as necessary by District staff and approved by the Board of Trustees.

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

Integrated Vector Management Response & Guidelines
Orange County Vector Control District

TABLE OF CONTENTS

List of Abbreviations

BMP	–	Best Management Practice for stormwater and urban runoff.
CAC	–	County Agricultural Commissioner Office.
CDC	–	Center for Disease Control and Prevention.
CDPH	–	California Department of Public Health.
CO_2	–	Carbon dioxide.
GIS	–	Geographical Information System.
HCPS	–	Hantavirus Cardiopulminary Symptom.
IVM	–	Integrated Vector Management.
OCHCA	–	Orange County Health Care Agency.
OCVCD	–	Orange County Vector Control District.
PCO	–	Pest Control Operator.
PHP	–	Public Health Pesticide.
RIFA	–	Red Imported Fire Ant.
SLE	–	St. Louis Encephalitis.
ULV	–	Ultra Low Volume.
USDS	–	Underground Storm Drain System.
WEE	–	Western Equine Encephalitis.
WNV	–	West Nile virus, On-Going Mosquito Control Activities.

Integrated Vector Management Response Plan

On-Going Mosquito Control Activities

Standard mosquito control activities follow the Immature Mosquito Management Guidelines and the Adult Mosquito Management Guidelines and 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.

- Increase public education and awareness through the regular distribution of media releases, attendance at public events, public lectures, and other similar outreach mechanisms.

- Monitor mosquito, mosquito-borne disease, and public health pesticide efficacy surveillance activities using the following:
  a. Mosquito and insect identification.
  b. CDC/CO_2-baited traps.
  c. Gravid traps.
  d. Encephalitis virus testing in mosquitoes, dead birds, and wild birds.
  e. Sentinel chicken testing.
  f. Develop GIS maps.
  g. Monitor Public Health Pesticide Efficacy.

- Conduct routine immature mosquito identification and management (See Immature Mosquito Management Guidelines).
  a. Evaluate sites for immature mosquito threshold densities by species.
  b. Maintain continuous surveillance for potential mosquito development sites.
  c. Conduct aerial surveillance for residential green pools.
  d. Evaluate environmental and regulatory conditions and requirements.
  e. Determine the possibility of source reduction by drainage or modification of site.
  f. Introduce biological control measures (such as mosquito fish) if appropriate.
  g. Apply public health pesticides when necessary.
  h. Maintain larval treatment cycle time between 7-30 days.

- Routine adult mosquito management (See Adult Mosquito Management Guidelines).
  a. Control in urban areas will be on an as needed basis, as determined by the Director of Operations and resident requests.
  b. Initiate adult mosquito management when threshold criteria are met or exceeded.
  c. Utilize historical mosquito distribution and abundance data to make control decision.

Detection of a Dead Bird/Mosquito Pool/ Sentinel Chicken/Animal with a Mosquito-borne Virus

The following responses are initiated when the District's Scientific and Technical Services Laboratory detects a mosquito-borne virus (WNV, WEE, SLE) or when CDPH notifies the District of a mosquito-borne virus from dead bird(s), mosquito pool(s), sentinel chicken(s), or animal(s) within District boundaries. This level is equivalent to the "California Mosquito-Borne Virus Surveillance and Response Plans" Level 2 Normal Season and Emergency Planning Rating.

Management Responsibility Notify the District Board of Trustees. Evaluate District staffing and program needs.	**Communications Department Responsibility** Distribute a News Release.
Scientific and Technical Services Responsibility Notify County Public Health Officials. Notify County and City Animal Services. Provide additional localized disease surveillance to determine scope of virus activity. Continue to collect mosquito pools for isolation of virus as scheduled. Continue to bleed sentinel chickens as scheduled. Provide GIS maps.	**Control Operations Management Responsibility** Prepare for controlling adult mosquitoes when initiation criteria are met.
Control Operations Zone Responsibility Inspect and treat mosquito larval development sites. Investigate mosquito service requests from the public. Assess adult mosquito populations. Inspect known green pool locations in area.	**Control Operations Special Services Responsibility** Inspect flood channels in area. Inspect problem underground water storage devices and BMPs in the area. Inspect possible breeding sites (Canyon Drains\Marshes\Reservoirs) in area. Inspect historical breeding sites. Inspect other tracked sources in the area.

Locally Acquired Human Case of a Mosquito-borne Virus

The following responses are initiated when the OCHCA, or CDPH notifies the District that a human has acquired a mosquito-borne infection(s) within Orange County. This level is equivalent to the "California Mosquito-Borne Virus Surveillance and Response Plans" Level 3 Emergency Planning and Epidemic Rating.

Management Responsibility Notify the District Board of Trustees. Evaluate District staffing and program release needs.	**Communications Department Responsibility** Coordinate the distribution of a news with OCHCA.
Scientific and Technical Services Responsibility Coordinate with County Public Health USDS Officials. Determine scope of virus activity to support control efforts. Continue to collect mosquito pools for isolation of virus as scheduled. Continue to bleed sentinel chickens as scheduled. Provide GIS maps.	**Control Operations Management Responsibility** Consider reducing the spray route and cycle time to 8-10 days. Consider controlling adult mosquitoes when initiation criteria are met.
Control Operations Zone Responsibility Inspect and treat mosquito larval development sites. Investigate mosquito service requests from the public. Assess adult mosquito populations. Inspect known green pool locations in area.	**Control Operations Special Services Responsibility** Inspect flood channels in area. Inspect problem underground water storage devices and BMPs in the area. Inspect possible breeding sites (Canyon Drains\Marshes\Reservoirs) in area. Inspect historical breeding sites. Inspect other known sources in the area.

Epidemic Conditions of a Mosquito-borne Virus

The following responses are initiated when OCHCA or CDPH officials notify the District that multiple infections have occurred within a specific area, or there is evidence that an epidemic condition exists. The epidemic area is defined as the geographic region in which human cases are clustered (incorporated city, community, neighborhood, or Zip Code). This level is equivalent to the "California Mosquito-Borne Virus Surveillance and Response Plans" Level 2 Normal Season and Emergency Planning Rating.

Management Responsibility Consider holding a special Board of Trustee meeting. Shift District staffing and resources to meet program needs.	**Communications Department Responsibility** Distribute a News Release. If truck mounted ULV is necessary, include additional information in News Release.
Scientific and Technical Services Responsibility Coordinate with County Public Health Officials. Determine scope of virus activity to support control efforts. Continue to collect mosquito pools for isolation of virus as scheduled. Continue to bleed sentinel chickens as scheduled. If truck mounted ULV is appropriate, evaluate the control program. Provide GIS maps.	**Control Operations Management Responsibility** Consider reducing the treatment cycle time below 8-10 days. Consider controlling adult mosquitoes when initiation criteria are met. Delineate and map the treatment area. As necessary, contact and coordinate with other local agencies.
Control Operations Zone Responsibility Inspect and treat mosquito larval development sites. Investigate mosquito service requests from the public. Assess adult mosquito populations. Inspect known green pool locations in area. Provide educational materials to affected area. Distribute information to collaborating agencies and stakeholders in the area.	**Control Operations Special Services Responsibility** Inspect flood control channels in area. Inspect problematic underground water storage devices and BMPs in the area. Inspect possible breeding sites (Canyon Drains\Marshes\Reservoirs) in area. Inspect historical breeding sites. Inspect other known sources in the area.

Response to Imported Malaria Case

The following responses are initiated when OCHCA notifies the District of an imported malaria case(s) within the District boundaries. District response to a reported malaria case(s) 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.

Scientific and Technical Services Responsibility Determine scope of activity. Identify adult mosquitoes collected. Determine if *Anopheles* spp.are infected with malaria parasites.	**Control Operations Management Responsibility** Determine if adult mosquito control is necessary if initiation criteria are met in area. Delineate treatment area, as necessary.
Control Operations Zone Responsibility Inspect *Anopheles* mosquito development sites in area. Assess adult mosquito population.	**Control Operations Special Services Responsibility** Inspect *Anopheles* breeding sites (Canyon Drains\Marshes\Reservoirs) in area. Inspect problem underground water storage devices and BMPs in the area. Inspect other known sources in the area.

Response to a Locally Acquired Malaria Case and/or Infected Mosquitoes

The following responses are initiated when Orange County Health Care Agency notifies the District of a locally acquired malaria case(s) and or when *Anopheles* spp. are found infected with malaria parasites within the District boundaries. District response 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.

Management Responsibility Notify District Board of Trustees President. Evaluate District staffing and program needs.	**Communications Department Responsibility** Prepare educational materials. Coordinate the distribution of a news release with OCHCA. Consider a region-wide press conference.
Scientific and Technical Services Responsibility Determine scope of activity. Identify adult mosquitoes collected. Analyze climate and meteorological data to determine if conditions are favorable for Anopheline development. Determine if *Anopheles* are infected with malaria parasites. Provide GIS maps.	**Control Operations Management Responsibility** Contact County Agricultural Commissioner. Delineate and map the treated area. Coordinate response with other local vector control agencies.
Control Operations Zone Responsibility Inspect *Anopheles* mosquito development sites in area. Assess adult mosquito population. Conduct surveillance for *Anopheles* at local airports. Distribute educational materials.	**Control Operations Special Services Responsibility** Inspect *Anopheles* breeding sites (Canyon Drains\Marshes\Reservoirs) in area. Inspect problem underground water storage devices and BMPs in the area. Inspect historical breeding sites. Inspect other known sources in the area.

Critical Response to the Detection of an Introduced, Non-Native Disease or Disease Vector Within Orange County

The following response is initiated when the District detects an introduced, nonnative disease, or disease vector within Orange County. The District recognizes that a quick, efficacious response is necessary to prevent the vector or disease from becoming established in Orange County and Southern California.

Management Responsibility Notify District Board of Trustees. Contact and coordinate response with other stakeholders.	**Communications Department Responsibility** Conduct a press conference and distribute a news release. Prepare educational materials. If truck mounted ULV spraying is necessary, include additional information in news release.
Scientific and Technical Services Responsibility Notify County Public Health Officials. Train District staff about the disease or disease vector. Identify insect vectors and develop a surveillance strategy. Determine scope of infestation. Sample vectors for the presence of disease organism. If truck mounted ULV is necessary, evaluate the control program. Provide GIS maps.	**Control Operations Management Responsibility** Contact County Agricultural Commissioner. Determine a control strategy. Delineate and map the treatment area. Coordinate control of disease vector when initiation criteria are met. As necessary, contact and coordinate with other local agencies.
Control Operations Zone Responsibility Assess adult population. Conduct a thorough inspection for and treat mosquito development sites. Control adult mosquitoes. Distribute educational materials.	**Control Operations Special Services Responsibility** Inspect flood control channels in area. Inspect problem underground water storage devices and BMPs in the area. Inspect possible breeding sites (Canyon Drains\Marshes\Reservoirs) in area. Inspect other known sources in the area.

Black Fly Control Operations

Standard black fly activities follow Black Fly Management Guidelines and generally consist of the components listed below.

- Routine public education and awareness through the distribution of media releases, attendance at public events, public lectures, and other similar outreach mechanisms.

- Routine black fly and public health pesticide efficacy surveillance activities. Occurrence of black flies may also be noted by resident complaints.
    a. Black fly Identification.
    b. CDC/CO_2-baited traps.
    c. Prepare GIS maps.
    d. Conduct posttreatment surveillance.

- Routine immature black fly management.
    a. Evaluate the site for immature black fly habitat.
    b. Evaluate environmental and regulatory conditions and requirements.
    c. If appropriate, apply PHP.
    d. Apply PHP again, if needed, at time interval noted on PHP label.

Fly Control Operations

Fly control is initiated when the District is notified of an infestation occurring within District boundaries. The response follows Fly Control Guidelines. The District only uses pesticides to control fly infestations where source reduction is not possible, in situations that are deemed significant, and considered a threat to public health and safety.

- Fly control is instigated only after a thorough evaluation of the site is conducted and should include:
  a. Identification of pest fly species and estimation of population density.
  b. Identification of larval breeding source.
  c. Reduction of larval breeding source through habitat and source reduction, when possible.

- If reduction of larval breeding source is conducted, but a significant population of flies remains, the use of a public health pesticide may be necessary to control the population.

Scientific and Technical Services Responsibility Identify fly species and estimate population density. Determine scope of infestation. Conduct posttreatment evaluation of fly population. If necessary, provide GIS maps detailing surveillance and control activities.	**Control Operations Management Responsibility** Determine a control strategy. Delineate treatment area. As necessary, contact and coordinate with other local agencies.
Control Operations Zone Responsibility Distribute educational materials.	**Control Operations Special Services Responsibility** Distribute educational materials. Assist in source removal, if necessary. Apply pesticides to control flies, if necessary.

Response to a Flea-borne Typhus Case

The following responses are initiated when the District is notified of a human case of flea-borne typhus occurring within Orange County. The District recognizes that a quick response is necessary to instigate a reduction of the flea population in the area.

- A comprehensive flea-borne typhus risk evaluation of the area is warranted and should include:
    a. Notification of surrounding residents that a flea-borne typhus case has occurred in the area and what can be done to reduce the flea population in the area (use of flea control measures on pets).
    b. Live-trapping of opossums to determine the flea species and flea load per animal and the collection of whole blood for assessment of transmission activity.
    c. Assessing the flea abundance on backyard wildlife and pets.
    d. Assessing the potential for humans to be exposed to vector fleas.
    e. Reviewing the past history of flea-borne typhus activity and/or flea-borne typhus cases in the region.

Management Responsibility Notify District Board of Trustees. Contact and coordinate response with other stakeholders.	**Communications Department Responsibility** Conduct a press conference and distribute a news release.
Scientific and Technical Services Responsibility Notify County Public Health Officials. Conduct comprehensive flea-borne typhus risk assessment. Determine scope of infestation. Sample vectors for the presence of disease organism. Provide GIS maps detailing surveillance and control activities.	**Control Operations Management Responsibility** As necessary, contact and coordinate with other local agencies.
Control Operations Zone Responsibility Distribute educational materials and assist with surveillance activities. Assist with comprehensive flea-borne typhus risk assessment.	

Response to a Tick-borne Disease Case (Lyme Disease, Rocky Mountain Spotted Fever, Tularemia)

The following responses are initiated when the District is notified of a human case of tick-borne disease occurring within Orange County.

- A comprehensive tick-borne disease risk evaluation of the area is warranted and should include:
    a. Live-trapping (flagging) ticks to estimate tick density and the presence and/or prevalence of pathogens within the tick population.
    b. Assessing the potential for humans to be exposed to ticks.
    c. Reviewing the past history of tick populations and tick-borne disease in the area.
    d. Distribution of tick-borne disease educational materials to landholders and/or the affected population.

Ongoing RIFA Activities

Standard RIFA control activities follow Red Imported Fire Ant Guidelines and generally consist of the components listed below.

- Routine public education and awareness through the distribution of educational DVDs and flyers and attendance at public events. Education of maintenance staff at infested sites, such as schools, parks, golf courses, and nurseries. Distribution of educational material to residents in affected neighborhoods.

- Routine RIFA surveillance activities and public health pesticide efficacy.
    a. Insect identification.
    b. Inspection for mounds, foraging ants, and other signs of RIFA infestation around residential treatment sites and adjacent to large treatment sites.
    c. Placement of RIFA surveillance lures.
    d. Evaluation of new sites in Orange County for RIFA populations.
    e. Monitor pesticide efficacy.

- Routine RIFA Residential Site Management (Residential RIFA Treatment Cycle).
    a. Initial report is followed up by District staff who conduct RIFA surveillance and identification, and apply a pesticide ant bait.
    b. 2nd Residential treatment is conducted by a local Pest Control Operator (PCO) after 3 months of initial treatment.
    c. 3rd Residential treatment is conducted by the same PCO after 3 months of the 2nd treatment.
    d. Posttreatment survey is conducted at selected sites by the District. If RIFA are identified, the site begins the treatment cycle again.
    e. If a residence reports RIFA activity while on a RIFA treatment cycle, the District will respond and treat the site.

- Routine RIFA Large-Site Management (Large-Site RIFA Treatment Cycle)
    a. Specific guidelines are in place for large sites such as sites >1 acre, parks, schools, golf courses, and rights-of-way.
    b. Initial report is followed up on by District staff who conduct RIFA surveillance, identification, and apply a pesticide ant bait.
    c. 2nd, 3rd, and posttreatment surveys are conducted by District staff.
    d. If a large site reports RIFA activity while on a RIFA treatment cycle, the District will respond and treat the site.

RIFA Activities in Response to a Stinging Incident

The following response is instigated when the District is notified of a RIFA stinging incident within county boundaries. The District recognizes that a quick and efficacious response is necessary.

- RIFA treatment in response to a stinging incident.
    a. The District will respond to a stinging incident as quickly as possible.
    b. Advise persons to stay away from the area and post area conspicuously to keep others away.
    c. Staff will identify ant species and bring a sample to the District for confirmation.
    d. Staff will treat the mound.
    e. If ants are confirmed as RIFA, a residential or large site RIFA treatment cycle will be initiated.

Ongoing Rat Control Activities

Standard rat control activities (*Rattus* spp.) follow the Rat Management Guidelines and generally consist of the components listed below.

- Routine public education and awareness through the education of residents by responding to service requests, attendance at public events, public lectures, and other similar outreach mechanisms.

- Rat inspections and control.
    a. Inspections for rat activity around residences, businesses, parks, schools, city, county, state, and federal lands in Orange County.
    b. Recommendations to abate rat harborage, food sources, and modify rat entry points in homes and structures.
    c. Placement of rodenticide in tamper-resistant bait stations around exterior of residences.

Ongoing Rodent Surveillance Activities

Standard rodent surveillance activities generally consist of the components listed below.

- Routine rodent and rodent-borne disease surveillance and rodenticide efficacy.
    a. Rodent trapping and identification (rats, mice, and ground squirrels).
    b. Rodent parasite identification.
    c. Testing of rodents for rodent-borne diseases, such as bubonic plague, Hantaviruses, and additional diseases as needed.
    d. Testing of squirrels for WNV.
    e. Monitoring rodenticide efficacy.

Response to a Human or Animal Plague Case

The following response is initiated when the District is notified of a human or rodent plague case within county boundaries. The District recognizes that a quick and efficacious response is necessary to control rodents and their parasites that can further transmit the pathogen. This response is equivalent to recommendations set forth in the "California Department of Public Health 2008 Compendium for Plague Control."

- A comprehensive plague risk evaluation of the area is warranted and should include:
  a. Live-trapping rodents to estimate the population densities of known plague-amplifying species and the collection of serum specimens for assessment of plague transmission activity.
  b. Assessing the extent and phase of the outbreak.
  c. Evaluating the abundance and infectivity of known vector fleas (flea index and flea pools for plague testing).
  d. Assess the potential for humans to be exposed to vector fleas.
  e. Review the past history of plague activity and/or human plague cases in the region.
  f. Collaborate with CDPH and the County Agricultural Commissioner's Office.
- A decision to suppress vector fleas on rodents or rodents is based on:
  a. The presence and prevalence of susceptible rodents and vector fleas in areas of human activity.
  b. A high potential for humans to be exposed to vector fleas.
  c. Confirmation of plague activity among susceptible rodents and/or fleas in areas of human activity.
  d. A history of plague activity and/or human cases in the area.

Management Responsibility	**Communications Department Responsibility**
Notify District Board of Trustees. Contact and coordinate response with other stakeholders.	Conduct a press conference and distribute a news release. Prepare educational materials. If burrow dusting flea control is necessary, include additional information in news release.

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Response to a Human or Animal Plague Case - cont'd.

Scientific and Technical Services Responsibility Notify County Public Health Officials. Conduct comprehensive plague risk assessment. Train staff about the disease and disease vector. Identify fleas and develop a surveillance strategy. Determine scope of infestation. Sample vectors for the presence of disease organism. If burrow dusting flea control is necessary, conduct a posttreatment evaluation. Provide GIS maps detailing surveillance and control activities.	**Control Operations Management Responsibility** Contact County Agricultural Commissioner. Determine a control strategy with Scientific and Technical Services. Delineate and map the treatment area. Coordinate burrow dusting flea control as necessary. As necessary, contact and coordinate with other local agencies.
Control Operations Zone Responsibility Distribute educational materials. Assist with comprehensive plague risk assessment.	**Control Operations Special Services Responsibility** Distribute educational materials. Assist with burrow dusting flea control as necessary.

Response to a Human Hantavirus Cardiopulminary Symptom (HCPS) Case

The following response is initiated when the District is notified of a human HCPS case within county boundaries. The District recognizes that a quick response is necessary to educate the public and determine the prevalence of the virus in vector species. This response is equivalent to recommendations set forth in the "California Department of Public Health "Guidelines for conducting surveillance for hantavirus in rodents in California, 2004."

- A comprehensive HCPS risk evaluation of the area is warranted and should include:
  a. Live-trapping rodents to estimate the population densities of known HCPS amplifying species and the collection of specimens for assessment of HCPS prevalence.
  b. Assessing the extent and phase of the infestation.
  c. Assessing the potential for humans to be exposed to rodent vectors.
  d. Reviewing the past history of HCPS activity in the region.

- A decision to suppress rodents is based on:
  a. The presence and prevalence of susceptible rodents in areas of human activity.
  b. A high potential for humans to be exposed to rodents.
  c. Confirmation of HCPS activity among susceptible rodents in areas of human activity.
  d. A history of HCPS activity in the area.

Management Responsibility Notify District Board of Trustees. Contact and coordinate response with other stakeholders.	**Communications Department Responsibility** Conduct a press conference and distribute a news release. Prepare educational materials including transmission and prevention information. If rodent suppression is necessary, include additional information in news release.
Scientific and Technical Services Responsibility Notify County Public Health Officials. Conduct comprehensive HCPS assessment. Train staff about the disease and hosts. Determine scope of infestation. Sample hosts for the presence of disease organism. If rodent suppression is necessary, conduct a posttreatment evaluation. Provide GIS maps detailing surveillance and control activities.	**Control Operations Management Responsibility** Contact County Agricultural Commissioner. Determine a control strategy with Scientific and Technical Services. As necessary, contact and coordinate with other local agencies.
Control Operations Zone Responsibility Distribute educational materials. Assist with comprehensive HCPS risk assessment.	**Control Operations Special Services Responsibility** Distribute educational materials.

Integrated Vector Management
Immature Mosquito Guidelines

Definitions

Catch basin – Curbside opening that collects water runoff from streets and serves as an entry point to the storm drain system.

Endangered Species – This is a list of animals found within California or off the coast of the State that have been classified as Endangered or Threatened by the California Fish & Game Commission (State list) or by the U.S. Secretary of the Interior or the U.S. Secretary of Commerce (Federal list).

Environmentally sensitive habitats – Wetlands, riparian areas, organic producers, State, Federal, local wildlife area, or other areas posted as such.

Flood control channel - Open waterway that is designed to carry large amounts of rain water.

Freeway drain – A ditch or drain used to collect water from freeways.

Green pool – A pool that is not serviced, allowing for mosquito larvae development.

Gutter –The edge of a street (below the curb) designed to drain water runoff from streets, driveways, parking lots, etc., into catch basins. Area formed by the curb and the street to prevent flooding by channeling runoff to the storm drains.

Mosquito breeding site – A location where mosquitoes can complete their lifecycle.

Public Health Pesticide (PHP) – A pesticide registered by the Environmental Protection Agency and the California Department of Pesticide Regulation for use against insects of public health importance in California.

Underground Storm Drain System (USDS) – A network of conveyance systems that includes catch basins, grates, gutters, underground pipes, creeks, or open channels designed to transport rain from developed areas and discharged to a receiving body of water.

Larvicide - General term used to describe immature mosquito control.

Additional Technical Considerations

USDS, Flood Channels, and Freeway Drains

These sites have unique properties that make it impossible to conduct surveillance for immature mosquitoes prior to every treatment. During the breeding season, nighttime temperature, historical surveillance data, response to arboviral activity, and complaints by residents initiate larval treatment.

Larval Sampling

Due to the skittish nature of some larval species, such as *Cx. erythrothorax*, visual counts of larvae on the water surface, instead of collections, are considered acceptable to consider larvicide applications.

PHP Use and Resistance Management

The PHP's label must be consulted prior to every treatment. PHPs will be rotated at the Operations Director's discretion. If resistance is suspected in the field, laboratory and operations staff should be notified for follow-up.

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Immature Mosquito Guidelines - cont'd.

Factors or conditions that may modify the Immature Mosquito Management Guidelines
Human malaria or encephalitis occurrence.
Encephalitis or malaria mosquito pool isolation.
Sentinel chicken seroconversion.
Cluster of dead animals indicating arboviral activity.
Unforeseen biological or environmental conditions.
Introduction of an invasive disease vector.
Legislation, regulation or precedential legislation.
Availability of District funding, resources, or equipment.
Availability of suitable larvicides.
Susceptibility of immature mosquito populations to larvicides.
Environmental condition not listed in the program.
Continued occurrence of immatures in a development site.
Natural Disasters.

Integrated Vector Management
Immature Mosquito Guidelines

Site Assessment

Criteria	*Evaluation*	*Decision*
Is site a historical mosquito producer?	Yes→	Collect mosquito larvae samples. Consider **source reduction.**
No ↓		
Is site a mitigation wetland?	Yes→	Consult with Supervisor and District Biologist prior to treatment. Consider **larvae sampling criteria.**
No ↓		
Is breeding site an USDS, flood channel, or freeway drain?	Yes→	See technical considerations for **USDS, flood channels, and freeway drains.**
No ↓		
Environmentally sensitive habitat?	Yes→	Consult supervisor about habitat. Avoid damage to sensitive areas. Consider **larvae sampling criteria.**
No ↓		
Are their active bird nests?	Yes→	Do not disturb habitat. Consult with District Biologist.
No ↓		
Are endangered species present?	Yes→	Consult Supervisor about habitat. Avoid taking endangered species.
No ↓		
Vernal pool?	Yes→	Consult Supervisor about habitat. Avoid taking endangered species.
No ↓		
Will mosquitoes develop in the habitat?	No→	Consult Supervisor about habitat. Consider reducing site surveillance. Consider **source reduction.**
Yes ↓		
Sample mosquito breeding site and then consider **source reduction.**		

Integrated Vector Management
Immature Mosquito Guidelines

Source Reduction

Criteria	*Evaluation*	*Decision*
Can I eliminate the mosquito breeding site? Can I remove the water? Can I drain the mosquito breeding site?	Yes→	Institute necessary **source reduction.**
No ↓		
Can habitat be modified to reduce mosquito breeding?	Yes→	Consult with Special Services Institute necessary **source reduction.**
No ↓		
Consider **biorational control measures.**		

Integrated Vector Management
Immature Mosquito Guidelines

Biorational Control Measures

Criteria	*Evaluations*	*Decision*
Will habitat support immature mosquitoes?	No →	Do not apply biorationals. Set a return inspection date.
Yes ↓		
Time water will remain in breeding site?	< 96 hours →	Consider **larvae sampling critiera.**
Semi-permanent or permanent (> 96 hours)		
Yes ↓		
Environmentally sensitive habitat?	Yes→	Consult with supervisor before release of mosquitofish or **larvicide application.**
No ↓		
Water quality?	Highly organic →	Consider **larvae sampling criteria.** Consider stocking mosquito fish. Consider **larvicide application.**
Fresh ↓		
Swimming pool or backyard pond?	Yes→	Can stock mosquitofish. Add to pool list and set a return inspection date.
No ↓		
Can apply mosquito fish if applicable. Set a return inspection date. Consider **larvae sampling criteria.**		

Integrated Vector Management
Immature Mosquito Guidelines

Larvae Sampling Criteria

Criteria	*Evaluation*	*Decision*
Mosquito stages present?	none→	Do not treat. Set a return inspection date.
eggs to pupa ↓		
Number of immature mosquitoes?	*Anopheles* spp. = 0 immature/40 dips→ *Culex* spp. = 0 immature/20 dips→ *Aedes* spp. or *Culiseta* spp. = 0 immature/10 dips→	Do not treat. Set a return inspection date.
Anopheles spp. ≥ 1 immature/40 dips *Culex* spp. ≥ 1 immature/20 dips *Aedes* spp. or *Culiseta* spp. ≥ 1 immature/10 dips ↓		
Mosquitofish present with immature mosquitoes?	*Anopheles* spp. ≤ 1 immature/40 dips→ *Culex* spp. ≤ 1 immature/20 dips→ *Aedes* spp. or *Culiseta* spp. ≤ 1 immature/10 dips→	Do not treat. Set a return inspection date.
Anopheles spp. ≥ 2 immatures/40 dips *Culex* spp. ≥ 2 immatures/20 dips *Aedes* spp. or *Culiseta* spp. ≥ 2 immatures/10 dips ↓		
Consider **larvicide application.**		

Integrated Vector Management
Immature Mosquito Guidelines

Larvicide Application

Criteria	*Evaluation*	*Decision*
Is development site an USDS, flood channel, or freeway drain?	Yes→	See technical considerations for **USDS, flood channels, and freeway drains**.
No ↓		
Mosquito development site size?	more than 1 acre→	Consult with **Special Services** for treatment.
less than 1 acre ↓		
Water quality	moderate to highly organic *Culex* spp.→	Apply appropriate larvicide and consider **treatment methods.**
Fresh ↓		
Majority of immature stages present?	late 4th to pupae stages→	Apply appropriate larvicide and consider **treatment methods.**
eggs to early 4th larval stages ↓		
Vernal pool?	Yes→	Consult supervisor and consider **treatment methods.**
No ↓		
Fairy shrimp present?	Yes→	Consult supervisor and consider **treatment methods.**
No ↓		
Apply appropriate larvicide and consider **treatment methods.**		

Integrated Vector Management
Immature Mosquito Guidelines

Treatment Method

Criteria	*Evaluation*	*Decision*
Distribution of immatures?	Isolated locations→	Treat selective areas.
Throughout source ↓		
Treat entire mosquito development site.		

Integrated Vector Management
Immature Mosquito Guidelines

USDS, Catch Basin and Freeway Drain Treatment Criteria

Criteria	*Evaluation*	*Decision*
Historical mosquito breeding site?	Consult historical records, if yes →	Treat with appropriate larvicide every 10-14 days during mosquito season
No ↓		
Standing water present and/or water flowing into site?	Yes→	Treat with appropriate larvicide and schedule inspection in 10-14 days.
No ↓		
Adult mosquitoes seen leaving system.	Yes→	Adulticide storm drain and schedule additional treatment for 10-14 days.
No ↓		
Inspect channel every 10-14 days during mosquito breeding season and consider ecologic criteria.		

Flood Channel Treatment Criteria

Criteria	*Evaluation*	*Decision*
Historical mosquito breeding site?	Consult historical records, if yes →	Collect and identify larvae from site at beginning of mosquito season. Treat with appropriate larvicide every 10-14 days during mosquito season.
No ↓		
Standing water present?	Yes→	Consider ecologic criteria. Treat with appropriate larvicide and schedule inspection in 10-14 days.
No ↓		
Inspect channel every 10-14 days during mosquito breeding season and consider ecologic criteria.		

Integrated Vector Management
Adult Mosquito Guidelines

Definitions

Adult Mosquito Control

The management of adult mosquitoes may consist of application of a PHP by ultra low volume (ULV) application equipment or direct application (barrier treatments) to residences, outbuildings, other structures and mosquito resting sites.

Continuance Criteria

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.

Initiation Criteria

Criteria that when achieved trigger the initial adult mosquito application measures. At present, the District recognizes eight separate conditions to be adult mosquito control application triggers.

Termination Criteria

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

Additional Technical Information

1. **Adult Mosquito Surveillance Devices**
   Each year, a surveillance device and/or method may be selected to measure the adult mosquito population. This device and/or method can be altered at the discretion of the Operations Manager and/or Laboratory Director.
2. **USDS, Catch basins, and Freeway Drains.**
   Adult mosquito control is initiated year round in these habitats when adult mosquitoes are seen flying from manhole covers upon inspection, and based on historical surveillance data.
3. **Evidence of a non-native, mosquito disease vector within District boundaries.**
   In the event a non-native, mosquito disease vector is introduced into Orange County the District will consider a single female specimen the trigger point for adult mosquito management.
4. **Delineate treatment area**
   The Operations Manager has the flexibility to delineate the treatment area for adult mosquito control when mosquito trigger points have been reached. Knowledge gained from surveillance and research can change the phased response recommendations. In the District treatment area, the primary goal of the adult mosquito management program is to maintain *Cx. tarsalis, Cx. quinquefasciatis, Cx. Stigmatostoma, and Cx. erythrothorax* populations below disease transmission levels. These species are the primary target for control because they vector mosquito-borne arboviruses like West Nile virus (WNV), western equine encephalitis (WEE), Saint Louis encephalitis (SLE), or California encephalitis (CE) in Southern California, and may play a role in other diseases, such as dog heartworm. *Anopheles freeborni* is targeted for management because it is a vector of malaria. These additional species are targeted because their biting habits also create a public nuisance. The boundaries of the area to be treated are determined by the mosquito species that achieved the

criterion, species biology and flight range, and the infested area. Defining a boundary does not imply that all or part of that area can or will be treated and that the mosquito species targeted will be eradicated within those boundaries.

Public Health Pesticide Use and Resistance Management

1. Consult Public Health Pesticide (PHP) label before treatment.
2. Apply PHPs within the same class or mode of activity on a rotational basis as determined by the Director of Operations.
3. If resistance is suspected in the field, laboratory and operations staff should be notified for follow-up.

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. Legislation, regulation or precedential case authority.
6. Unforeseen biological conditions.
7. Presence or absence of mosquito-borne disease.
8. Introduction of an invasive disease vector of public health importance.

Integrated Vector Management
Adult Mosquito Guidelines

Meterological Conditions for Ground Applications

Temperature inversion?	Absent→	Delay Instituting **Adult Mosquito Management.**
Present ↓		
Wind Speed?	Exceeds PHP label recommendations→	Delay Instituting **Adult Mosquito Management.**
Less than maximum PHP label recommendations ↓		
Institute Adult Mosquito Management with Appropriate Public Health Pesticide.		

Integrated Vector Management
Adult Mosquito Guidelines

Delineate Treatment Area

Is the inititation or continuance criteria met?	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 **Meterological Conditions** within the **Delineated Treatment Area.**
No ↓		
Environmentally sensitive habitat?	Yes→	Consider treatments compatible with an environmentally sensitive habitat, then consider **Meteorological Conditions** within the **Delineated Treatment Area.**
No ↓		
Organically grown crops?	Yes→	Consider treatments that meet Organic Standards, then consider **Meteorolgical Conditions** within the **Delineated Treatment Area.**
No ↓		
Consider **Meterological Conditions** within the **Delineated Treatment Area.**		

Integrated Vector Management
Adult Mosquito Guidelines

USDS, Catch Basin and Freeway Drain Treatment Criteria

Criteria	*Evaluation*	*Decision*
Historical mosquito breeding site?	Consult historical records, if yes →	Treat with appropriate larvicide every 10-14 days during mosquito season
No ↓		
Standing water present and/or water flowing into site?	Yes→	Treat with appropriate larvicide and schedule inspection in 10-14 days.
No ↓		
Adult mosquitoes seen leaving system.	Yes→	Adulticide storm drain and schedule additional treatment for 10-14 days.
No ↓		
Inspect channel every 10-14 days during mosquito breeding season and consider ecologic criteria.		

Flood Channel Treatment Criteria

Criteria	*Evaluation*	*Decision*
Historical mosquito breeding site?	Consult historical records, if yes →	Collect and identify larvae from site at beginning of mosquito season. Treat with appropriate larvicide every 10-14 days during mosquito season.
No ↓		
Standing water present?	Yes→	Consider ecologic criteria. Treat with appropriate larvicide and schedule inspection in 10-14 days.
No ↓		
Inspect channel every 10-14 days during mosquito breeding season and consider ecologic criteria.		

Integrated Vector Management
Adult Mosquito Guidelines

Initiation Criteria

Criteria	*Evaluation*	*Decision*
#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 by 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→	Determine level of mosquito activity.
No ↓		
#5 Evidence of a non-native, introduced mosquito species within Distict boundaries.	Yes→	Determine level of mosquito activity.
No ↓		
#6 CDC/CO_2 trap or Gravid Trap collection within the District boundaries of:	50 or more **female** *Cx. tarsalis*, and/or **75 female** *Cx. quinquefasciatus*, *Cx. stigmatastoma* *Cx. erythrothorax*, or *Anopheles* per collection **per trap nights**, and/or→ **5** or more **female** of any *Aedes or* 10 of a *Culiseta* species per collection **per trap nights**, and/or→ **100** or more total **female** mosquitoes per collection **per trap nights**→	Delineate treatment area and consider treatment method.
50 female *Cx. tarsalis*, and/or less than **75 female** *Cx. erythrothorax*, *Cx. stigmatastoma*, *Cx. quinquefasciatus* or *Anopheles* per collection **per trap nights**, and/or less than 5 **female** of any *Aedes* or 10 of a *Culiseta* species per collection **per trap nights**, and/or less than **100** or more total **female** mosquitoes per collection **per trap nights.** ↓		
#7 Presence of adult mosquitoes in an USDS, catch basin, or freeway drain.	1 or more *Culex* species →	USDS Treatment Criteria.
↓		
#8 Mosquitoes creating a public health nuisance at a residence.	1 or more **female** mosquito(s) collected by a homeowner or on a homeowner's property→	Delineate treatment area and consider treatment method.
↓		
Adult mosquito sample not collected.		
Do Not Initiate Adult Mosquito Management		

5/11/10

Integrated Vector Management
Adult Mosquito Guidelines

Continuance Criteria

Criteria	*Evaluation*	*Decision*
CDC/CO_2 trap or Gravid Trap collection with	**25** or more **female** *Cx. tarsalis, Cx. erythorthorax, Cx. stigmatastoma Cx. quinquefasciatus*, or *Anopheles* per collection per **trap night, and/or** →	Consider Meterological Conditions in the Treatment Area.
	5 or more **female** of any *Aedes* or **10** *Culiseta* per collection per **trap night,** and/or →	
	25 or more total **female** mosquitoes per collection per **trap night** →	
less than **25 female** *Cx. tarsalis, Cx. erythorthorax, Cx. stigmatastoma, Cx. quinquefasciatus,* or *Anopheles* per collection per **trap night,** and/or less than **5 female** of any *Aedes* or **10** *Culiseta* per collection per **trap night,** and/or less than **25** total **female** mosquitoes per collection per **trap night** ↓		
Presence of adult mosquitoes in an USDS, catch drains	**1** or more *Culex* species →	USDS Treatment Criteria.
↓		
Do Not Institute Adult Mosquito Management		

Integrated Vector Management
Adult Mosquito Guidelines

Termination Criteria

Criteria	*Evaluation*	*Decision*
Date?	after December 1st →	Terminate Adult Mosquito Control Applications within the delineated treatment area.
before December 1st ↓		
CDC/CO_2 Light trap or Gravid Trap collection with	less than **15** or more **female** *Cx. tarsalis, Cx. quinquefasciatus, Cx. erythrothorax, or Cx. stigmatastoma, or Anopheles* per collection for per **trap night**, and/or→ less than **1 female** of any *Aedes* or **5** *Culiseta* species per collection for per **trap night**, and/or → less than **25** total **female** mosquitoes per collection for **per trap night** →	Terminate Adult Mosquito Control Applications within the delineated treatment area.
15 or more **female** *Cx. tarsalis, Cx. quinquefasciatus, Cx. erythrothorax, or Cx. stigmatastoma* per collection per **trap night**, and/or **1** or more **female** of any *Aedes or* **5** *Culiseta* species per collection per **trap night**, and/or **25** or more total **female** mosquitoes per collection per **trap night** ↓		
Environmental conditions?	10 consecutive nights unfavorable for ULV treatments →	Terminate Adult Mosquito Control Applications within the delineated treatment area.
Favorable for adult mosquito management ↓		
Continue to Consider Continuance Criteria		

Integrated Vector Management
Adult Mosquito Guidelines

Determine Level of Mosquito Activity

Criteria	*Evaluation*	*Decision*
Malaria case? Mosquito Not Present ↓ Do Not Inititiate Adult Mosquito Management	*Anopheles freeborni* present in a trap within 1/4 mile radius of human case	Delineate Treatment Area.
WNV, WEE, SLE, or other mosquito-borne virus case? Mosquito Not Present ↓ Do Not Institute Adult Mosquito Management	*Cx. tarsalis, Cx. quinquefasciatus,* or another mosquito species that can vector a virus pathogen within a one mile radius of a human case.	Delineate Treatment Area.
Collection of an invasive disease vector within District boundaries.	1 specimen of a **female** invasive disease vector.	Delineate Treatment Area.

Integrated Vector Management

Surveillance Indicators

WNV, SLE or, WEE

Criteria	*Critical Value*
Positive mosquito pool	Ct value <30 for E Primer set or < 35 for NS1 Primer set
Positive dead bird (kidney)	Ct value <30 for E Primer set or < 37 for NS1 Primer set
Positive dead bird (BIC)	Ct value <30 for E Primer set or < 37 for NS1 Primer set
Wild bird seroconversion rate	> 5% of population sampled from a site
Human infection/blood donor	Determined by OCHCA and reported to OCVCD

Malaria

Criteria	*Critical Value*
Malaria parasite.	1 *Plasmodium* spp. as determined by appropriate analysis.

Mosquito Abundance

Criteria	*Definition*
Historical mosquito breeding site.	Consistant mosquito collections at a site in previous years.
Trap night	One trap set for one night. Ten trap nights equals one trap set for ten nights or ten traps set for one night.

Integrated Vector Management
Black fly Guidelines

Black Fly Site Assessment

Criteria	*Evaluation*	*Decision*
Have black flies been identified by laboratory staff?	No→	Do not treat.
Yes ↓		
Does development site contain black fly habitat (flowing water)?	No→	Do not treat.
Yes ↓		
Are their active bird nests?	Yes→	Do not disturb habitat. Consult with District Biologist.
No ↓		
Are endangered species present?	Yes→	Consult supervisor about habitat. Avoid taking endangered species. Sample development site.
No ↓		
Environmentally sensitive habitat?	Yes→	Consult supervisor about habitat. Avoid damage to sensitive areas. Sample development site.
No ↓		
Consider black fly treatment		

Integrated Vector Management
Black fly Guidelines

Black Fly Site Treatment

Criteria	*Evaluation*	*Decision*
Does development site contain black fly habitat (flowing water)?	No→	Do not treat.
Yes ↓		
Water quality		
Fresh ↓		
Apply appropriate **Public Health Pesticide.**		

Integrated Vector Management
Fly Control Guidelines

Fly Site Assessment

Criteria	*Evaluation*	*Decision*
Have fly larvae been identified from source?	No→	Collect larvae at source for identification.
Yes ↓		
Can source be modified or reduced?	No→	Treat with PHP.
Yes ↓		
Modify or reduce fly source. Return to monitor fly production in 3-5 days.		

Integrated Vector Management
Red Imported Fire Ant Control Guidelines

Definitions

Large treatment site – A RIFA treatment site that is > 1 acre: school, park, golf course, rights-of-way, or multiple family housing such as apartments, duplexes, townhomes, condominiums, or mobile homes.

Mound treatment – A pesticide application of ant bait that eliminates a RIFA colony within 1-3 days.

Mound drench treatment – A pesticide application of a liquid residual insecticide that eliminates a RIFA colony immediately.

PCOs – A Pest Control Operator as licensed by the California Department of Consumer Affairs, Structural Pest Control Board.

Residential site – A single-family home RIFA treatment site.

Stinging incident – An incident where a person is stung multiple times by ants.

Additional Technical Considerations

RIFA Treatment Manual

The RIFA Treatment Manual contains more details and technical specifications for RIFA surveillance, site assessment and treatment. The Manual is provided to all technicians treating for RIFA and is available from the Operations Department on request.

RIFA Public Health Pesticide Use and Resistance Management

1. Consult pesticide label before treatment.
2. Apply pesticides on a rotational basis, as determined by the Director of Operations.
3. If resistance and/or bait aversion is suspected in the field, laboratory and operations staff should be notified for follow-up.

Factors That May Influence the Implementation or Modification of the Program

1. Availability of suitable pesticide bait.
2. Susceptibility of RIFA populations to pesticide bait.
3. Environmental conditions not listed in the guidelines.
4. Availability of District funding or resources.
5. Legislation, regulation, or precedential case authority.
6. Unforeseen biological conditions.
7. Presence or absence of swarming ants and/or a stinging incident.
8. Introduction of an invasive disease vector of public health importance.

Integrated Vector Management
Red Imported Fire Ant Control Guidelines

RIFA Site Assessment & Treatment

Criteria	*Evaluation*	*Decision*
Is property adjacent to waters of the United States?	Yes	Conduct surveillance for RIFA, refer to RIFA treatment manual, and consult management before treatment
No ↓		
Is property considered an environmentally sensitive site or adjacent to an environmentally sensitive site?	Yes	Conduct surveillance for RIFA, refer to RIFA treatment manual, and consult management before treatment
No ↓		
Are endangered species present?	Yes	Conduct surveillance for RIFA, confirm identification of RIFA, refer to RIFA treatment manual, and consult management before treatment.
No ↓		
Is property a single-family residence?	Yes	Conduct surveillance for RIFA, confirm identification of RIFA, refer to RIFA treatment manual, and apply PHPs according to residential treatment guidelines.
No ↓		
Is property a large treatment site (> 1 acre): park, golf course, apartment complex, or condominium complex?	Yes	Conduct surveillance for RIFA, confirm identification of RIFA, consult RIFA treatment manual, and apply PHPs according to large treatment site guidelines.
No ↓		
Is property a school?	Yes	Conduct surveillance for RIFA, confirm identification of RIFA, consult RIFA treatment manual, and apply PHPs according to school treatment site guidelines.
No ↓		
Conduct surveillance for RIFA and consult manager for site treatment protocol.		

Integrated Vector Management
Red Imported Fire Ant Control Guidelines

RIFA Surveillance

Criteria	*Evaluation*	*Decision*
Fire ant mounds visible at site	Yes	Collect a sample and submit to laboratory for identification.
No ↓		
Foraging ants visible at site	Yes	Collect a sample and submit to laboratory for identification.
No ↓		
Place RIFA surveillance lure to collect foraging ants.	Ants on lure	Collect a sample and submit to laboratory for identification.
No ants found on lure ↓		
Site considered free of RIFA		

Integrated Vector Management
Red Imported Fire Ant Control Guidelines

Residential Treatment

Criteria	*Evaluation*	*Decision*
Is site a single-family residence?	No	Refer to District RIFA program.
Yes ↓		
The District RIFA Program conducts initial inspection and treatment within 3 business days.		Conduct **site assessment**. Collect ant sample to confirm RIFA identification by the District. Broadcast treatment with RIFA pesticide ant bait in accordance with pesticide label.
↓		
Referral to PCO for 2nd treatment (month 3)		Broadcast treatment with RIFA pesticide ant bait in accordance with pesticide label.
↓		
RIFA complaint by resident	Yes	OCVCD conducts treatment in accordance with pesticide label.
No ↓		
3rd treatment by PCO (month 6)		Broadcast treatment with RIFA pesticide ant bait in accordance with pesticide label.
↓		
The District post-treatment survey (month 9-12).	RIFA Absent	Site is removed from the residential treatment cycle.
RIFA present ↓		
Begin Residential Treatment Cycle		

Integrated Vector Management
Red Imported Fire Ant Control Guidelines

Large Area RIFA Treatment

Criteria	*Evaluation*	*Decision*
Is site > 1 acre: school, golf course, park, apartment, condominium or rights-of-way?	No	The District RIFA staff will investigate site and determine treatment protocol.
Yes ↓		
Conduct site assessment & RIFA surveillance.	RIFA not present	Provide education to property owner.
RIFA present at site ↓		
Initial treatment		Collect sample to confirm identification. Apply RIFA pesticide bait according to label specifications.
↓		
2nd treatment		Apply RIFA pesticide bait according to label specifications.
↓		
3rd treatment		Apply RIFA pesticide bait according to label specifications.
↓		
The District posttreatment survey (month 9-12).	RIFA Absent	Site is removed from the RIFA Large Site Treatment Cycle.
RIFA present ↓		
Begin RIFA Large-Site Treatment Cycle.		

Additional Technical Considerations

Bait Station Placement – Generally, only two bait stations are placed on a property after the property owner has been instructed to abate rodent harborage and food sources, and signed a Release of Liability form (Appendix I). Bait stations should be placed outside of structures in areas accessible only to rodents. Bait stations should be appropriately labeled and tamper-proof in accordance with rodenticide label requirements. Bait stations should be serviced every six months.

Rat Control & Rodent Disease Surveillance – The District only provides control for rats (*Rattus* spp.) to residents in Orange County. The District conducts surveillance for rodent-borne diseases in Orange County.

Environmentally Sensitive Areas - When properties are adjacent to environmentally sensitive areas, traps should be used prior to bait station placement.

Rodenticide Use and Resistance Management

1. Consult rodenticide label before treatment.
2. Apply rodenticides on a rotational basis as determined by the Director of Operations.
3. If resistance is suspected in the field, laboratory and operations staff should be notified for follow-up.

Factors That May Influence the Implementation or Modify the Program

1. Availability of a suitable rodenticide.
2. Susceptibility of rodent populations to rodenticides.
3. Environmental conditions not listed in the guidelines.
4. Availability of District funding or resources.
5. Legislation, regulation, or precedential case authority.
6. Unforeseen biological conditions.
7. Presence or absence of rodent-borne disease.
8. Introduction of an invasive disease vector of public health importance.

Integrated Vector Management
Rat Control Guidelines

Rodent Control Site Assessment

Criteria	*Evaluation*	*Decision*
Is homeowner, or adult > 18 years old, available for consulation?	No	Reschedule inspection if possible.
Yes ↓		
Interview homeowner about rat activity on their property. ↓		
Conduct inspection of property looking specifically for rodent harborage, food sources, structural issues allowing rodents access to home, and rodent droppings.	Yes	Discuss findings with homeowner, provide educational materials, consider rodent **bait station placement.**
No ↓		
Do not install bait stations and/or remove bait stations and schedule an inspection for 6 months.		

Integrated Vector Management
Rat Control Guidelines

Rodent Bait Station Placement

Criteria	*Evaluation*	*Decision*
Are rats entering the building?	Yes	Do not place bait station.
No ↓		
Signs of active rodent infestation	Yes	Distribute educational materials and encourage abatement of rodent harborage and food source. Consider rodent bait station placement only after abatement and Release of Liability Form is signed.
No ↓		
Does property have pets and/or small children?	Yes	Distribute educational materials and only place bait station out of reach of pets and small children after Release of Liability Form is signed.
No ↓		
Is adjacent property contributing to a rodent infestation?	Yes	Distribute educational materials and attempt contact of neighbor. Consider rodent bait station placement only after Release of Liability Form is signed.
No ↓		
Is the property adjacent to an environmentally sensitive habitat?	Yes	Distribute educational materials and encourage abatement of rodent harborage and food source. Consider rodent bait station placement only after abatement and after Release of Liability Form is signed.
No ↓		
Consider rodent bait station placement only after abatement and after Release of Liability Form is signed.		

Rat Control Release of Liability

K'WEST PRINTING (714) 997-9630

ORANGE COUNTY VECTOR CONTROL DISTRICT
13001 Garden Grove Blvd., Garden Grove, CA 92843-2102
Phone: (714) 971-2421 • (949) 654-2421
www.ocvcd.org

Date

ZONE NO.	MAP AREA

Thomas Bros. Guide

PAGE NO.	GRID

SERVICE REQUEST NUMBER

RELEASE OF LIABILITY

The undersigned does hereby RELEASE the ORANGE COUNTY VECTOR CONTROL DISTRICT and its officers, agents, and employees from any and all liability arising out of claims or damage pertaining to the placement of rodenticide on the property address listed below.

The undersigned acknowledges that the rodenticide is a poison that should be considered dangerous and may be lethal. Keep all children and pets away from this rodenticide bait.

X _____
Occupant's Signature

WARNING AND AGREEMENT

THE RODENTICIDE BAITS USED IN ROOF RAT EXTERMINATION CONTAIN POISONS AND SHOULD BE CONSIDERED DANGEROUS AND CAN BE LETHAL IF INGESTED. KEEP ALL CHILDREN AND PETS AWAY FROM PLACED RODENTICIDE BAIT.

If accidentally swallowed by humans, domestic animals, or pets, rodenticides used in roof rat control can reduce the clotting ability of blood and cause internal hemorrhaging. In such cases, immediate medical help should be sought. The antidote recommended for this type of anticoagulant rodenticide is intravenous and oral administrations of Vitamin K combined with blood transfusions. This is the indicated treatment for hemorrhage caused by accidental ingestion of anticoagulant rodenticides.

☐ Dog(s) and/or other domestic pet(s) presently reside on this property. I have been warned of the dangers of this rodenticide being ingested by dog(s) and other domestic pet(s). I will keep my pets away from the rodenticide bait and containers.

X _____
Occupant's Signature

☐ No dogs reside on property.

I request that the ORANGE COUNTY VECTOR CONTROL DISTRICT take such steps as are necessary to control roof rat infestation and give my permission for the use of rodenticide bait on my property. I have read the warnings as to the dangers inherent with the use of rodenticide bait and hereby release the ORANGE COUNTY VECTOR CONTROL DISTRICT from any liability for injury, death, and/or damage that may arise from such use.

I agree to warn all persons coming on to my property of the presence of rodenticide thereon, and also agree to indemnify, defend, and hold ORANGE COUNTY VECTOR CONTROL DISTRICT harmless from any claim, liability, injury, death, and/or damage resulting from or caused by the use of said rodenticide.

I further agree to follow the recommendations made by the VECTOR CONTROL INSPECTOR in regard to roof rat control and prevention. In the event that I sell or vacate this property, or feel that the rat problem has abated, I will notify the ORANGE COUNTY VECTOR CONTROL DISTRICT for proper disposal of any existing rodenticide placed on my property.

I understand that in the event that the recommendations presented by the VECTOR CONTROL INSPECTOR are not followed, that no further rat control measures will be taken by the ORANGE COUNTY VECTOR CONTROL DISTRICT.

I have been advised to rat-proof the structures on my property and agree that the ORANGE COUNTY VECTOR CONTROL DISTRICT has no obligation to remove any carcasses from my property.

X _____
Occupant's Signature

_____
Occupant's Name (Please Print)

_____
Street Address Apt. No.

_____
City Zip Code

_____
Telephone Number

_____
Inspector's Name Phone Ext. No.

DO NOT RELOCATE BAIT BLOCKS OR BAIT STATIONS.

BAIT PLACEMENT DIAGRAM

(FRONT)

Number of Bait Blocks Placed: Chlorophacinone_____ Bromadiolone_____

Date Replaced _____ Date Removed _____

Number of Bait Stations Placed: ☐ Number of Bait Stations Replaced: ☐ Number of Bait Stations Removed: ☐

White Copy - Administrative Yellow Copy - Occupant Pink Copy - Inspector

Appendix II

California Mosquito-Borne Virus Surveillance and Response Plan

Separate Document

ORANGE COUNTY MOSQUITO AND VECTOR CONTROL DISTRICT

INTEGRATED VECTOR MANAGEMENT AND RESPONSE PLAN

SUPPLEMENTAL CHANGES TO THE 2010 INTEGRATED VECTOR MANAGEMENT AND RESPONSE PLAN AS IT RELATES TO

WEST NILE VIRUS EMERGENCY MOSQUITO RESPONSE

Orange County Mosquito and Vector Control District
13001 Garden Grove Blvd, Garden Grove CA, 92843
Email: ocvcd@ocvcd.org
www.ocvcd.org

August 20, 2015

WEST NILE VIRUS EMERGENCY MOSQUITO RESPONSE PLAN

Introduction

The Orange County Mosquito and Vector Control District (OCMVCD), previously known as the Orange County Vector Control District (OCVCD), was originally formed in 1947 as a mosquito abatement district. Over time, the OCMVCD's mosquito surveillance plan has changed following the introduction of West Nile virus (WNV) in 2003, and because of the on-going threat from invasive mosquitoes and other vector-borne diseases. The present program has been in place since 2008 when in-house real-time reverse transcription PCR (PCR) testing was added to the surveillance program. This plan was initially adopted by the OCMVCD Board of Trustees in May, 2010. Changes were made to the plan following the 2014 WNV super epidemic that resulted in 280 human infections and nine deaths. Since its introduction to Orange County, a total of 532 people have been confirmed infected with WNV and 18 have died.

This document describes an enhanced surveillance and response program for Orange County, which is dependent on the risk level of mosquito-borne virus transmission to humans. The Mosquito-borne Virus Surveillance & Response Plan, 2015 (Appendix A), was generated by the California Department of Public Health (CDPH), Mosquito & Vector Control Association of California and the University of California. This plan constitutes the core of the OCMVCD's WNV Risk Assessment (Table 1). The California Plan's WNV Risk Assessment assigns values to various benchmarks within multiple Surveillance Factor categories. In the OCMVCD's West Nile Virus Risk Assessment worksheet, adjustments were made to the WNV Surveillance Factors to make categories relative to the conditions specific to Orange County.

The risk ratings generated from this assessment can be used to communicate levels of WNV activity to the Local Health Officer to determine whether a declaration of a local public health emergency should be considered. The risk ratings can be used as a basis to communicate risk to the Orange County Emergency Operation Center (EOC). Additionally, the risk rating can be used as justification to request Federal public health exemptions from FIFRA (40 CFR 166) and emergency pesticide tolerance exemptions (40 CFR 176).

In conjunction with the Orange County Health Care Agency (OCHCA) Emergency Operations Plan (EOP), and the OCMVCD Integrated Vector Management (IVM) & Response Plan (Appendix B), the following operational procedure for the OCMVCD has been developed. This follows the recommendations of the California Public Health and Medical Emergency Operations Manual, and the procedure is in coordination with the Orange County Medical Health Operational Area Coordinator (MHOAC) Annex to the OCHCA EOP.

In the event of a local, state, or federal declaration of emergency, the OCMVCD shall assist the MHOAC with investigation and control of vector-borne diseases. The OCMVCD will notify the County Epidemiology Program of any unusual event or finding related to vector-borne diseases. Examples of an unusual event include surveillance data indicating an increased risk of vector-borne disease transmission to residents of Orange County, OCMVCD's intention to implement

area-wide adult mosquito control to target vector-borne diseases in high risk areas, or the presence of a recently introduced vector or disease agent of concern. Epidemiology will notify the MHOAC as needed of any situations affecting human health. The OCMVCD will update the MHOAC, as necessary and if requested, of current vector surveillance, testing volumes and capacity, intended applications of area-wide adult mosquito control, and of any needs for supplies, equipment or personnel due to the emergency or unusual event. OCMVCD may request assistance through the MHOAC to minimize and respond to vector-borne disease events.

WEST NILE VIRUS RISK ASSESSMENT

Response Levels

The OCMVCD's IVM & Response Plan is based on conditions that exist at three response levels: 1) Normal Season, 2) Elevated Risk, and 3) High Risk. Six WNV surveillance factors are analyzed to determine the appropriate response level and include:

1. Environmental conditions (temperature)
2. Adult mosquito abundance
3. WNV infection rate in mosquitoes
4. Number of WNV-positive dead birds
5. WNV antibody seroprevalence in free-ranging birds
6. Human infections of WNV

The majority of the factors listed above are rated on a scale of 1 to 5 with 5 representing conditions indicative of a high risk of human infection with WNV. Factors 5 (seroprevalence) and 6 (human infections) are weighted differently than the other four factors and are rated on adjusted scales of 2 to 5 and 3 to 5, respectively. An overall rating is determined by computing the mean of the six risk factors and is correlated with the response level as follows:

Level 1: Normal Season (Rating – 1.0 to 2.5)

Level 2: Elevated Risk (Rating – 2.6 to 4.0)

Level 3: High Risk (Rating – 4.1 to 5.0)

The West Nile Virus Risk Assessment worksheet (Table 1) is designed to determine the appropriate rating for each of the risk factors for the entire County. These ratings are used to trigger the response levels listed above. Supporting reference documentation can be found in Tables 2 through 9 and Figures 1 through 5. In the event that WNV surveillance factors values are elevated in the historically high WNV risk area of Orange County, additional risk assessment ratings will be calculated for that specific area to generate an appropriate response level (Figure 5). Roles and responsibilities of key agencies involved in implementing the surveillance and response plan are outlined in OCMVCD Response Levels to Risk Ratings. The appropriate

response implemented at each level shall be determined based on the degree and magnitude of risk factors presenting. The WNV surveillance factors used to determine the response level are described below.

Guidelines for adult mosquito surveillance, processing mosquitoes for arbovirus detection, testing of dead birds, as well as information regarding human case definitions and public health pesticides approved for mosquito control in California are part of the State of California Mosquito-Borne Virus Surveillance & Response Plan, 2015 (Appendix A). Specific triggers for mosquito operational decisions can be found in the IVM & Response Plan (Appendix B).

West Nile Virus Surveillance Factors

Environmental Conditions

OCMVCD reviews weather reports from local, state, and federal agencies biweekly to assess current conditions and analyze the potential influence on mosquito breeding and virus replication. The average high, low, and mean temperatures by month from 2010 through 2014 are found in Table 2 (UCIPM Online, 2015). Total precipitation is also considered but has not been found to be a critical factor in mosquito-borne disease outbreaks in southern California.

Additional websites related to weather conditions can be found in the California State Mosquito-Borne Virus Surveillance & Response Plan, 2015 (Appendix A).

Adult *Culex quinquefasciatus* and *Culex tarsalis* Mosquito Abundance

Adult mosquito surveillance in Orange County is conducted by setting 63 carbon dioxide (CO_2) baited traps and 33 gravid traps on a weekly basis during the warm months of March through November and by setting 21 carbon dioxide (CO_2) baited traps and 15 gravid traps on a biweekly basis during cooler weather from December – March (Table 3 and Table 4). Additional adult mosquito surveillance is conducted after the detection of WNV-positive dead birds, human infections, and in response to nuisance biting complaints from the public. Only routinely trapped locations using CO_2 and gravid traps are used to generate a five-year average for abundance, which is then used as a baseline to compare current mosquito abundance. Mosquito trap locations (Tables 3 and 4; Figures 1 and 2) and average monthly *Cx. quinquefasciatus* abundance can be found in Table 5 (*Cx tarsalis* averages not shown). *Cx. tarsalis* and *Cx. quinquefasciatus* abundance is scored separately when calculating the WNV Risk Assessment ratings and response level.

Guidelines for mosquito surveillance are summarized in the California State Mosquito-Borne Virus Surveillance & Response Plan, 2015 (Appendix A).

Infection Rates in *Culex quinquefasciatus* and *Culex tarsalis* Mosquitoes

Adult mosquito abundance and their WNV infection rates are the key factors used to evaluate the risk of disease transmission to humans. Once collected in CO_2-baited and gravid traps, mosquitoes are pooled into variable sized samples containing five (5) to 50 mosquitoes. Pooled

samples are then tested at OCMVCD using real time PCR. Results are generated up to two times per week during the months of high mosquito activity. Infection rates [calculated using the Maximum Likelihood Estimator (MLE), Biggerstaff, 2003] are determined biweekly and represent the number of WNV-positive mosquito pools found in collections of a particular mosquito species over a defined time period. The OCMVCD's current system is designed to detect WNV in real time, with retrospective testing of samples for other arboviruses, such as St. Louis encephalitis (SLE) and western equine encephalomyelitis (WEE).

Procedures for processing mosquitoes for virus infection are summarized in the California State Mosquito-Borne Virus Surveillance & Response Plan, 2015 (Appendix A).

Dead Bird WNV Infection

The OCMVCD began testing dead birds for WNV in 2003. Currently, dead birds are reported to OCMVCD for collection and tested in-house by PCR. The OCMVCD works with the public, local animal control agencies, and wildlife rehabilitators to coordinate collection of dead birds. Dead birds are necropsied at OCMVCD and the kidney is removed for WNV testing. The number of dead birds tested and positive for WNV is updated weekly on the OCMVCD website. The number of WNV-positive dead birds collected in Orange County summarized biweekly over the last five years can be found in Table 6.

Guidelines for Procedures for Testing Dead Birds are found in California State Mosquito-Borne Virus Surveillance & Response Plan, 2015 (Appendix A).

WNV Antibody Seroprevalence in Free-Ranging Birds

Detection of WNV transmission in avian populations can be achieved by collecting, and testing the samples obtained from free-ranging birds to detect anti-WNv antibodies and circulating viral RNA. Currently, the OCMVCD operates multiple bird traps within historically defined areas of moderate-to-high WNV activity (Table 8). Traps are baited with bird seed on a biweekly basis and birds are captured, held overnight, bled and released. This activity is permitted by the United States Geological Survey (Permit #23547) and the California Department of Fish and Wildlife Scientific Collecting Permit (Permit ID Number 009202). Protocols for bleeding and testing of free-ranging birds can be found in Fair et al. 2010, Hall 1995, and Lanciotti et al. 2000. Patterns observed in avian herd immunity to WNV (i.e., seroprevalence) show that in some years when seroprevalence is less than 10 percent in late winter and spring, outbreaks of West Nile virus neuroinvasive disease occurred in the ensuing summer (Kwan et al. 2012). Based on the analysis of eleven years of serological data (2004-2014), similar patterns of "herd" immunity are observed in avian populations in Orange County. Thus, free-ranging bird seroprevalence has been incorporated as a surveillance factor in the OCMVCD's West Nile Virus Risk Assessment worksheet. Seroprevalence data from 2008 to 2014 are included in Table 7. Locations of bird traps are listed in Table 8 and shown in Figure 3.

Human Infections

In general, human infections are not a sensitive surveillance indicator of neurotropic arbovirus activity, such as WNV, SLE, WEE, because most human infections (> 80%) have no, or only mild, symptoms. Communication with key hospitals and local health officials has been enhanced following the super epidemic of WNV in 2014. Rapid detection and reporting of confirmed human cases of WNV and of other arboviral diseases is crucial to local mosquito control agencies in planning and expending emergency control activities to prevent additional human infections. Human infections by year of onset are listed in Table 9 for 2004 - 2014. Human infections by week of onset for 2004 – 2014 are depicted in Figure 4.

More information about human case reporting and testing are found in the California State Mosquito-Borne Virus Surveillance and Response Plan, 2015 (Appendix A).

Historical Risk Area Consideration

Spatial and Temporal Predictors of High WNV Risk in Orange County

Orange County has been recognized as a hotspot of WNV activity since 2004. An analysis of WNV surveillance factors throughout Orange County from 2004 to 2013 produced a spatial model (Figure 5) that captured 84.4% of all WNV human cases (Liao et al. 2014). When comparing years with high WNV activity (2004, 2008, 2012, and 2014) to years with low WNV activity (2005 to 2007; 2009 to 2011; and 2013), several indicators have emerged as reliable predictors of an impending WNV epidemic:

- Low (< 10%) winter/spring WNV antibody seroprevalence rates in wild birds;
- Early season (May/June) detection of WNV-positive dead birds at infection rates > 20%;
- Early season (May/June) detection WNV-positive mosquito pools at MLE infection rates > 2.1;
- Early season (March - June) detection of WNV human infections.

In the event that WNV surveillance factors are occurring in the historically high WNV risk area of Orange County, especially from May through June, additional Risk Assessment ratings for that area will be calculated and presented to determine an appropriate OCMVCD response (Figure 5).

OCMVCD Response Levels to Risk Ratings

Normal Risk Rating: 1.0 – 2.5

General Conditions
• Cool to moderate seasonal temperatures (< 65°F) • Mosquito abundance at or below five year average (key indicator = adults of vector species) • Mosquito infection rates (0 – 1.0 MLE) • None or 1 (or more) WNV positive dead bird(s) in neighboring county • Approximately 20-30% antibody seroprevalence in free-ranging birds • No human cases
Response Activities by Role
District Manager • Ensure adequate emergency funding • Establish and maintain routine communication with the Emergency Operations Center personnel
Director of Communications • Conduct routine public education (eliminate standing water around homes, use personal protection measures) • Release routine press notices • Inform the public about adult mosquito control pesticide applications, if appropriate • Notify OCHCA of the need to alert physicians and/or veterinarians of the surveillance activity
Director of Scientific and Technical Services • Compile data for West Nile Virus Risk Assessment worksheet • Conduct routine mosquito and virus surveillance activities • Evaluate pesticide resistance in vector species
Director of Operations • Coordinate routine mosquito larval control activities • Define target area for potential adult mosquito control activities • Inventory pesticides and equipment • Ensure aerial adulticide contract is current • Contact OC Agricultural Commissioner to obtain current list of registered organic growers • Establish communication chain between OCHCA and OCMVCD for potential distribution of ecologic investigations of human exposure sites

Elevated Risk Rating 2.6-4.0

General Conditions
• Temperatures above average (66-79° F) • Adult mosquito abundance average within 91 – 150 % of 5-year average • One or more WNV positive mosquito collections (MLE < 5) • Multiple WNV positive dead birds distributed broadly throughout the County • Late winter and early spring avian WNV seroprevalence ranging from 10 to 20% or evidence of recent infection in wild birds including WNV isolation, multiple seroconversions in hatch-years, or notable seroprevalence increase in the wild bird population • One human case in Orange County • Viral activity (mosquito pools and dead birds) occurring in historical high risk area
Response Activities by Role
District Manager • Review epidemic response plan • Notify Board of Trustees of increased WNV risk • Prepare to coordinate epidemic response in consultation with management team • Consider suspending other District programs as needed or necessary
Director of Communications • Review epidemic response plan • Enhance public education, coordinate with OCHCA to distribute messages on signs and symptoms of encephalitis and recommend medical care if needed • Inform public about adult mosquito control pesticide applications, if appropriate • Enhance information to public health providers • Notify key agencies and impacted cities of presence of viral activity, including the EOC
Director of Scientific and Technical Services • Compile data for West Nile Virus Risk Assessment • Review epidemic response plan • Increase adult mosquito surveillance • Increase number of mosquito pools tested for virus • Review candidate pesticides for availability and susceptibility of vector mosquito species • Identify any special environmental compliance concerns in affected area and communicate with Lead District staff
Director of Operations • Coordinate routine ecologic investigations of human exposure sites and report to OCHCA • Review epidemic response plan • Increase surveillance and control of mosquito larvae by decreasing cycle times • Coordinate localized chemical control of adult mosquitoes • Brief aerial adulticide contractor about the current status of WNV surveillance factors

High Risk Rating 4.1-5.0

General Conditions
• Temperatures well above average (>79° F) • Adult vector population above 5-year average (>150%) • Multiple WNV positive mosquito collections (MLE > 5.0) • Multiple clusters of WNV positive dead birds throughout the County • One or more WNV positive human cases within the County • Late winter and early spring avian WNV seroprevalence below 10% or evidence of recent infection in wild birds including WNV isolation, multiple seroconversions in hatch-years, or notable seroprevalence increase in the wild bird population • Temporal and spatial clustering of viral activity (mosquito pools and dead birds) occurring in historical high risk area
Response Activities by Role
District Manager • Ensure adequate emergency funding • Coordinate epidemic response and communicate plan with Board of Trustees • Discuss with OCHCA anticipated need for area-wide adult mosquito control and request notification of the MHOAC • Notify Orange County Agricultural Commissioner of area-wide adult mosquito control • Schedule adult mosquito control as appropriate by ground-based equipment or aircraft • Contact aerial mosquito control contractor; schedule aerial application, if appropriate • Discuss with local Health Officer whether declaration of a local public health emergency should be considered • Coordinate the response with the Emergency Operations Center • Provide situational status updates to MHOAC if requested • Request public health exemptions from FIFRA (40 CFR 166) and emergency tolerance exemptions (40 CFR 176)
Director of Administrative Services • Secure state funds and resources, if available, to assist epidemic control efforts • Work with aerial mosquito control contractor to schedule payment for control efforts
Director of Communications • Conduct full scale media campaign • Implement campaign to notify residents of area-wide adult mosquito control pesticide application • Continue mosquito education and control programs until mosquito abundance or mosquito infection rates are substantially reduced and no additional human cases are detected
Director of Scientific and Technical Services • Determine flight plan for aerial pesticide application, if appropriate • Continue to compile data for WNV Risk Assessment • Ensure remaining environmental compliance requirements are met • Deploy surveillance equipment for evaluation of pesticide applications

• Notify registered organic growers of area-wide application of public health pesticides
Director of Operations • Coordinate ecologic investigations of human exposure sites and reporting to OCHCA • Continue enhanced larval surveillance/ control and reduce larviciding cycle times • Coordinate adult mosquito control efforts in high risk areas • Determine target area for ground-based public health pesticide application, if appropriate. • Determine flight plan for aerial public health pesticide application, if appropriate

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Table 1 – Orange County Mosquito and Vector Control District West Nile Virus Risk Assessment

Table 1. WNV Surveillance Factor	Assessment Value	Benchmark	Value	
1. Environmental Conditions Favorable environmental conditions in Orange County for WNV multiplication/transmission. Considers temperature for prior 2 week period.	1	Average daily temperature ≤ 56°F		
	2	Average daily temperature 57 - 65°F		
	3	Average daily temperature 66 - 72°F		
	4	Average daily temperature 73 - 79°F		
	5	Average daily temperature > 79°F		
			Cx. quinq.	***Cx. tarsalis***
2. Abundance of adult *Culex quinquefasciatus* and/or *Culex tarsalis* Area wide average of adult mosquitoes the last 5 years = mosquitoes/trap night by month.	1	Vector abundance well below average (≤ 50%)		
	2	Vector abundance below average (51 - 90%)		
	3	Vector abundance average (91 - 150%)		
	4	Vector abundance above average (151 - 300%)		
	5	Vector abundance well above average (> 300%)		
3. WNV Infection rate (MLE) in variable pool sizes of *Culex quinquefasciatus* and *Culex tarsalis* mosquitoes. Considers pooled data for prior 1 or 2 week period.	1	MLE = 0		
	2	MLE ≥ 0.001 – 1.0		
	3	MLE = 1.1 – 2.0		
	4	MLE = 2.1 - 5.0		
	5	MLE > 5.0		
4. Dead Bird WNV Infection Number of birds that have tested positive (recent infections only) for WNV during the prior 30 days.	1	No WNV-positive dead birds in Southern California		
	2	One or more WNV-positive dead birds in neighboring county		
	3	One WNV-positive dead bird in Orange County		
	4	Multiple WNV-positive dead birds in broad region of Orange County		
	5	Multiple WNV-positive dead birds in specific region of Orange County		
5. Seroprevalence of WNV in free-ranging birds WNV antibody-positive/total sampled biweekly.	2	> 30% seroprevalence		
	3	21 - 30% seroprevalence		
	4	11 - 20% seroprevalence		
	5	< 10% seroprevalence		
6. Human WNV Infections This factor is not included in calculations if no cases are detected in region	3	One or more human WNV infections in neighboring county		
	4	One or more human WNV infections in Orange County		
	5	Multiple human WNV infections in specific region of Orange County		
			Cx. quinq.	***Cx. tarsalis***
WNV Response Level/Average Rating Normal Season (1.0 to 2.5) Elevated Risk (2.6 to 4.0) High Risk (4.1 to 5.0)		**TOTAL**		
		AVERAGE		

Table 2 – Average Minimum and Maximum Temperatures (°F) in Orange County, California.

Time Period (biweekly)	2010			2011			2012			2013			2014			5-Year Average		
	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min
Jan 1-15	76	63	49	65	54	43	73	58	42	61	49	37	72	59	45	70	56	43
Jan 16-31	65	56	46	73	59	45	68	56	43	71	58	45	72	59	47	70	58	45
Feb 1-14	66	57	47	69	55	41	69	57	44	62	52	41	67	57	46	67	55	44
Feb 15-28	70	59	48	60	50	41	65	54	42	67	54	40	72	60	48	67	55	44
Mar 1-15	64	54	45	70	57	45	71	57	44	71	58	45	74	62	51	70	58	46
Mar 16-31	74	61	48	66	55	45	64	55	45	69	58	47	71	61	51	69	58	47
Apr 1-15	67	57	47	68	58	47	69	56	43	69	59	49	75	62	49	70	58	47
Apr 16-30	67	58	48	72	62	51	73	62	51	73	61	49	75	64	53	72	61	50
May 1-15	72	61	51	74	61	49	71	61	51	77	65	54	82	69	55	75	64	52
May 16-30	70	61	52	70	60	50	74	64	53	74	65	55	77	67	57	73	63	53
Jun 1-15	74	66	58	73	65	56	73	64	55	74	66	57	78	68	58	75	66	57
Jun 16-31	74	65	56	76	66	56	77	66	54	80	69	57	79	69	59	77	67	56
Jul 1-15	76	67	58	81	71	60	79	68	58	82	72	61	84	73	63	80	70	60
Jul 16-31	78	68	59	79	68	58	79	68	57	78	68	59	84	73	62	80	69	59
Aug 1-15	77	66	55	80	69	57	86	74	62	83	69	55	84	73	63	82	70	58
Aug 16-31	85	71	58	84	70	57	86	75	63	87	74	61	85	73	61	85	73	60
Sep 1-15	79	67	54	82	69	56	88	74	61	88	75	62	90	76	63	85	72	59
Sep 16-30	84	70	55	77	67	57	86	72	58	81	68	56	84	73	61	82	70	57
Oct 1-15	76	67	57	79	65	51	80	68	56	78	66	53	86	72	58	80	67	55
Oct 16-31	70	62	55	74	62	50	77	65	53	75	63	51	79	68	56	75	64	53
Nov 1-15	79	64	50	68	57	45	73	60	47	78	64	50	77	65	53	75	62	49
Nov 16-30	63	52	42	69	58	46	69	59	48	67	58	49	76	63	50	69	58	47
Dec 1-15	71	57	44	63	52	41	66	57	49	65	54	42	69	61	53	67	56	46
Dec 16-30	61	53	46	68	54	41	60	51	41	70	58	45	66	56	46	65	54	44

Table 3 – List of Gravid Trap Locations in Orange County, 2015.

Site Name	City	LATITUDE	LONGITUDE
39 Marsh	Huntington Beach	33.652188	-117.987509
Central Park	Huntington Beach	33.70633	-118.001806
Seal Beach - Hellman	Seal Beach	33.749845	-118.099752
Seal Beach - Leisure World	Seal Beach	33.773958	-118.095089
Pett's Residence	Huntington Beach	33.681454	-117.991867
Fairview Park	Costa Mesa	33.666769	-117.940251
Seal Beach NWS - Nature Center	Seal Beach	33.744892	-118.080668
Westminster Cemetery	Westminster	33.74818	-117.994807
Fairhaven Cemetery	Santa Ana	33.769162	-117.841918
Centennial Park	Santa Ana	33.72119	-117.910417
Grijalva Park	Orange	33.792321	-117.819961
Holy Sepulcher Cemetery	Orange	33.81407	-117.766031
W MAIN STREET	TUSTIN	33.741344	-117.827109
OCMVCD	Garden Grove	33.775497	-117.903915
SJWS	Irvine	33.660505	-117.841037
Aliso Creek	Laguna Hills	33.595058	-117.710332
IVC, Irvine Valley College	Irvine	33.676322	-117.77922
Modjeska Park	Anaheim	33.815466	-117.954318
La Habra (Osornio Park Creek)	La Habra	33.944906	-117.966635
Los Alamitos Race Track	Los Alamitos	33.806482	-118.046184
Anaheim Cemetery	Anaheim	33.843172	-117.900118
Craig Park	Fullerton	33.894518	-117.885981
Forest Lawn Cemetery	Cypress	33.834147	-118.059148
Memory Gardens Cemetery	Brea	33.934612	-117.902757
Miller Basin	Anaheim	33.866413	-117.856114
Ralph B. Clark Regional Park	Fullerton	33.89256	-117.975951
Muckenthaler Cultural Center	Fullerton	33.875414	-117.944426
Oso Creek	Mission Viejo	33.575091	-117.672476
Ortega Equestrian Center	San Juan Capistrano	33.49953	-117.655236
Saddleback College	Mission Viejo	33.547222	-117.661944
San Clemente Skeet Club	San Clemente	33.409465	-117.592236
Vista Terrace	Lake Forest	33.667811	-117.663571
Michelson Dr.	Irvine	33.673654	-117.843569

Table 4 – List of CO2 Trap Locations, Orange County 2015.

Site Name	City	LATITUDE	LONGITUDE
39 Marsh	Huntington Beach	33.652188	-117.987509
(BC) South	Huntington Beach	33.684587	-118.025231
(BC) Harriet Wieder Park	Huntington Beach	33.68896	-118.019877
(BC) North	Huntington Beach	33.708072	-118.040666
Central Park	Huntington Beach	33.70633	-118.001806
Kadane Marsh-LC	Costa Mesa	33.643377	-117.945098
Kadane Marsh-Central	Costa Mesa	33.643377	-117.945098
Pett's Residence	Huntington Beach	33.681454	-117.991867
Fairview Park	Costa Mesa	33.666769	-117.940251
Seal Beach NWS - Torpedo 88	Seal Beach	33.745951	-118.072744
Seal Beach NWS - Gun Range	Seal Beach	33.743059	-118.085266
Seal Beach NWS - Nature Center	Seal Beach	33.744892	-118.080668
Centennial Park	Santa Ana	33.72119	-117.910417
W MAIN STREET	TUSTIN	33.741344	-117.827109
OCMVCD	Garden Grove	33.775497	-117.903915
Peter's Canyon	Orange	33.784894	-117.758989
Villa Park	Orange	33.81407	-117.766031
SJWS	Irvine	33.660505	-117.841037
Bayview Park	Newport Beach	33.653122	-117.868002
Big Canyon – Back Bay	Newport Beach	33.631582	-117.884634
Moulton Res	Laguna Hills	33.621102	-117.73149
Carlson Marsh	Irvine	33.662975	-117.848811
Harvard X University	Irvine	33.657253	-117.838397
Laguna Lakes	Laguna Beach	33.610764	-117.755176
Mason Park	Irvine	33.653493	-117.828902
UCIM #13	Irvine	33.66228	-117.850016
UCIM #14	Irvine	33.663	-117.852
UCIM #20	Irvine	33.655323	-117.85342
UCIM #5	Irvine	33.660195	-117.854598
University at La Vida	Newport Beach	33.647924	-117.864769
Modjeska Park	Anaheim	33.815466	-117.954318
La Habra (Osornio Park Creek)	La Habra	33.944906	-117.966635
Los Alamitos Race Track	Los Alamitos	33.806482	-118.046184
Muckenthaler Cultural Center	Fullerton	33.875414	-117.944426
Arroyo Trabuco G.C.,Trabuco Creek	Mission Viejo	33.545719	-117.659839
Coto de Caza - South	Rancho Santa Margarita	33.563714	-117.58829
Coto de Caza North	Rancho Santa Margarita	33.564936	-117.587779

Table 4 Cont. – List of CO2 Trap Locations, Orange County 2015.

Site Name	City	LATITUDE	LONGITUDE
Horno Creek	San Juan Capistrano	33.526194	-117.648425
Ladera Ranch - Arroyo Trabuco Marsh	Ladera Ranch	33.569793	-117.644967
Nichols Institute	Unincorporated OC	33.564205	-117.545294
Oso Creek	Mission Viejo	33.575091	-117.672476
San Clemente Skeet Club	San Clemente	33.409465	-117.592236
Trestles	San Clemente	33.387137	-117.594023
Arroyo Trabuco G.C.,Trabuco Creek	Mission Viejo	33.545719	-117.659839
Vista Terrace	Lake Forest	33.667811	-117.663571
Shadow Rock Marsh	Rancho Santa Margarita	33.661392	-117.564722
Serrano Creek	Lake Forest	33.649256	-117.689534
Kite Hill	Laguna Niguel	33.543176	-117.71591
Oso Res	Mission Viejo	33.65987	-117.627349
Severyns Rd	Tustin	33.717077	-117.825311
Robinson Ranch, Plano Trabuco	Rancho Santa Margarita	33.651982	-117.597164
21st and Alona	Santa Ana	33.763257	-117.89359
Romneya Dr. and N West St	Anaheim	33.850771	-117.932236
N. Bristol St & W Park Ln	Santa Ana	33.771996	-117.884815
Townley St & Marty Ln	Santa Ana	33.769379	-117.90684
W. Civic Center Dr. & English St	Santa Ana	33.751474	-117.89665
Monarch St & Blades Av	Garden Grove	33.791689	-118.006764
Burning Tree Rd & Moore Av	Fullerton	33.875828	-117.973553
S Manchester Av & City Bl W	Orange	33.787531	-117.8932
Markon Dr & Patterson Dr	Garden Grove	33.798364	-118.008114
W Chapman Av & N Basque Av	Fullerton	33.873761	-117.950633
Walnut St	La Habra	33.939778	-117.950458
N Schaffer St & E Cumberland Rd	Orange	33.825314	-117.849045

Table 5 – Average Number of *Culex quinquefasciatus* Mosquitoes in Gravid Traps by Month, 2010-2014.

Month	2010	2011	2012	2013	2014	5 Year Average
Jan	9.33	1.17	5.25	7.63	18.56	8.76
Feb	4.98	1.50	6.66	2.25	2.60	4.75
Mar	18.01	0.30	6.02	17.13	2.20	10.82
Apr	19.63	4.13	19.31	18.36	40.56	19.85
May	35.27	6.77	21.24	22.62	18.56	22.12
Jun	42.30	17.53	24.60	21.56	31.21	27.50
Jul	39.55	34.94	22.15	15.93	27.28	27.39
Aug	12.05	34.50	22.25	22.77	43.18	28.54
Sep	5.65	20.33	17.70	16.13	32.15	18.39
Oct	5.00	18.45	14.60	23.76	39.62	22.50
Nov	6.13	17.19	16.67	22.47	33.23	21.59
Dec	3.69	7.58	13.67	16.88	22.83	11.78

Table 6 – West Nile Virus Positive Dead Bird Collections, 2010-2014.

	2010	2011	2012	2013	2014	5 YEAR AVG
Jan 1-15	0	0	0	0	1	0.2
Jan 16-31	0	0	0	0	0	0
Feb 1-14	0	0	0	0	0	0
Feb 15-28	0	0	0	0	0	0
Mar 1-15	0	0	0	0	0	0
Mar 16-31	0	0	0	0	0	0
Apr 1-15	0	0	0	0	0	0
Apr 16-30	0	0	0	0	0	0
May 1-15	0	1	0	0	0	0.2
May 16-31	1	1	0	0	0	0.4
Jun 1-15	0	0	0	1	6	1.4
Jun 16-31	0	2	0	0	3	1
Jun 1-15	1	0	1	1	9	2.4
Jun 16-30	1	0	0	1	12	2.8
Jul 1-15	1	6	3	1	30	8.2
Jul 16-31	2	2	5	10	77	19.2
Aug 1-15	2	3	13	6	82	21.2
Aug 15-31	5	6	31	2	45	17.8
Sep 1-15	0	13	25	6	53	19.4
Sep 16-30	0	9	15	3	68	19
Oct 1-15	3	2	13	3	24	9
Oct 15-30	0	2	2	4	14	4.4
Nov 1-15	1	1	2	1	11	3.2
Nov 15-30	0	0	0	0	4	0.8
Dec 1-15	0	0	0	0	0	0
Dec 16-31	0	0	0	0	4	0.8

Table 7 – Herd Immunity (% seropositive) for House Finches by Quarter and Number of Human Infections (2008-2014), Orange County.

Year	Quarter	% WNV-Seropositive	Number of Human Cases with Known Onset Date
2008	Jan-Mar	9.91	0
	Apr-Jun	2.39	2
	Jul-Sep	8.12	68
	Oct-Dec	18.90	1
2009	Jan-Mar	13.02	0
	Apr-Jun	5.18	1
	Jul-Sep	3.30	2
	Oct-Dec	3.16	1
2010	Jan-Mar	2.42	0
	Apr-Jun	4.49	0
	Jul-Sep	0.00	1
	Oct-Dec	3.23	0
2011	Jan-Mar	11.90	0
	Apr-Jun	6.28	0
	Jul-Sep	11.84	8
	Oct-Dec	22.46	2
2012	Jan-Mar	16.00	0
	Apr-Jun	7.78	0
	Jul-Sep	9.75	36
	Oct-Dec	28.21	7
2013	Jan-Mar	20.21	0
	Apr-Jun	14.95	0
	Jul-Sep	8.43	6
	Oct-Dec	12.50	4
2014	Jan-Mar	7.38	1
	Apr-Jun	9.09	2
	Jul-Sep	45.19	232
	Oct-Dec	60.78	14

Table 8 – Location of Free-Ranging Bird Traps, Orange County 2010-1015.

Location	City	Latitude	Longitude
OCMVCD	Garden Grove	33.775497	-117.903915
Modjeska Park	Anaheim	33.815466	-117.954318
Anaheim Cemetery	Anaheim	33.843172	-117.900118
Blooms	Tustin	33.765149	-117.806015

Table 9 – Human West Nile Virus Infections, Orange County, 2004-2014.

Year	Total Human Infections (Deaths)
2004	64 (4)
2005	17 (0)
2006	7 (0)
2007	10 (0)
2008	79 (3)
2009	4 (0)
2010	1 (0)
2011	10 (0)
2012	48 (2)
2013	12 (0)
2014	280 (9)
Grand Total	**532 (18)**

Figure 1 – Map of Gravid Trap Locations in Orange County, 2014.

Figure 2 – Map of CO2 Trap Locations in Orange County, 2014.

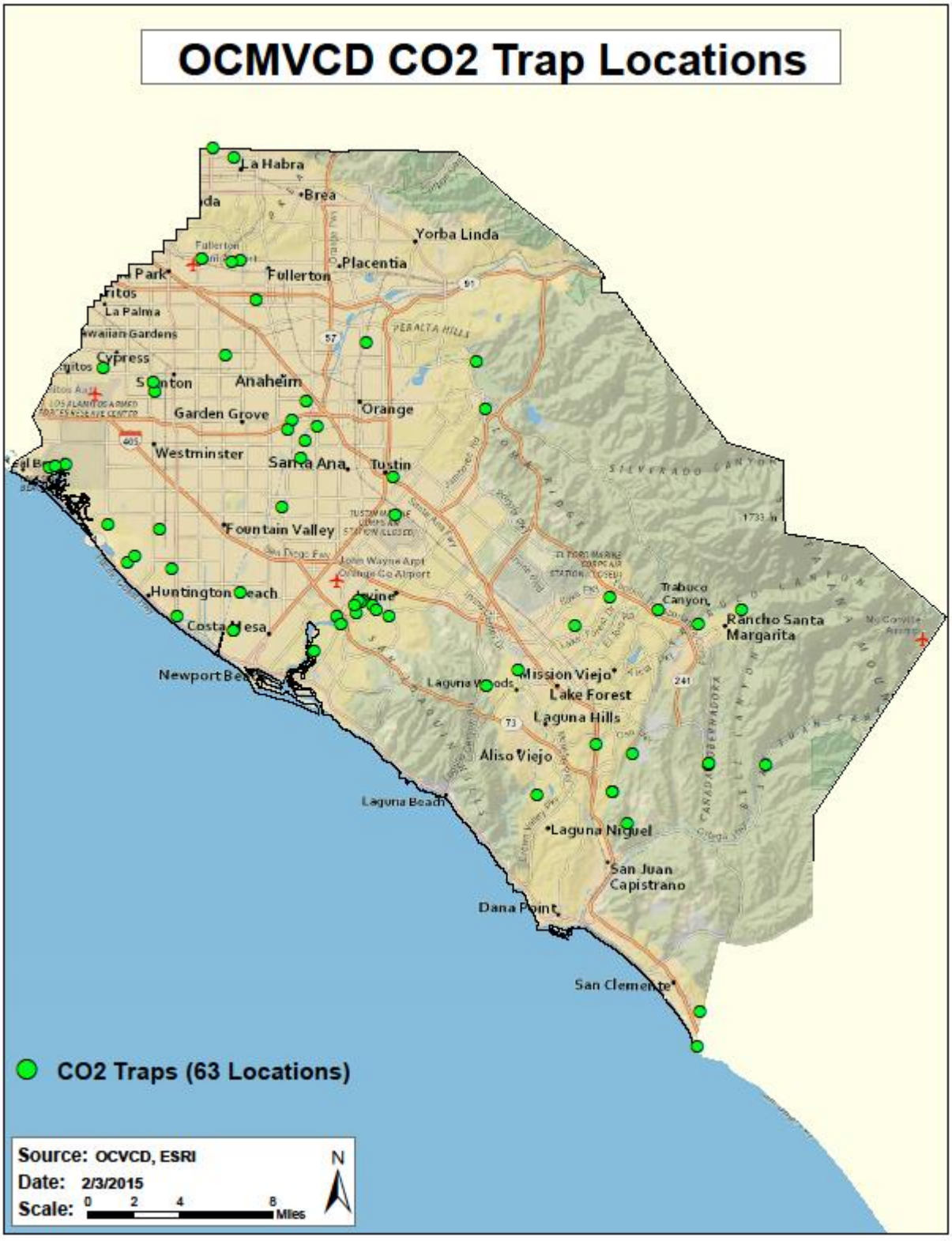


Figure 3 – Map of Free-Ranging Bird Traps, Orange County, 2014.

Figure 4 – Historical Human WNV Infections by Disease Onset Week, Orange County, 2004 – 2014.

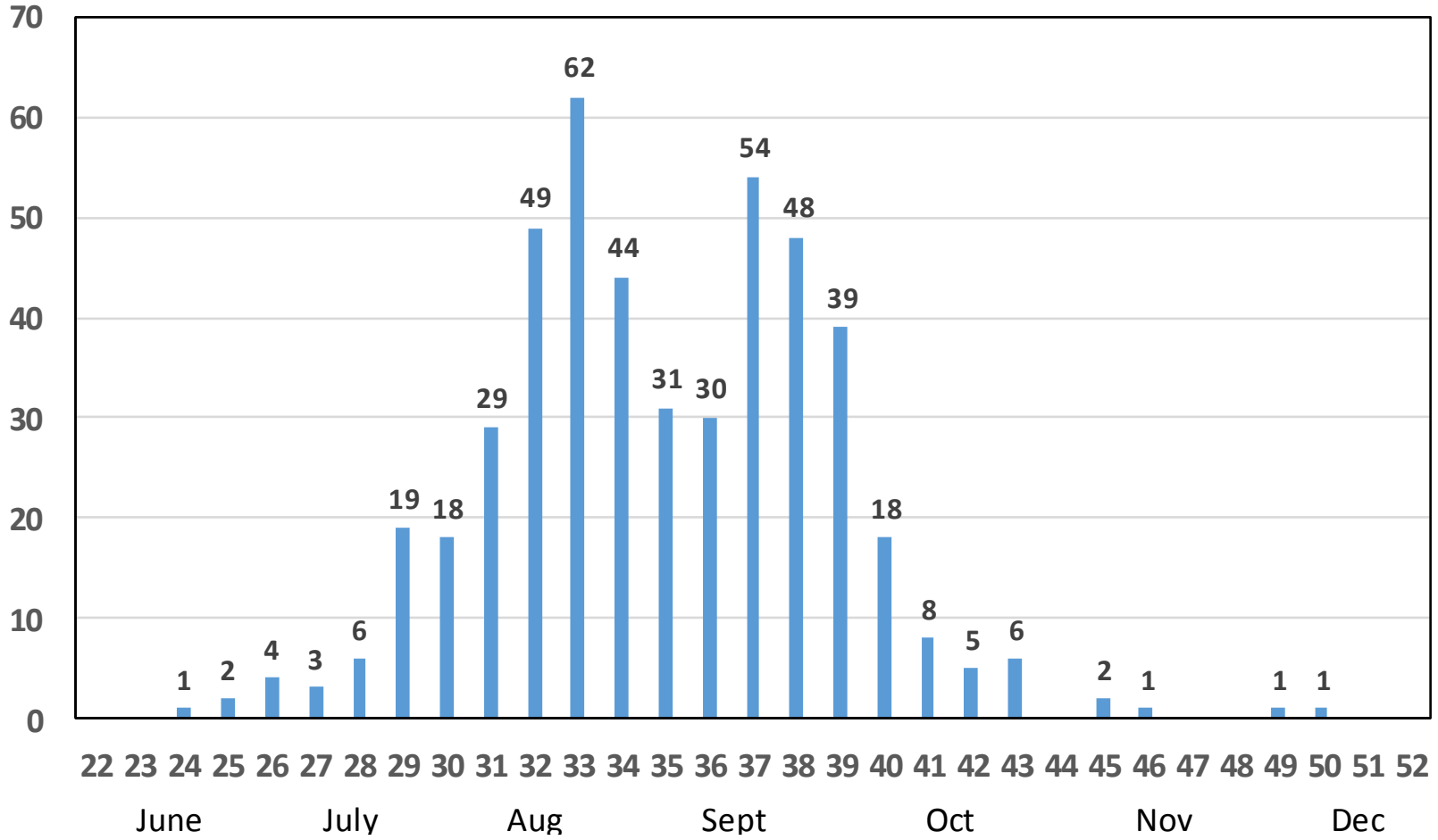
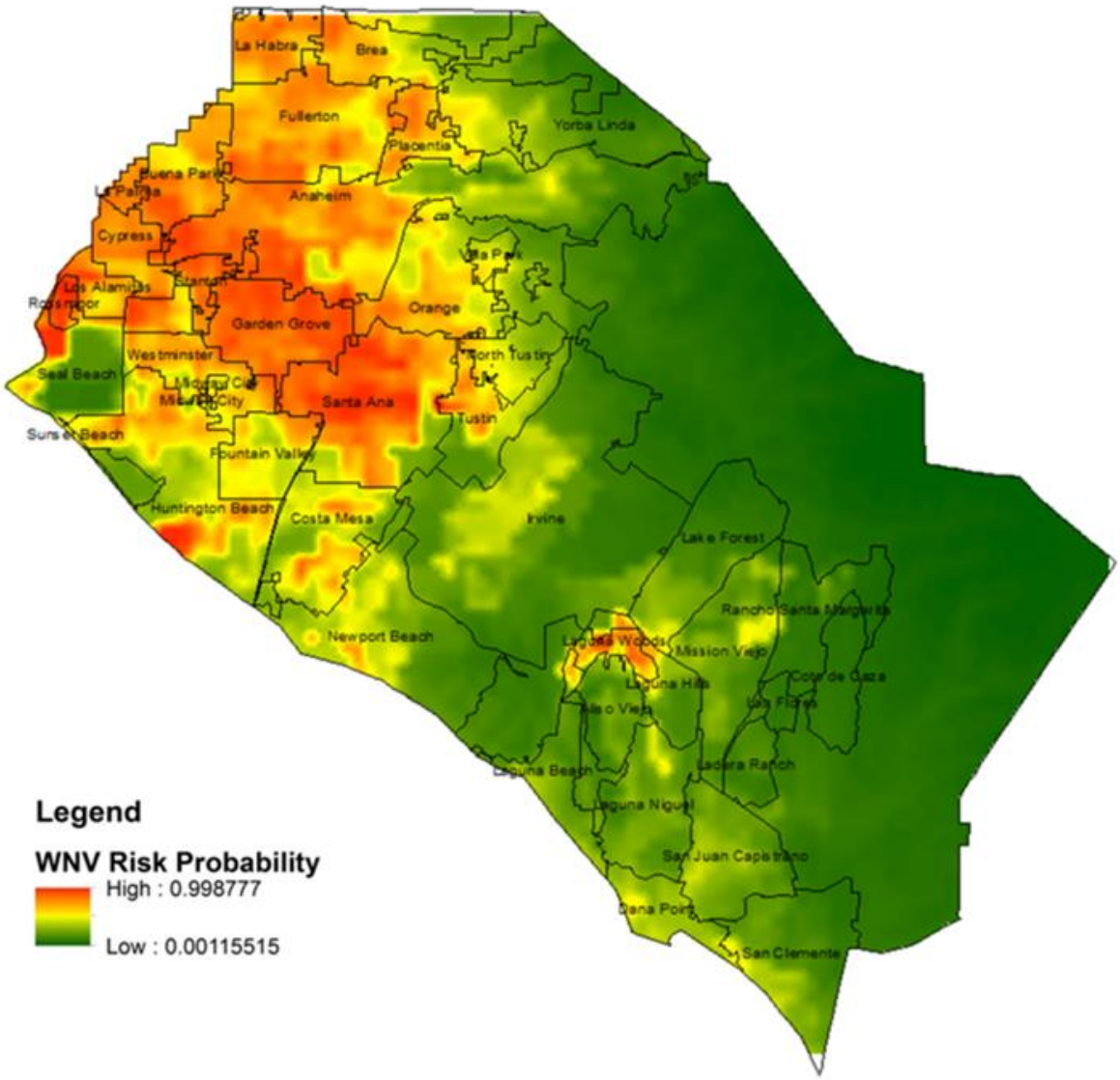


Figure 5 – WNV High Risk Area Based on Environmental and Historical Surveillance Factors, 2004-2013.



Appendix A

Appendix B

CALIFORNIA MOSQUITO-BORNE VIRUS SURVEILLANCE & RESPONSE PLAN

Arnold Schwarzenegger, Governor

California Department of Public Health
Mosquito & Vector Control Association of California
University of California

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April 2010

CALIFORNIA MOSQUITO-BORNE VIRUS SURVEILLANCE AND RESPONSE PLAN

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Objectives

The California Mosquito-borne Virus Surveillance and Response Plan was developed to meet several objectives. Specifically, the Plan:

- Provides guidelines and information on the surveillance and control of mosquito-borne viruses in California, including West Nile, St. Louis encephalitis, and western equine encephalomyelitis viruses;
- Incorporates surveillance data into risk assessment models;
- Prompts surveillance and control activities associated with virus transmission risk level;
- Provides local and state agencies with a decision support system; and
- Outlines the roles and responsibilities of local and state agencies involved with mosquito-borne virus surveillance and response.

This document provides statewide guidelines, but can be modified to meet local or regional conditions.

Introduction

California has a comprehensive mosquito-borne disease surveillance program that has monitored mosquito abundance and mosquito-borne virus activity since 1969 (Reeves et al. 1990) and is an integral part of integrated mosquito management programs conducted by local mosquito and vector control agencies. Surveillance and interagency response guidelines have been published previously by the California Department of Public Health formerly known as the California Department of Health Services (Walsh 1987) and the Mosquito and Vector Control Association of California (Reisen 1995). The detection of West Nile virus (WNV) in New York, a virus not recognized in the Western Hemisphere prior to 1999, prompted the review and enhancement of existing guidelines to ensure that surveillance, prevention, and control activities were appropriate for WNV. From New York, WNV spread rapidly westward and by 2004 had been detected in all 48 states in the continental United States. In addition to WNV, California is vulnerable to introduction of other highly virulent mosquito-borne viruses of public and veterinary health concern, such as Japanese encephalitis, dengue, yellow fever, Rift Valley fever, chikungunya and Venezuelan encephalitis viruses. If an existing or introduced virus is detected, it is critical that local and state agencies are prepared to respond in a concerted effort to protect people and animals from infection and disease. The current document describes an enhanced surveillance and response program for mosquito-borne viruses in the State of California. Its contents represent the collective effort of the California Department of Public Health (CDPH), the Mosquito and Vector Control Association of California (MVCAC), and the University of California at Davis (UCD).

Background

Mosquito-borne viruses belong to a group of viruses commonly referred to as arboviruses (for **ar**thropod-**bo**rne). Although 12 mosquito-borne viruses are known to occur in California, only WNV, western equine encephalomyelitis virus (WEE) and St. Louis encephalitis virus (SLE) are significant causes of human disease. WNV is having a serious impact upon the health of humans, horses, and wild birds throughout the state. Since 2004, there have been 2874 WNV human cases with 95 deaths and 1132 horse cases. Consequently, the California Arbovirus Surveillance Program emphasizes forecasting and monitoring the temporal and spatial activity of

WNV, WEE, and SLE. These viruses are maintained in wild bird-mosquito cycles that do not depend upon infections of humans or domestic animals to persist. Surveillance and control activities focus on this maintenance cycle, which involves primarily *Culex* mosquitoes, such as the western encephalitis mosquito, *Culex tarsalis*, and birds such as house finches and house sparrows.

Immature stages (called larvae and pupae) of *Culex tarsalis* can be found throughout California in a wide variety of aquatic sources, ranging from clean to highly polluted waters. Most such water is associated with irrigation of agricultural crops or urban wastewater. Other mosquito species, such as *Culex pipiens, Culex quinquefasciatus*, and *Culex stigmatosoma*, play an important role in WNV, and possibly SLE, transmission cycles in urban and suburban areas. Historically, *Aedes melanimon*, a floodwater mosquito, played a role in a secondary transmission cycle of WEE involving rabbits. Additional mosquitoes such as *Aedes vexans* and *Culex erythrothorax* also could be important bridge (i.e. bird to mammal) vectors in transmission.

Mosquito control is the only practical method of protecting the human population from infection. There are no known specific treatments or cures for diseases caused by these viruses and vaccines are not available for public use. Infection by WEE virus tends to be most serious in very young children, whereas infections caused by WN and SLE viruses affect the elderly most seriously. WNV also kills a wide variety of native and non-native birds. There are WEE and WNV vaccines available to protect horses since both viruses can cause severe disease in horses. Mosquito-borne disease prevention strategies must be based on a well-planned integrated pest management (IPM) program that uses real-time surveillance to detect problem areas, focus control, and evaluate operational efficacy. The primary components of an IPM program include education, surveillance, and mosquito control.

Education

Residents, farmers, and duck club owners can play an important role in reducing the number of adult mosquitoes by eliminating standing water that may support the development of immature mosquitoes. For instance, residents can help by properly disposing of discarded tires, cans, or buckets; emptying plastic or unused swimming pools; and unclogging blocked rain gutters around homes or businesses. Farmers and ranchers can be instructed to use irrigation practices that do not allow water to stand for extended periods, and duck club owners can work with mosquito control agencies to determine optimum flooding schedules. Educating the general public to curtail outdoor activities during peak mosquito biting times, use insect repellents, and wear long-sleeved clothing will help reduce exposure to mosquitoes. Clinical surveillance is enhanced through education of the medical and veterinary communities to recognize the symptoms of WEE, SLE, and WNV and to request appropriate laboratory tests. Public health officials need to be alerted if a mosquito-borne viral disease is detected, especially if the public health risk is high.

Surveillance

Surveillance includes the monitoring, visualization, and analysis of data on climatic factors, immature and adult mosquito abundance, and virus activity measured by testing mosquitoes, sentinel chickens, wild birds (including dead birds for WNV), horses, and humans for evidence

of infection. Surveillance must focus not only on mosquito-borne viruses known to exist in California, but be sufficiently broad to also detect newly introduced viruses.

Climate Variation

The California Mediterranean climate provides ideal opportunities for forecasting mosquito abundance and arbovirus activity, because most precipitation falls as rain at lower elevations or as snow at higher elevations during winter. Spring and summer temperatures then determine the rate of snow pack melt and runoff, mosquito population growth, the frequency of blood feeding, the rate of virus development in the mosquito, and therefore the frequency of virus transmission. In general, WEE virus outbreaks have occurred in the Central Valley when wet winters are followed by warm summers, whereas SLE and WN virus outbreaks seemed linked to warm dry conditions that lead to large populations of urban *Culex*. Although climate variation may forecast conditions conducive for virus amplification, a critical sequence of epidemiological events is required for amplification to reach outbreak levels.

Mosquito Abundance

Mosquito abundance can be estimated through collection of immature or adult mosquitoes. The immature stages (larvae and pupae) can be collected from water sources where mosquitoes lay their eggs. A long-handled ladle ("dipper") is used to collect water samples and the number of immature mosquitoes per "dip" estimated. In most local mosquito control agencies, technicians search for new sources and inspect known habitats for mosquitoes on a 7 to 14-day cycle. These data are used to direct control operations. Maintaining careful records of immature mosquito occurrence, developmental stages treated, source size, and control effectiveness can provide an early warning to forecast the size of the adult population.

Adult mosquito abundance is a key factor contributing to the risk of virus transmission. Monitoring the abundance of adult mosquito populations provides important information on the size of the vector population as it responds to changing climatic factors and to larval control efforts. Four adult mosquito sampling methods are currently used in California: New Jersey light traps, carbon dioxide-baited traps, gravid (egg-laying) traps, and resting adult mosquito collections. The advantages and disadvantages of these sampling methods, and guidelines for the design, operation, and processing of the traps have been discussed in Guidelines for Integrated Mosquito Surveillance (Meyer et al. 2003) and are summarized in Appendix A.

Mosquito Infections

Early virus activity may be detected by testing adult mosquitoes for virus infection. Because *Culex tarsalis* is the primary rural vector of WNV, SLE, and WEE, and *Culex quinquefasciatus* and *Culex pipiens* are important urban vectors of WNV and SLE, surveillance efforts emphasize the testing of these species. Another species that should be tested is *Culex stigmatosoma*, which is a highly competent but less widely distributed vector of WNV and SLE that feeds on birds and is probably important in enzootic transmission where it is found in high abundance. Female mosquitoes are trapped, usually using carbon dioxide-baited or gravid traps, identified to species and counted into groups (pools) of 50 females each for testing at the Center for Vectorborne Diseases (CVEC) at UC Davis. Procedures for submitting and processing mosquitoes for detecting virus infection are detailed in Appendix B. The current surveillance system is designed

to detect and measure levels of infection with WNV, SLE, and WEE. Although generally less sensitive than sentinel chickens, mosquito infections may be detected earlier in the season than chicken seroconversions and therefore provide an early warning of virus activity. Testing adult mosquitoes for infection is one of the best methods to detect newly introduced or emerging mosquito-borne viruses. Testing mosquito species other than *Culex* may be necessary to detect the introduction of viruses that do not have a primary avian-*Culex* transmission cycle.

Avian Infections

Detection of arboviral transmission within bird populations can be accomplished by 1) using caged chickens as sentinels and bleeding them routinely to detect viral antibodies (seroconversions), 2) collecting and bleeding wild birds to detect viral antibodies (seroprevalence), and 3) testing dead birds reported by the public for WNV.

In California, flocks of ten chickens are placed in locations where mosquito abundance is known to be high or where there is a history of virus activity. Each chicken is bled every two weeks by pricking the comb and collecting blood on a filter paper strip. The blood is tested at the CDPH Vector-Borne Disease Section for antibodies to SLE, WEE, and WNV. Some agencies conduct their own testing, but send positive samples to CDPH for confirmation and official reporting. Because SLE cross-reacts with WNV in antibody testing, SLE or WNV positive chickens are confirmed and the infecting virus is identified by western blot or cross-neutralization tests. Frequent testing of strategically placed flocks of sentinel chickens provides the most sensitive and cost-effective method to monitor encephalitis virus transmission in an area. Because chickens are continuously available to host-seeking mosquitoes, they are usually exposed to more mosquitoes than can be collected by trapping, especially when adult mosquito abundance or viral infection rates are low. Sentinel housing, bleeding instructions, and testing protocols are provided in Appendix C.

Virus activity in wild bird populations can be monitored by bleeding young (hatching year) birds to detect initial virus infection or by bleeding a cross-section of birds in an area and comparing seroprevalence among age strata to determine if the prevalence of the virus in the region has changed. Elevated seroprevalence levels ("herd immunity") among key species during spring may limit virus transmission and dampen amplification. New infections also can be detected by bleeding banded birds in a capture-recapture scheme. In contrast to the convenience of using sentinel chickens, the repeated collection and bleeding of wild birds generally is too labor intensive, technically difficult, and expensive for most local mosquito control agencies to perform routinely. In addition, the actual place where a wild bird became infected is rarely known, because birds may travel over relatively long distances and usually are collected during daylight foraging flights and not at nighttime roosting sites where they are bitten by mosquitoes.

Unlike WEE and SLE, WNV frequently causes death in North American birds, especially those in the family Corvidae (e.g. crows, ravens, magpies, jays). Dead bird surveillance was initiated by CDPH in 2000 to provide early detection of WNV. Dead bird surveillance has been shown to be one of the earliest indicators of WNV activity in a new area. Birds that meet certain criteria are necropsied at the California Animal Health and Food Safety Laboratory and kidney snips tested for WNV RNA by RT-PCR at CVEC or oral swabs of American crows tested by rapid antigen tests by local agencies. Dead birds are reported to CDPH's dead bird hotline (1-877-

WNV-BIRD) or via the website, http://westnile.ca.gov. The communication and testing algorithm for the dead bird surveillance program is detailed in Appendix D.

Since 2005, CDPH has used the Dynamic Continuous-Area Space-Time (DYCAST) model to identify areas of increased WNV activity in space and time based on the occurrence of dead bird reports. This model was developed in cooperation with the Center for Advanced Research of Spatial Information at Hunter College, City University of New York. DYCAST generates daily risk maps for the entire state of California, available on the Surveillance Gateway website, to help local agencies focus WNV surveillance, control, and public education efforts. A real-time alert system was also introduced in 2006 to provide high WNV activity counties with custom reports about WNV transmission levels. In a recent survey, local agencies reported that they used DYCAST to assist in decision-making processes for mosquito larviciding and adulticiding. In 2010, the DYCAST procedure will again be run statewide and daily maps will be made available online through the CALSURV Gateway (http://gateway.calsurv.org) from March through August.

Tree Squirrel Infections

In 2004, tree squirrels were included as a WNV surveillance tool, based upon evidence that they were susceptible to WNV and could provide information on localized WNV transmission (Padgett et al. 2007). In conjunction with dead birds, tree squirrels were reported to the California WNV hotline, necropsied at the California Animal Health and Food Safety Laboratory and kidney tissue was tested by RT-PCR at CVEC. Tree squirrels will continue to be tested for WNV in 2010 and are included in the submission protocol in Appendix D.

Equine Infections

Currently, equine disease due to WEE and WNV is no longer a sensitive indicator of epizootic (unusually high incidence of infections in animals other than humans) activity in California because of the widespread intentional or natural vaccination of equines (horses, donkeys, and mules). If confirmed cases do occur, it is a strong indication that WEE or WNV has amplified to levels where tangential transmission has occurred in that region of the State and human cases are imminent. Veterinarians are contacted annually by CDPH and the California Department of Agriculture (CDFA) to advocate equine vaccination and to describe diagnostic services that are available in the event of a suspected case of WEE or WNV encephalitis. Other mosquito-borne viruses may also cause encephalitis in horses, and testing of equine specimens for these other viruses is available (see Appendix E).

Human Infections

Local mosquito control agencies rely on the rapid detection and reporting of confirmed human cases to plan and implement emergency control activities to prevent additional infections. However, human cases of arboviral infection are an insensitive surveillance indicator of virus activity because most persons who become infected develop no symptoms. For those individuals who do become ill, it may take up to two weeks for symptoms to appear, followed by additional time until the case is recognized and reported. No human cases of SLE or WEE have been reported in California in recent years. However, a total of 2,877 cases of WNV have been reported in California from 2003-2009.

To enhance human WNV testing and surveillance efforts throughout the state, a regional public health laboratory network was established in 2002. The laboratory network consists of the state Viral and Rickettsial Disease Laboratory (VRDL) as well as 26 county public health laboratories that are able to conduct WNV testing. Providers are encouraged to submit specimens for suspect WNV cases to their local public health laboratories. Specimens for patients with encephalitis may also be submitted directly to the California Encephalitis Project, which is based in the VRDL and offers diagnostic testing for many agents known to cause encephalitis, including WNV and other arboviruses. In addition, VRDL collaborates with reference laboratories such as the regional laboratories of Kaiser Permanente to ascertain additional suspect WNV cases.

In accordance with Title 17 of the California Code of Regulations (Sections 2500 and 2505), physicians and laboratories are required to report cases of WNV infection or positive test results to their local health department. Positive WNV or other arbovirus test results are investigated by local health department officials to determine whether a patient meets the clinical and laboratory criteria for a WNV diagnosis. If so, the local health department collects demographic and clinical information on the patient using a standardized West Nile virus infection case report, and forwards the report to the state health department. The local health department also determines whether the infection was acquired locally, imported from a region outside the patient's residence, or acquired by a non-mosquito route of transmission such as blood transfusion or organ transplantation. Appendix F contains the protocol for submission of specimens to the regional public health laboratory network for WNV testing. Appendix G provides the national surveillance case definition for arboviral disease, including WNV infection.

Mosquito Control

Problems detected by surveillance are mitigated through larval and adult control. Mosquito control is the only practical method of protecting people from mosquito-borne diseases. Mosquito control in California is conducted by over 70 local agencies, including mosquito and vector control districts, environmental health departments, and county health departments. Compounds currently approved for larval and adult mosquito control in California are listed in Appendix H. Considerations regarding adult mosquito control in urban areas are described in Appendix I.

Larval Control

Mosquito larval and pupal control methods are target-specific and prevent the emergence of adult female mosquitoes which are capable of transmitting pathogens, causing discomfort, and ultimately producing another generation of mosquitoes. For these reasons, most mosquito control agencies in California target the immature stages rather than the adult stage of the mosquito. Larval mosquito control has three key components: environmental management, biological control, and chemical control.

Environmental management decreases habitat availability or suitability for immature mosquitoes, and may include water management, such as increasing the water disposal rate through evaporation, percolation, recirculation, or drainage. Laser-leveling of fields minimizes pooling at low spots, allows even distribution of irrigation water, and precludes standing water for long periods. Controlled irrigation or the careful timing of wetland flooding for waterfowl can reduce

mosquito production or limit emergence to times of the year when virus activity is unlikely. Environmental management may include vegetation management because emergent vegetation provides food and refuge for mosquito larvae. Management strategies include the periodic removal or thinning of vegetation, restricting growth of vegetation, and controlling algae.

Biological control uses natural predators, parasites, or pathogens to reduce immature mosquito numbers. Mosquitofish, *Gambusia affinis*, are the most widely used biological control agent in California. These fish are released annually in a variety of habitats, such as rice fields, small ponds, and canals.

There are several mosquito control products that are highly specific and thus have minimal impact on non-target organisms. These include microbial control agents, such as *Bacillus thuringiensis israelensis* (Bti) and *Bacillus sphaericus*, and insect growth regulators, such as methoprene, that prevent immature mosquitoes from developing into adults. Surface films are very effective against both larvae and pupae, but also may suffocate other surface breathing aquatic insects. Organophosphate pesticides are used infrequently because of their impact on nontarget organisms and the environment.

Adult Control

When larval control is not possible or has been used to the fullest extent possible, adult mosquito control may be required to suppress populations of infected mosquitoes and interrupt epidemic virus transmission. Adult mosquito control products may be applied using ground-based equipment, fixed wing airplanes, or helicopters. Products applied in ultralow volume [ULV] formulations and dosages include organophosphates, such as malathion and naled, pyrethroids, such as resmethrin, sumithrin, and permethrin, and pyrethrins such as Pyrenone crop spray. Factors to consider when selecting an adulticide include: 1) efficacy against the target species or life cycle stage, 2) resistance status, 3) pesticide label requirements, 4) availability of pesticide and application equipment, 5) environmental conditions, 6) cost, and 7) toxicity to nontarget species, including humans.

Response Levels

The California Mosquito-borne Virus Surveillance and Response Plan was developed to provide a semi-quantitative measure of virus transmission risk to humans that could be used by local agencies to plan and modulate control activities. Independent models are presented for WEE, SLE and WNV to accommodate the different ecological dynamics of these viruses (Barker et al. 2003). SLE and WN viruses are closely related, require similar environmental conditions and employ the same *Culex* vectors. Seven surveillance factors are measured and analyzed to determine the level of risk for human involvement and thereby gauge the appropriate response level:

1. Environmental or climatic conditions (snowpack, rainfall, temperature, season)
2. Adult *Culex* vector abundance
3. Virus infection rate in *Culex* mosquito vectors
4. Sentinel chicken seroconversions
5. Fatal infections in birds (WNV only)
6. Infections in humans
7. Proximity of detected virus activity to urban or suburban regions (WEE only)

Each factor is scored on an ordinal scale from 1 (lowest risk) to 5 (highest risk). The mean score calculated from these factors corresponds to a response level as follows: normal season (1.0 to 2.5), emergency planning (2.6 to 4.0), and epidemic (4.1 to 5.0). Table 1 provides a worksheet to assist in determining the appropriate rating for each of the risk factors for each of the three viruses. Appendix J shows sources of data useful in the calculation of risk in Table 1.

For surveillance factor 2 (vector abundance), abundance is scaled as an anomaly and compared to the area average over 5 years for the same preceding two week period. The area typically encompasses the boundaries of a local mosquito and vector control district. The mosquito virus infection rate should be calculated using the most current data (prior two week period) and expresses as minimum infection rate (MIR) per 1,000 female mosquitoes tested. Calculations can also use maximum likelihood estimate (Biggerstaff 2003), which accounts for varying numbers of specimens in pools. For WNV and SLE, risk may be estimated separately for *Cx. tarsalis* and the *Cx. pipiens* complex, respectively, because these species generally have different habitat requirements and therefore spatial distributions (e.g., rural vs. urban).

Each of the three viruses differs in its response to ecological conditions. WEE activity typically is greatest during El Niño conditions of wet winters, excessive run-off and flooding, cool springs, and increased *Culex tarsalis* abundance. Historically, WEE virus spillover into a secondary *Aedes*-rabbit cycle was common in the Central Valley, but has not been detected for the past 25 years. In contrast, SLE and perhaps WNV activity appears to be greatest during La Niña conditions of drought and hot summer temperatures and both SLE and WNV transmission risk increases when temperatures are above normal. Abundance and infection of the *Culex pipiens* complex are included in both SLE and WNV estimates of risk because these mosquito species are important vectors, particularly in suburban/urban environments. The occurrence of dead bird infections is included as a risk factor in the WNV calculations. For surveillance factors 4-6 (chickens, birds, humans), specific region is defined as the area within the agency's boundary and the broad region includes the area within 150 miles (~241 km) of the agency's boundary.

Proximity of virus activity to human population centers is considered an important risk factor for all three viruses of public health concern. In the risk assessment model in Table 1 this was accommodated in two different ways. WEE virus transmitted by *Culex tarsalis* typically amplifies first in rural areas and then spreads towards small and then larger communities. A risk score was included to account for where virus activity was detected. WNV and SLE virus may be amplified concurrently or sequentially in rural and urban cycles. The rural cycle is similar to WEE virus and is transmitted primarily by *Cx. tarsalis*, whereas the urban cycle is transmitted primarily by members of the *Culex pipiens* complex. If the spatial distributions of key *Culex* species differ within an area (e.g., rural vs. urban), it may be advantageous to assess risk separately by species for abundance and infection rates in *Cx. tarsalis* and the *Cx. pipiens* complex. This would result in two estimates of overall risk for the areas dominated by each species.

Each of these surveillance factors can differ in impact and significance according to time of year and geographic region. Climatic factors provide the earliest indication of the potential for increased mosquito abundance and virus transmission and constitute the only risk factor actually measured from the start of the calendar year through mid-spring when enzootic surveillance commences in most areas. Climate is used prospectively to forecast risk during the coming

season. Other epidemiological factors that may inform control efforts as the season progresses are typically, in chronological order: mosquito abundance, infections in non-humans (e.g., dead birds for WNV, mosquitoes, sentinel chickens), and infections in humans. Enzootic indicators measure virus amplification within the *Culex*-bird cycle and provide nowcasts of risk, whereas human infections document tangential transmission and are the outcome measure of forecasts and nowcasts. Response to the calculated risk level should consider the time of year; epidemic conditions in October would warrant a less aggressive response compared to epidemic conditions in July because cooler weather in late fall will contribute to decreased risk of arbovirus transmission.

The ratings listed in Table 1 are benchmarks only and may be modified as appropriate to the conditions in each specific region or biome of the state. Calculation and mapping of risk has been enabled by tools included in the Surveillance Gateway. Roles and responsibilities of key agencies involved in carrying-out the surveillance and response plan are outlined in "Key Agency Responsibilities."

Table 1. Mosquito-borne Virus Risk Assessment.

WNV Surveillance Factor	Assessment Value	Benchmark	Assigned Value	
1. Environmental Conditions High-risk environmental conditions include above-normal temperatures with or without above-normal rainfall, runoff, or snowpack. Weather data link: http://ipm.ucdavis.edu	1	Avg daily temperature during prior 2 weeks ≤ 56 °F		
	2	Avg daily temperature during prior 2 weeks 57 – 65 °F		
	3	Avg daily temperature during prior 2 weeks 66 – 72 °F		
	4	Avg daily temperature during prior 2 weeks 73 – 79 °F		
	5	Avg daily temperature during prior 2 weeks > 79 ° F		
			Cx tars	*Cx pip*
2. **Adult *Culex tarsalis* and *Cx. pipiens* complex relative abundance*** Determined by trapping adults, enumerating them by species, and comparing numbers to those previously documented for an area for the prior 2-week period.	1	Vector abundance well below average (≤ 50%)		
	2	Vector abundance below average (51 - 90%)		
	3	Vector abundance average (91 - 150%)		
	4	Vector abundance above average (151 - 300%)		
	5	Vector abundance well above average (> 300%)		
3. **Virus infection rate in *Culex tarsalis* and *Cx. pipiens* complex mosquitoes*** Tested in pools of 50. Test results expressed as minimum infection rate per 1,000 female mosquitoes tested (MIR) for the prior 2-week period.	1	MIR = 0		
	2	MIR = 0.1 - 1.0		
	3	MIR = 1.1 - 2.0		
	4	MIR = 2.1 - 5.0		
	5	MIR > 5.0		
4. **Sentinel chicken seroconversion** Number of chickens in a flock that develop antibodies to WNV during the prior 2-week period. If more than one flock is present in a region, number of flocks with seropositive chickens is an additional consideration. Typically 10 chickens per flock.	1	No seroconversions in broad region		
	2	One or more seroconversions in broad region		
	3	One or two seroconversions in a single flock in specific region		
	4	More than two seroconversions in a single flock or two flocks with one or two seroconversions in specific region		
	5	More than two seroconversions per flock in multiple flocks in specific region		
5. **Dead bird infection** Number of birds that have tested positive (recent infections only) for WNV during the prior 3-month period. This longer time period reduces the impact of zip code closures during periods of increased WNV transmission.	1	No positive dead birds in broad region		
	2	One or more positive dead birds in broad region		
	3	One positive dead bird in specific region		
	4	Two to five positive dead birds in specific region		
	5	More than five positive dead birds in specific region		
6. **Human cases** Do not include this factor in calculations if no cases are detected in region.	3	One or more human infections in broad region		
	4	One human infection in specific region		
	5	More than one human infection in specific region		
			Cx tars	*Cx pip*
Response Level / Average Rating: Normal Season (1.0 to 2.5) Emergency Planning (2.6 to 4.0) Epidemic (4.1 to 5.0)		**TOTAL**		
		AVERAGE		

* Calculation of separate risk values for *Cx. tarsalis* and the *Cx. pipiens* complex may be useful if their spatial distributions (e.g., rural vs. urban) differ within the assessment area.

SLE Surveillance Factor	Assessment Value	Benchmark	Assigned Value	
1. Environmental Conditions High-risk environmental conditions include above-normal temperatures with or without above-normal rainfall, runoff, or snowpack. Weather data link: http://ipm.ucdavis.edu	1	Avg daily temperature during prior 2 weeks ≤ 56 °F		
	2	Avg daily temperature during prior 2 weeks 57 – 65 °F		
	3	Avg daily temperature during prior 2 weeks 66 – 72 °F		
	4	Avg daily temperature during prior 2 weeks 73 – 79 °F		
	5	Avg daily temperature during prior 2 weeks > 79 ° F		
			Cx tars	*Cx pip*
2. **Adult *Culex tarsalis* and *Cx. pipiens* complex relative abundance*** Determined by trapping adults, enumerating them by species, and comparing numbers to those previously documented for an area for the prior 2-week period.	1	Vector abundance well below average (≤ 50%)		
	2	Vector abundance below average (51 - 90%)		
	3	Vector abundance average (91 - 150%)		
	4	Vector abundance above average (151 - 300%)		
	5	Vector abundance well above average (> 300%)		
3. **Virus infection rate in *Culex tarsalis* and *Cx. pipiens* complex mosquitoes*** Tested in pools of 50. Test results expressed as minimum infection rate per 1,000 female mosquitoes tested (MIR) for the prior 2-week collection period.	1	MIR = 0		
	2	MIR = 0.1 - 1.0		
	3	MIR = 1.1 - 2.0		
	4	MIR = 2.1 - 5.0		
	5	MIR > 5.0		
4. **Sentinel chicken seroconversion** Number of chickens in a flock that develop antibodies to SLEV during the prior 2-week period. If more than one flock is present in a region, number of flocks with seropositive chickens is an additional consideration. Typically 10 chickens per flock.	1	No seroconversions in broad region		
	2	One or more seroconversions in broad region		
	3	One or two seroconversions in a single flock in specific region		
	4	More than two seroconversions in a single flock or two flocks with one or two seroconversions in specific region		
	5	More than two seroconversions per flock in multiple flocks in specific region		
5. **Human cases** Do not include this factor in calculations if no cases are detected in region.	3	One or more human cases in broad region		
	4	One human case in specific region		
	5	More than one human case in specific region		
			Cx tars	*Cx pip*
Response Level / Average Rating: Normal Season (1.0 to 2.5) Emergency Planning (2.6 to 4.0) Epidemic (4.1 to 5.0)		**TOTAL**		
		AVERAGE		

* Calculation of separate risk values for *Cx. tarsalis* and the *Cx. pipiens* complex may be useful if their spatial distributions (e.g., rural vs. urban) differ within the assessment area.

WEE Surveillance Factor	Assessment Value	Benchmark	Assigned Value
1. **Environmental Conditions** High-risk environmental conditions include above normal rainfall, snow pack, and runoff during the early season followed by a strong warming trend. Weather data link: http://ipm.ucdavis.edu	1	Cumulative rainfall and runoff well below average	
	2	Cumulative rainfall and runoff below average	
	3	Cumulative rainfall and runoff average	
	4	Cumulative rainfall and runoff above average	
	5	Cumulative rainfall and runoff well above average	
2**. Adult *Culex tarsalis* abundance** Determined by trapping adults, enumerating them by species, and comparing numbers to averages previously documented for an area for the prior 2-week period.	1	*Cx. tarsalis* abundance well below average (≤ 50%)	
	2	*Cx. tarsalis* abundance below average (51 - 90%)	
	3	*Cx. tarsalis* abundance average (91 - 150%)	
	4	*Cx. tarsalis* abundance above average (151 - 300%)	
	5	*Cx. tarsalis* abundance well above average (> 300%)	
3. **Virus infection rate in *Cx. tarsalis* mosquitoes** Tested in pools of 50. Test results expressed as minimum infection rate per 1,000 female mosquitoes tested (MIR) for the prior 2-week collection period.	1	*Cx. tarsalis* MIR = 0	
	2	*Cx. tarsalis* MIR = 0.1 - 1.0	
	3	*Cx. tarsalis* MIR = 1.1 - 2.0	
	4	*Cx. tarsalis* MIR = 2.1 - 5.0	
	5	*Cx. tarsalis* MIR > 5.0	
4. **Sentinel chicken seroconversion** Number of chickens in a flock that develop antibodies to WEEV during the prior 2-week period. If more than one flock is present in a region, number of flocks with seropositive chickens is an additional consideration. Typically 10 chickens per flock.	1	No seroconversions in broad region	
	2	One or more seroconversions in broad region	
	3	One or two seroconversions in a single flock in specific region	
	4	More than two seroconversions in a single flock or two flocks with one or two seroconversions in specific region	
	5	More than two seroconversions per flock in multiple flocks in specific region	
5. **Proximity to urban or suburban regions** (score only if virus activity detected) Risk of outbreak is highest in urban areas because of high likelihood of contact between humans and vectors.	1	Virus detected in rural area	
	3	Virus detected in small town or suburban area	
	5	Virus detected in urban area	
6. **Human cases** Do not include this factor in calculations if no cases found in region or in agency.	3	One or more human cases in broad region	
	4	One human case in specific region	
	5	More than one human case in specific region	
<u>Response Level / Average Rating:</u> Normal Season (1.0 to 2.5) Emergency Planning (2.6 to 4.0) Epidemic (4.1 to 5.0)		**TOTAL**	
		AVERAGE	

General suggestions for applying the risk assessment model locally

- Use a consistent time period for environmental conditions, adult mosquito abundance, mosquito infection rates, and human cases. If you use a period that differs from the prior two-week period defined in the risk assessment -- such as the prior month -- use the same period for all other relevant measures. Note that sentinel seroconversions and dead bird infections may need special treatment to accommodate bleeding schedules and zip code closures, respectively. For sentinel seroconversions, use the sentinel seroconversions from the most recent collection.
- If you have multiple trap types in your surveillance program, determine the vector abundance anomaly for each trap type and species and use the most sensitive trap type's value in the risk assessment.
- When determining the vector abundance anomaly, there should be at least two and preferably five years of prior data to provide a comparative baseline for the particular trap type. Ideally, the prior years should be contiguous and immediately precede the time period being evaluated.

Risk assessment as implemented by the CalSurv Gateway (http://gateway.calsurv.org)

- Assessment reports will be generated and delivered to the primary contacts of each agency by email every Monday.
- The time frame of each assessment report will be for the prior two-week period ending on the previous Saturday.
- Only those agencies with active Gateway accounts and active surveillance programs will receive the reports.
- All calculations are done at the agency level, thus the specific region is the area within the agency's boundary and the broad region includes the area within 150 miles (~241 km) of the agency's boundary.
- Due to privacy concerns and delays in detection and reporting, human cases are not part of the Gateway's risk assessment.
- All of the general suggestions from the prior section are used in the Gateway's implementation.
- Risk estimates based on mosquito abundance and infection rates will be calculated separately for the key mosquito species, *Cx. tarsalis* and the *Cx. pipiens* complex.
- For sentinel seroconversions, flavivirus positives are treated as WNV positives. If SLE is found, this will be adjusted accordingly.

Characterization of Conditions and Responses

Level 1: Normal Season

Risk rating: 1.0 to 2.5

CONDITIONS
• Average or below average snowpack and rainfall; below or average seasonal temperatures (<65F) • *Culex* mosquito abundance at or below five year average (key indicator = adults of vector species) • No virus infection detected in mosquitoes • No seroconversions in sentinel chickens • No recently infected WNV-positive dead birds • No human cases
RESPONSE
• Conduct routine public education (eliminate standing water around homes, use personal protection measures) • Conduct routine mosquito and virus surveillance activities • Conduct routine mosquito control, with emphasis on larval control. • Inventory pesticides and equipment • Evaluate pesticide resistance in vector species • Ensure adequate emergency funding • Release routine press notices • Send routine notifications to physicians and veterinarians • Establish and maintain routine communication with local office of emergency services personnel; obtain Standardized Emergency Management System (SEMS) training

Level 2: Emergency Planning

Risk rating: 2.6 to 4.0

CONDITIONS
• Snowpack and rainfall and/or temperature above average (66-79F) • Adult *Culex* mosquito abundance greater than 5-year average (150% to 300% above normal) • One or more virus infections detected in *Culex* mosquitoes (MIR / 1000 is <5) • One or more seroconversions in single flock or one to two seroconversions in multiple flocks in specific region • One to five recently infected WNV-positive dead birds in specific region • One human case in broad or specific region • WEE virus detected in small towns or suburban area
RESPONSE
• Review epidemic response plan • Enhance public education (include messages on the signs and symptoms of encephalitis; seek medical care if needed; inform public about pesticide applications if appropriate) • Enhance information to public health providers • Conduct epidemiological investigations of cases of equine or human disease • Increase surveillance and control of mosquito larvae • Increase adult mosquito surveillance • Increase number of mosquito pools tested for virus • Conduct or increase localized chemical control of adult mosquitoes as appropriate • Contact commercial applicators in anticipation of large scale adulticiding • Review candidate pesticides for availability and susceptibility of vector mosquito species • Ensure notification of key agencies of presence of viral activity, including the local office of emergency services

Level 3: Epidemic Conditions

Risk rating: 4.1 to 5.0

CONDITIONS
• Snowpack, rainfall, and water release rates from flood control dams and/or temperature well above average (>79F) • Adult vector population extremely high (>300%) • Virus infections detected in multiple pools of *Culex tarsalis* or *Cx. pipiens* mosquitoes (MIR / 1000 > 5.0) • More than two seroconversions per flock in multiple flocks in specific region • More than five recently infected WNV-positive dead birds and multiple reports of dead birds in specific region • More than one human case in specific region • WEE virus detection in urban or suburban areas
RESPONSE
• Conduct full scale media campaign • Alert physicians and veterinarians • Conduct active human case detection • Conduct epidemiological investigations of cases of equine or human disease • Continue enhanced larval surveillance and control of immature mosquitoes • Broaden geographic coverage of adult mosquito surveillance • Accelerate adult mosquito control as appropriate by ground and/or air • Coordinate the response with the local Office of Emergency Services or if activated, the Emergency Operation Center (EOC) • Initiate mosquito surveillance and control in geographic regions without an organized vector control program • Determine whether declaration of a local emergency should be considered by the County Board of Supervisors (or Local Health Officer) • Determine whether declaration of a "State of Emergency" should be considered by the Governor at the request of designated county or city officials • Ensure state funds and resources are available to assist local agencies at their request • Determine whether to activate a Standardized Emergency Management System (SEMS) plan at the local or state level • Continue mosquito education and control programs until mosquito abundance is substantially reduced and no additional human cases are detected

For more detailed information on responding to a mosquito-borne disease outbreak, please refer to:

Operational Plan for Emergency Response to Mosquito-Borne Disease Outbreaks, California Department of Public Health (supplement to California Mosquito-Borne Virus Surveillance and Response Plan). http://www.westnile.ca.gov/resources.php

Key Agency Responsibilities

Local Mosquito and Vector Control Agencies

- Gather, collate, and interpret regional climate and weather data.
- Monitor abundance of immature and adult mosquitoes.
- Collect and submit mosquito pools to CVEC for virus detection.
- Maintain sentinel chicken flocks, obtain blood samples, and send samples to VBDS.
- Pick-up and ship dead birds for necropsy and WNV testing, or test oral swabs from American crows locally via rapid antigen screening assays.
- Update CDPH weekly of all birds that are independently reported and/or tested by VecTest, RAMP or immunohistochemistry.
- Update the surveillance gateway weekly with mosquito pool results that are independently tested by RAMP or PCR.
- Conduct routine control of immature mosquitoes.
- Conduct control of adult mosquitoes when needed.
- Educate public on mosquito avoidance and reduction of mosquito breeding sites.
- Coordinate with local Office of Emergency Services personnel.
- Communicate regularly with neighboring agencies

Mosquito and Vector Control Association of California

- Coordinate purchase of sentinel chickens.
- Receive, track, and disperse payment for surveillance expenses.
- Coordinate surveillance and response activities among member agencies.
- Serve as spokesperson for member agencies.
- Establish liaisons with press and government officials.

California Department of Public Health

- Collate adult mosquito abundance data submitted by local agencies; provide summary of data to local agencies.
- Maintain a WNV information and dead bird reporting hotline, 1-877-WNV-BIRD, and a WNV website: www.westnile.ca.gov
- Coordinate submission of specimens for virus testing.
- Provide supplies for processing mosquito pool and sentinel chicken diagnostic specimens
- Test sentinel chicken sera for viral antibodies.
- Test human specimens for virus.
- Distribute a weekly bulletin summarizing surveillance test results.
- Send weekly surveillance results to the UC Davis interactive website.
- Provide statewide, daily DYCAST human risk maps, available through the California Vectorborne Disease Surveillance Gateway (http://gateway.calsurv.org).
- Provide analysis of DYCAST risk data and notification to local agencies when appropriate.
- Immediately notify local vector control agency and public health officials when evidence of viral activity is found.
- Conduct epidemiological investigations of cases of human disease.
- Coordinate and participate in a regional emergency response in conjunction with California Emergency Management Agency.

- Conduct active surveillance for human cases.
- Provide oversight to local jurisdictions without defined vector-borne disease control program.
- Maintain inventory of antigens and antisera to detect exotic viruses.
- Provide confirmation of tests done by local agencies.

University of California at Davis

- Conduct research on arbovirus surveillance, transmission of mosquito-borne diseases, and mosquito ecology and control.
- Test mosquito pools and dead birds for endemic and introduced viruses.
- Provide a proficiency panel of tests for identification of viruses from human, equine, bird, or arthropod vectors to local agencies to ensure quality control.
- Maintain an interactive website (http://gateway.calsurv.org) for dissemination of mosquito-borne virus information and data.
- Maintain inventory of antigens, antisera, and viruses to detect the introduction of exotic viruses.
- Provide confirmation of tests done by local or state agencies.

California Department of Food and Agriculture

- Notify veterinarians and veterinary diagnostic laboratories about WEE and WNV and testing facilities available at UCD Center for Vectorborne Disease Research.
- Provide outreach to general public and livestock and poultry producers on the monitoring and reporting of equine and ratite encephalitides.
- Facilitate equine and ratite sample submission from the field.
- Conduct epidemiological investigations of equine cases.

California Animal Health and Food Safety Laboratory

- Identify species of dead birds submitted for WNV testing.
- Conduct necropsies and testing on dead birds.
- Submit bird tissues to CVEC for testing.
- Test equine specimens for WNV.

Local Health Departments and Public Health Laboratories

- Test human specimens for WNV.
- Refer human specimens to CDPH for further testing.
- Notify local medical community, including hospitals and laboratories, if evidence of viral activity is present.
- Collect dead birds and ship carcasses to testing laboratories when needed.
- Test American crows via rapid assay or RT-PCR as resources allow.
- Participate in emergency response.
- Conduct epidemiological investigations of cases of human disease.
- Report WNV cases to CDPH.
- Conduct public education.

California Emergency Management Agency

- Coordinate the local, regional, or statewide emergency response under epidemic conditions in conjunction with CDPH via the Standardized Emergency Management System (SEMS).
- Serve as liaison with the Federal Emergency Management Agency (FEMA) in the event that a federal disaster has been declared.

Federal Centers for Disease Control and Prevention

- Provide consultation to state and local agencies in California if epidemic conditions exist.
- Provide national surveillance data to state health departments.

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Appendix A: Guidelines for Adult Mosquito Surveillance

The objective of Appendix A is to standardize mosquito sampling and reporting procedures to provide comparable and interpretable abundance measures among collaborating mosquito control agencies in California. This section summarizes information from Integrated Mosquito Surveillance Program Guidelines for California that recently has been adopted by the Mosquito and Vector Control Association (MVCAC) (Meyer et al. 2003). The MVCAC guidelines recommend stratifying the use of different sampling methods in rural, small town, and urban environments for each of the major biomes of California and provide a listing of target vector and nuisance mosquito species. The stratified sampling approach monitors vector populations and virus activity in rural enzootic foci, agricultural or suburban amplification sites, and densely populated urban centers to provide estimates of early, eminent, and current epidemic risk.

The four sampling methods currently used by mosquito control agencies are: 1) New Jersey (American) light trap, 2) CDC or EVS style CO_2-baited trap, 3) gravid trap, and 4) adult resting collections. Collection location sites should be geocoded and registered using the Surveillance Gateway [http://gateway.calsurv.org/]. Studies comparing trap design and efficiency for surveillance purposes have been published (Reisen et al. 2000; Reisen et al. 2002). These guidelines describe: 1) a comparison of the sampling methods, 2) equipment design, 3) operation, 4) specimen processing, 5) data recording and analysis, and 6) data usage.

Advantages and Disadvantages of Mosquito Sampling Methods:

New Jersey Light Trap	
Pros	**Cons**
• All female metabolic states and males collected • Minimal collection effort (can be run nightly without service) • Long history of use in California	• Selective for phototactic nocturnally active mosquitoes • Ineffective in the presence of competing light sources • Sorting time excessive because of other insects in traps • Specimens dead; less useful for virus detection • Collects comparatively few specimens
CDC/EVS CO_2 Trap	
Pros	**Cons**
• Samples biting population • Collects large numbers of virus vector species • Specimens alive; suitable for virus detection • Without light, collects mostly mosquitoes thus reducing sorting time • Battery operated, portable	• Collects >50% nullipars (females that have never blood fed or laid eggs) • Must be set and picked-up daily • Dry ice cost high; availability can be a problem • Does not collect males or bloodfed or gravid females
Gravid Trap	
Pros	**Cons**
• Collects females that have bloodfed and digested the blood meal; may have higher infection rate than CO_2 trap • Specimens alive; suitable for virus detection • Extremely sensitive for *Cx.quinquefasciatus* in urban habitat • Bait inexpensive • Battery operated, portable	• Collects only foul-water *Culex* [mostly *pipiens* complex] • Bait has objectionable odor • Must be set and picked-up daily

Resting Catches	
Pros	**Cons**
• All metabolic states collected • Minimal equipment needed • Specimens alive; suitable for virus detection • Blooded and gravid specimens can be tested to improve sensitivity of virus surveillance	• Standardization is difficult due to: 1. Variable shelter size and type 2. Variable collector efficiency • Labor intensive; difficult to concurrently sample a large number of sites

New Jersey (American) Light Trap (NJLT)

Operation

At a minimum, one trap should be located in each principal municipality of a district or have a distribution of one trap/township (36 sq. mi.). Correct placement of the NJLT is a critical factor in its performance as an effective surveillance mechanism for measuring the relative abundance of phototaxic mosquitoes. Place the traps at six-foot height. This can be done by using a metal standard, or by hanging the traps from tree limbs or roof eaves. These distances should maximize attractancy over a 360 degree radius. The trap should be placed on the leeward side of a structure or tree line to decrease the influence of wind on trap catch.

Traps should be kept away from smoke or chemical odors that may be repellent to the mosquitoes. Traps should be away from buildings in which animals are housed and not be in the immediate vicinity of sentinel flocks to diminish attractancy competition. Traps should be placed away from street and security lights that may diminish attractancy of the trap bulb. A trap should be placed approximately 100-200 feet from each sentinel chicken flock when possible.

Traps should be operated from week 14 to week 44 of the calendar year for districts north of the Tehachapi Mountains and all year long for districts south of the Tehachapi. Ideally, the traps should run for four to seven nights before the collection is retrieved (Loomis and Hanks 1959). The trap should be thoroughly cleaned with a brush to remove spider webs or any other debris that may hinder airflow through the trap. A regular cleaning schedule should be maintained during the trapping season to maintain trap efficiency.

Processing

Adult mosquitoes from the NJLT collection should be sorted from the other insects in an enamel pan before being identified and counted at 10x magnification under a dissecting microscope. Counting aliquots or subsamples of all specimen samples should be discouraged, because vector species may comprise only a small fraction of the total mosquito collection.

CDC style CO_2-baited trap

Operation

Carbon dioxide-baited traps can be used for abundance monitoring or capturing mosquitoes for virus testing. Traps should be hung from a 6-foot tall standard (approximately 4 feet above ground level) to standardize trap placement for population and virus infection rate monitoring. Knowledge of the host-seeking patterns of the target species is essential in determining CO_2-baited trap placement in the habitat to enhance catch size and therefore sampling sensitivity. *Culex tarsalis* primarily bloodfeed on birds and hunt along vegetative borders and tree canopies where birds roost and nest. *Culex erythrothorax* are best collected within wetland areas near

dense stands of tules and cattails. In large, open breeding sources such as rice fields, CO_2-baited traps could be hung on standards on the up-wind side of the source for *Culex tarsalis* and *Anopheles freeborni* collections. *Aedes melanimon* and *Aedes nigromaculis* are mammal feeders and typically seek hosts over open fields.

When used to supplement sentinel chickens for arbovirus surveillance, traps should be operated at different locations to enhance geographical coverage and thus surveillance sensitivity. Labor and time constraints determine the extent of sampling. When used to monitor population abundance, traps should be operated weekly or biweekly at the same fixed stations. Temperature, wind speed, wind direction, and rainfall should be recorded because these factors affect catch size. The mini-light should be removed, because it attracts other phototactic insects that may hinder sorting and/or damage female mosquitoes in the collection container and may repel members of the *Culex pipiens* complex. The CO_2-baited trap should not be placed in immediate proximity to the sentinel chicken flock because it will compete with, and therefore lessen, exposure of the sentinel birds, but may be placed within a 100-200 foot radius of the sentinel flock site, but no closer than 100 feet from the flock.

Processing

Mosquitoes collected for arbovirus surveillance should be processed according to the procedures outlined in Appendix B. If possible, ten pools of a species (*Culex tarsalis*, *Culex pipiens, Culex quinquefasciatus, Culex stigmatosoma, Aedes melanimon*, and *Aedes dorsalis*) should be submitted for virus testing from a given geographical location at a given time. Only live mosquitoes should be pooled for virus testing. Dead, dried specimens should be counted and discarded. Only whole specimens should be submitted; avoid including detached body parts (which may be from other mosquito species) or other Diptera (i.e., *Culicoides*, etc.) in the pool to prevent sample contamination. Avoid freezing specimens before sorting and counting. Mosquitoes collected for population monitoring should be anesthetized in a well-ventilated area or under a chemical hood using triethylamine, identified to species under a dissecting microscope, counted, pooled and immediately frozen at -80C or on dry ice for later virus testing.

Reiter/Cummings gravid traps

Trap design and components

The Reiter/Cummings gravid traps consist of a rectangular trap housing [plastic tool box] with an inlet tube on the bottom and an outlet tube on the side or top. The rectangular housing is provided with legs to stabilize the trap over the attractant basin containing the hay-infusion mixture. (Cummings 1992). The oviposition attractant consists of a fermented infusion made by mixing hay, Brewer's yeast and water. The mixture should sit at ambient temperature for three to four days to allow fermentation and increase attractancy. New solutions should be made at least biweekly to maintain consistent attractancy.

Operation

The Reiter/Cummings gravid trap is primarily used in suburban and urban residential settings for surveillance of gravid females in the *Culex pipiens* complex. The trap is placed on the ground near dense vegetation that serves as resting sites for gravid females. Specimens may be retrieved on a one to three day basis.

Processing

Culex pipiens complex females collected with the gravid trap for arbovirus surveillance should be retrieved daily and the protocol for mosquito pool submission as outlined in Appendix B should be followed. For population monitoring of the *Culex pipiens* complex, collections may be retrieved every third day. The females are killed, identified and counted before being discarded. Autogenous females may also be attracted to the gravid trap.

Adult resting collections

Trap design and operation

A flashlight and mechanical aspirator can be used to collect adult mosquitoes resting in habitats such as shady alcoves, buildings, culverts, or spaces under bridges. Highest numbers usually are collected at humid sites protected from strong air currents. Adults resting in vegetation may be collected using a mechanical sweeper such as the AFS (Arbovirus Field Station) sweeper (Meyer et al. 1983). For quantification, time spent searching is recorded and abundance expressed as the number collected per person-hour.

Red boxes were developed to standardize collections spatially. Different researchers have used red boxes of varying dimensions. Largest catches are made in semi-permanent walk-in red boxes which measure 4' x 4' x 6' (Meyer 1985). Smaller 1' x 1' x 1' foot boxes typically collect fewer specimens, but are readily portable. The entrance of the walk-in red box should be left open, draped with canvas, or closed with a plywood door. The canvas or plywood door should have a 1 or 2 ft gap at the bottom to allow entry of mosquitoes, while affording some protection from the wind and decreasing the light intensity within the box. The box entrance should not face eastward into the morning sun or into the predominant wind direction.

Processing

Mosquitoes should be anesthetized with triethylamine, identified under a dissecting microscope, sorted by sex and female metabolic status (i.e., empty or unfed, blood fed or gravid), and counted. Females may be counted into ten pools of approximately 50 females per site per collection date for virus monitoring (see Appendix B). Only living females should be used for arbovirus surveillance. Data on metabolic status may indicate population reproductive age as well as diapause status.

Data recording and analysis

Counts from NJLTs, EVS, and gravid traps and information on pools submitted for testing or tested locally should be entered directly in electronic format through the California Vectorborne Disease Surveillance Gateway (http://gateway.calsurv.org/). Import from local or proprietary data systems is available. For comparisons of abundance over time, space, or collection methods, refer to Biddlingmeyer (1969).

Data usage

Mosquito collections from some or all of the four sampling methods collectively can be used to:

1. Assess control efforts.
2. Monitor arbovirus vector abundance and infection rates.
3. Compare mosquito abundance from collections with the number of service requests from the public to determine the tolerance of neighborhoods to mosquito abundance.
4. Determine proximity of breeding source(s) by the number of males present in collections from the NJLTs and red boxes.
5. Determine age structure of females collected by CO_2 traps and resting adult collections; such data are critical to evaluating the vector potential of the population.

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Appendix B: Procedures for Processing Mosquitoes for Arbovirus Detection

1. Collect mosquitoes alive and return them immediately to the laboratory. Collections should be kept humid during transport with moist toweling to prevent desiccation. Females should be offered 5-10 percent sucrose if held overnight or longer before processing.

2. Anesthetize mosquitoes by cold, carbon dioxide, or triethylamine (TEA). TEA is recommended because specimens are permanently immobilized with minimal mortality and with no loss of virus titer. TEA should be used either outdoors or under a chemical hood. Collections can be anesthetized outdoors using a few drops of TEA, the specimens transferred to Petri dishes, and then taken into the laboratory for processing. If refrigerated and kept humid, mosquitoes will remain alive in covered Petri dishes for one or two days without additional anesthesia. If mosquitoes are frozen before processing, sorting to species and enumeration must be done on a chill table to prevent virus loss.

3. Sort mosquito collections to species under a dissecting microscope at 10X to ensure correct identification and to make sure that extraneous mosquito parts (i.e., legs, wings) or other small insects such as chironomids or *Culicoides* are not inadvertently included in the pools. This is extremely important because diagnostics have transitioned from virus isolation to sensitive RT-PCR methods of viral detection. Count and discard dead and dried mosquitoes. Lots of 50 females per pool of each vector species from each collection site are then counted into individual polystyrene vials with snap caps containing two 5mm glass beads. Recommended sampling effort is ten pools of 50 females of each species from each site per week to detect minimum infection rates (MIRs) ranging from 0 to 20 per 1,000 females tested. Vials with pools should be labeled sequentially starting with #1 each year after the site code; e.g., KERN-1-10; where 10 refer to year 2010. Data on each pool can be entered directly in electronic format through the California Vectorborne Disease Surveillance Gateway (http://gateway.calsurv.org/). POOLS MUST BE ACCOMPANIED BY "MOSQUITO POOLS SUBMITTED FORM MBVS-3" AND CAN ONLY BE TESTED FROM REGISTERED SITES. Surveillance sites should be registered online at: **http://gateway.calsurv.org/.** Faxed registration forms (MBVS-1) will be accepted from agencies without adequate internet access.

   List the site code for each pool that consists of a designated four-letter agency code followed by four digits identifying the site, i.e., KERN0001. Keep the pool numbers in sequence for the whole year regardless of the number of site codes: e.g., pool #1 may be from KERN0001, and pool #2 may be from KERN0004.

4. Freeze pools immediately at -70°C either on dry ice in an insulated container or in an ultra-low temperature freezer. Pools should be shipped frozen on dry ice to CVEC for testing by real time multiplex RT-PCR. Pools received by noon on Wednesday will be tested and reported by Friday or sooner using the Gateway website and automated email notification, in addition to the routine reporting within the weekly Arbovirus Surveillance Bulletin. Each pool is screened for WNV, SLE, and WEE viruses by a multiplex assay, with positives confirmed by a singleplex RT-PCR. Pools from selected areas also are screened for additional viruses using Vero cell culture with isolates identified following sequencing.

Care must be taken not to allow pools to defrost during storage or shipment, because each freeze-thaw cycle may result in a 10-fold decrease in viral titer, and all virus will be lost if the specimens sit at room temperature for extended periods. Address shipment to: Center for Vectorborne Diseases, University of California, Old Davis Road, Davis CA 95616.

5. Local agencies that conduct their own testing by PCR or RAMP® tests need to complete and pass a proficiency panel each year for the results to be reported by CDPH.

Appendix C: Procedures for Maintaining and Bleeding Sentinel Chickens

1. Procure hens in March or when they become available as notified by CDPH when the chickens are 14-18 weeks of age to ensure minimal mortality during handling. Hens at this age have not yet begun to lay eggs, but they should have received all their vaccinations and been dewormed.
2. Ten sentinel chickens can be housed in a 3Wx6Lx3H ft coop framed with 2x2 and 2x4 inch construction lumber and screened with no smaller than 1x1 inch welded wire. It is critical that the wire mesh be large enough to allow the mosquitoes to easier enter the coop and the coops be placed in locations with a history of arbovirus transmission and/or high mosquito abundance. The site of and band numbers located at each coop must be registered online at: http://gateway.calsurv.org/. Faxed registration forms (MBVS-1) will be accepted from agencies without adequate internet access. Coops should be at least two feet off the ground to reduce predator access, facilitate capture of the birds for bleeding, and allow the free passage of the feces through the wire floor to the ground. A single, hinged door should be placed in the middle of the coop, so that the entire coop is accessible during chicken capture. After construction, the lumber and roof should be protected with water seal. A self-filling watering device should be fitted to one end of the coop and a 25 lb. feeder suspended in the center for easy access. In exchange for the eggs, a local person (usually the home owner, farm manager, etc.) should check the birds (especially the watering device) and remove the eggs daily. If hung so the bottom is about four inches above the cage floor and adjusted properly, the feeder should only have to be refilled weekly (i.e., 100 lb. of feed per month per flock of ten birds). Therefore, if proper arrangements can be made and an empty 55-gallon drum provided to store extra feed, sentinel flocks need only be visited bi-weekly when blood samples are collected.
3. Band each bird in the web of the wing using metal hog ear tags and appropriate pliers. This band number, the date, and site registration number must accompany each blood sample sent to the laboratory for testing.
4. Bleed each hen from the distal portion of the comb using a standard lancet used for human finger "prick" blood samples. The bird can be immobilized by wedging the wings between the bleeder's forearm and thigh, thereby leaving the hand free to hold the head by grabbing the base of the comb with the thumb and forefinger. Use alcohol swabs on comb before bleeding. Blood samples are collected on half-inch wide filter paper strips, which should be labeled with the date bled and wing band number. The comb should be "pricked" with the lancet and blood allowed to flow from the "wound" to form a drop. Collect the blood by touching the opposite end of the pre-labeled filter paper strip to the wound. THE BLOOD MUST COMPLETELY SOAK THROUGH ON A ¾ INCH LONG PORTION OF THE STRIP. Place the labeled end of the strip into the slot of the holder (or "jaws" of the clothes pin) leaving the blood soaked end exposed to air dry.
5. Attach the completely dry filter paper strips to a 5x7 card in sequential order, from left to right by stapling the labeled end towards the top edge of the card, and leaving the blood soaked end free so that the laboratory staff can readily remove a standard punch sample. Write the County, Agency Code, Site, and Date Bled onto the card and place it into a zip lock plastic bag. Do not put more than one sample card per bag. It is important that blooded ends do not become dirty, wet, or touch each other. VERY IMPORTANT: CHICKEN SERA MUST BE ACCOMPANIED BY SENTINEL CHICKEN BLOOD

FORM (MBVS- 2) OUTSIDE THE ZIP-LOCK BAG. Do not staple the form to the bag. Samples from each bleeding date then can be placed into a mailing envelope and sent to:

Department of Public Health, Richmond Campus
Specimen Receiving Unit Room B106 **(ATTN: ARBO)**
850 Marina Bay Parkway
Richmond, CA 94804

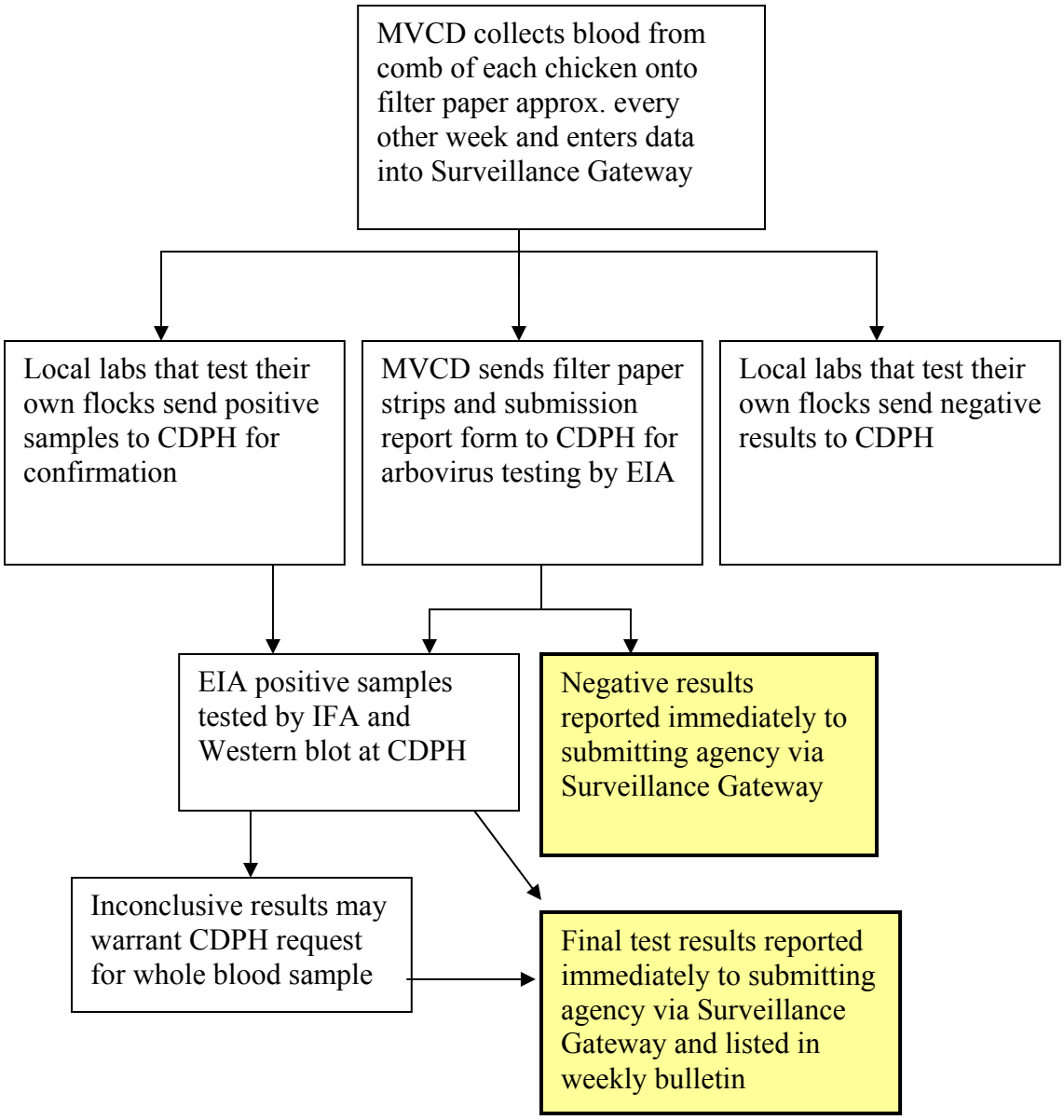
Specimens should be mailed to arrive no later than noon on Tuesdays for testing to begin that week.

6. In the laboratory, a single punch is removed from the blooded end of the paper and placed into one well of a 96-well plate with 150 µl of diluent. Specimens are allowed to soak for 2 hours on a rotator and the eluate is tested for WEE, SLE, and WNV IgG antibody using ELISA. Positive specimens are tested further with an indirect fluorescent antibody test and confirmed with a Western blot. Inconclusive SLE or WNV positives are confirmed and identified by cross-neutralization tests. Test results are made available online at: http://gateway.calsurv.org/.

Reference

Reisen, W.K. 1995. Guidelines for Surveillance and Control of Arboviral Encephalitis in California, In: Interagency Guidelines for the Surveillance and Control of Selected Vector-borne Pathogens in California, Mosquito and Vector Control Association of California, Sacramento.

California Procedure for Testing Sentinel Chickens for the Presence of Antibodies to Flaviviruses (SLE and WNV) and WEE



Key:

EIA:	Enzyme immunoassay test
IFA:	Indirect fluorescent antibody test
MVCD:	Local Mosquito and Vector Control District/Health Dept.
SLE:	St. Louis encephalitis
CDPH:	CDPH Vector-Borne Disease Section, Richmond
WEE:	Western equine encephalitis
WNV:	West Nile virus encephalitis

Surveillance for Mosquito-borne Viruses
Registration of Agencies and Sites

1. Participation of agencies

Agencies interested in participating in the statewide surveillance program for mosquito-borne viruses should place orders for mosquito pool testing by UC Davis Center for Vectorborne Diseases (CVEC) through the Mosquito and Vector Control Association (MVCAC). Sentinel chicken testing should be ordered through the California Department of Public Health (CDPH). Agencies will be billed in advance for the number of samples to be tested.

Agencies are responsible for registering their sites online at: http://gateway.calsurv.org/.

2. Registration of sentinel flock sites and wing band numbers

Agencies must use the unique band numbers assigned to their district by CDPH each year. Prior to submitting any sentinel chicken blood samples to CDPH, each agency must ensure that each flock site and accompanying band numbers are registered online at: http://gateway.calsurv.org/. CDPH will only test samples if they are accompanied by the form "SENTINEL CHICKEN BLOOD – 2010" (MBVS-2) for each flock site, which includes the registered agency code, the registered site code (assigned by local agency), the wing band numbers assigned to that site, and date bled. **Also, the form should indicate any changes made and match the sample card exactly.**

3. Registration of mosquito sampling sites

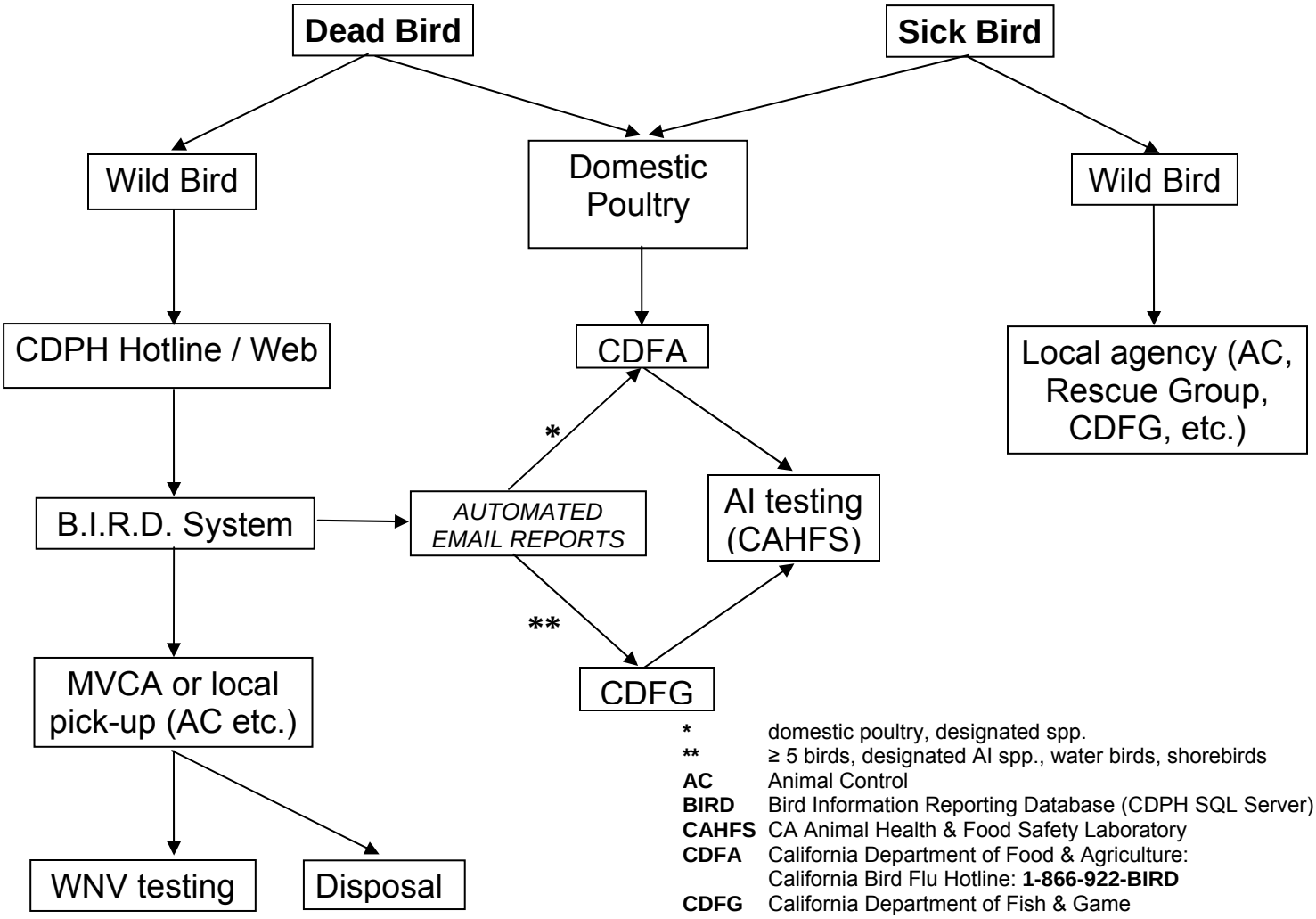
Registration of new sites used for collection of mosquitoes for virus testing may be accomplished by accessing the California Vectorborne Disease Surveillance Gateway http://gateway.calsurv.org/. Beginning in 2010, the CalSurv Gateway has enhanced spatial capabilities that allow users the option of directly entering geographic coordinates for sites or interactively selecting the location using a new Google Maps-based interface. The laboratory will test the pools provided that adequate information is provided on the "MOSQUITO POOL SUBMISSION" form (MBVS-3, revised 01/12/06), including your agency code, your site code for the site and geographic coordinates.

The geographic coordinates will be used to generate computer maps that show all registered sites and test results for each site. Also, as part of a collaborative effort, CVEC will host real-time maps in ArcGIS format at http://maps.calsurv.org. In addition to these maps, agencies can access maps using Google Earth through the California Vectorborne Disease Surveillance Gateway (http://gateway.calsurv.org) that provide enhanced functionality and detail.

Appendix D: Procedures for Testing Dead Birds and Squirrels

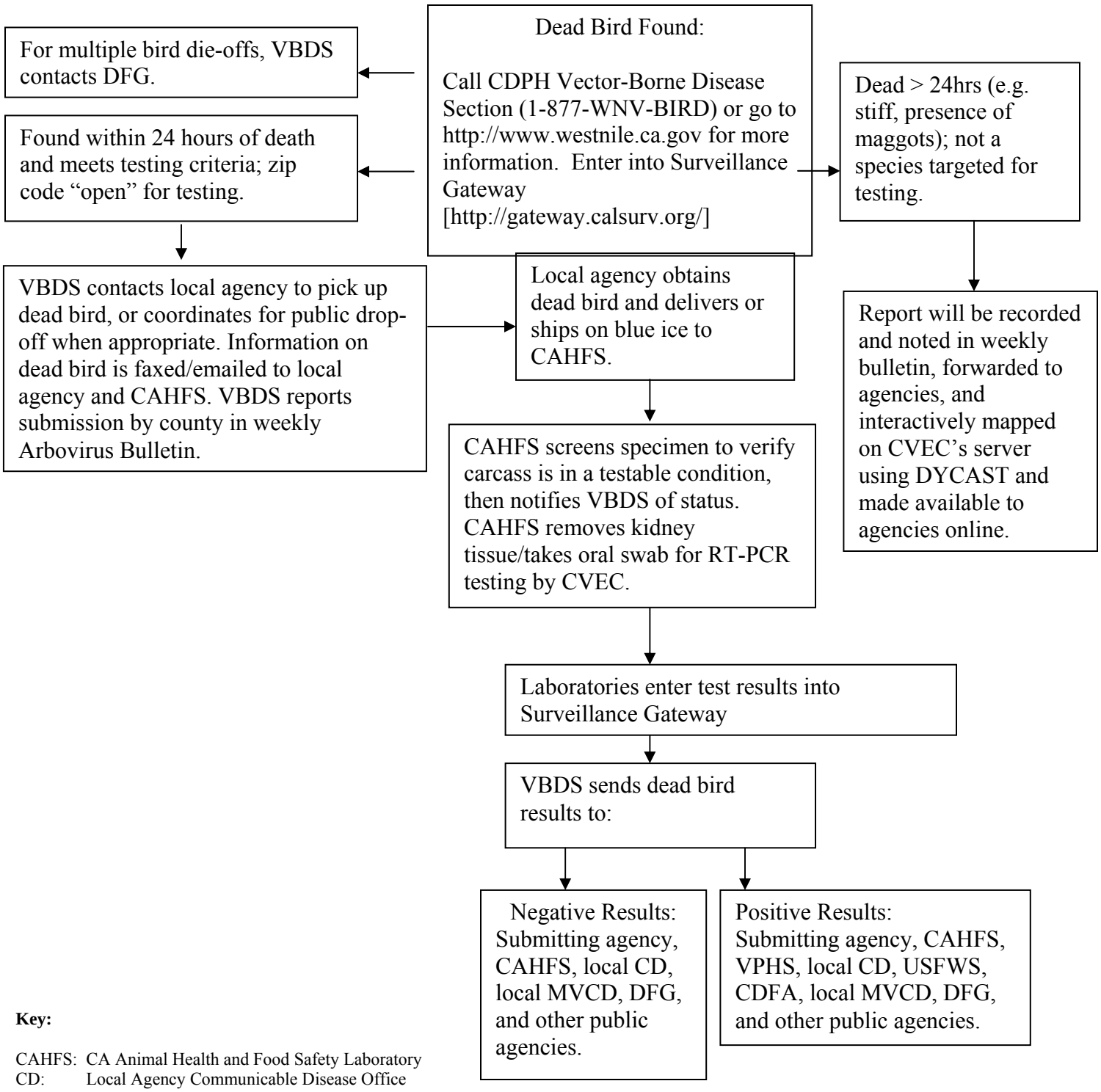
In 2000, CDHS initiated a dead bird surveillance program in collaboration with other public agencies. CDPH annually notifies about 600 agencies, organizations, and veterinarians involved with wildlife, including rehabilitation centers, about the program. The public is also notified about the program through the media and outreach materials. Dead birds and squirrels are reported to CDPH or data entered electronically through the Surveillance Gateway [http://gateway.calsurv.org/] and shipped to the California Animal Health & Food Safety (CAHFS) laboratory at UC Davis for screening and removal of kidney tissue (an oral swab is taken instead if the bird is an American Crow), which is then sent to the UC Davis Center for Vectorborne Diseases (CVEC) for WNV RNA detection via RT-PCR. Beginning in 2010, results from RT-PCR testing at CVEC will distinguish between birds that have been recently infected with WNV ("positive-recent") and those with older, chronic infections that are of limited value for surveillance ("positive-chronic") based on cycle threshold (Ct) values. Overviews of the dead bird reporting and testing algorithms are provided below.

Sick / Dead Bird Reporting Protocol for Public and Local Agencies



*	domestic poultry, designated spp.
**	≥ 5 birds, designated AI spp., water birds, shorebirds
AC	Animal Control
BIRD	Bird Information Reporting Database (CDPH SQL Server)
CAHFS	CA Animal Health & Food Safety Laboratory
CDFA	California Department of Food & Agriculture: California Bird Flu Hotline: **1-866-922-BIRD**
CDFG	California Department of Fish & Game http://www.dfg.ca.gov/regions/index.html
CDPH	California Department of Public Health West Nile virus & Dead Bird hotline: **1-877-968-BIRD** website: www.westnile.ca.gov
MVCA	Mosquito & Vector Control Agency

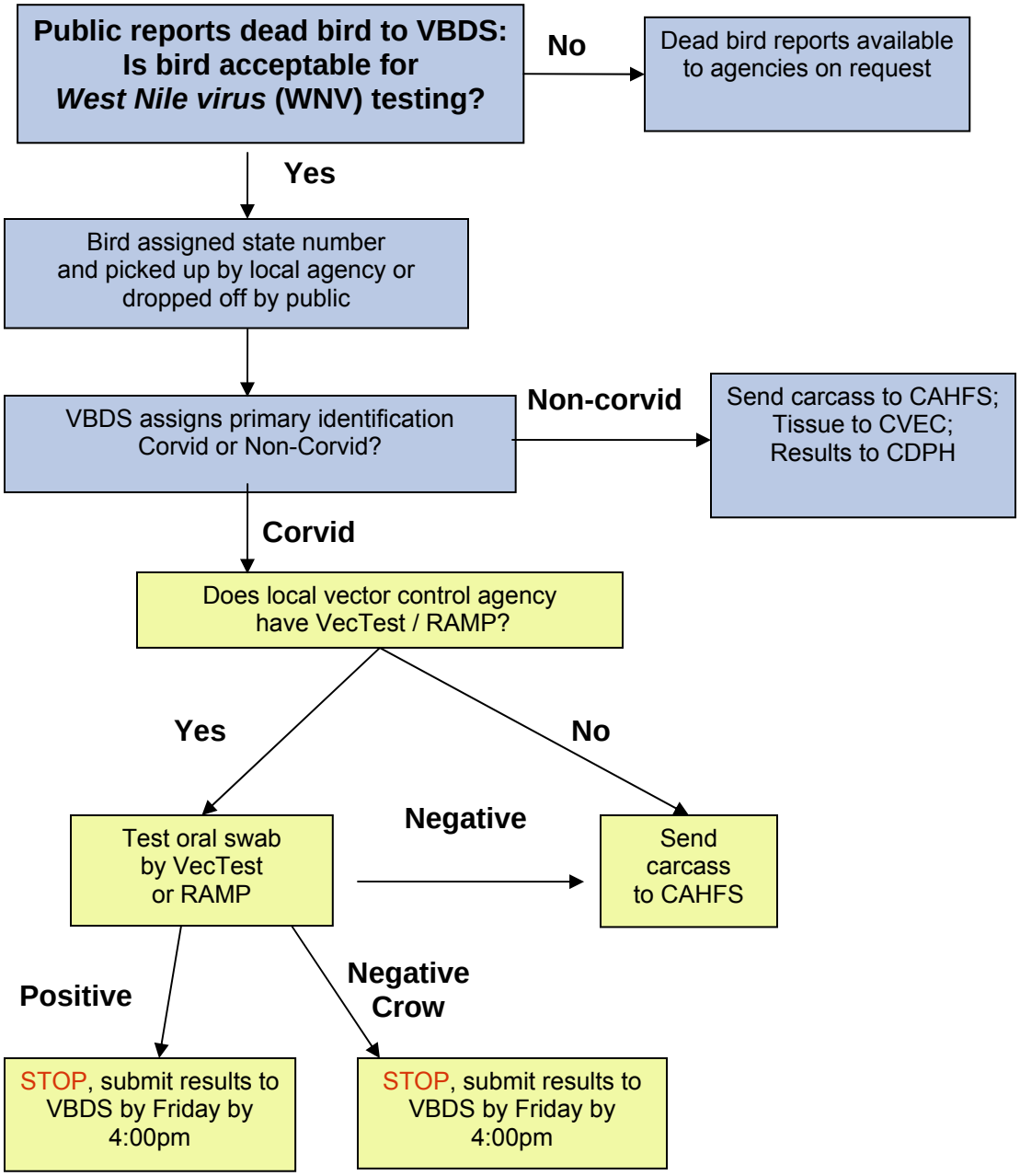
Procedures for Testing Dead Birds: RT-PCR



Key:

CAHFS: CA Animal Health and Food Safety Laboratory
CD: Local Agency Communicable Disease Office
CDFA: CA Dept. of Food and Agriculture
CVEC: UC Davis Center for Vectorborne Diseases
DFG: CA Dept. of Fish and Game
MVCD: Local Mosquito and Vector Control District
USFWS: US Fish and Wildlife Service
VBDS: CDHS Vector-Borne Disease Section, Richmond
VPHS: CDHS Veterinary Public Health Section, Sacramento
IHC: Immunohistochemistry

Procedures for Testing Dead Birds: Rapid Assays



CVEC = Center for Vectorborne Disease Research
VBDS = Vector-Borne Disease Section, California Department of Public Health
CAHFS = California Animal Health and Food Safety Laboratory

VBDS

Local Agencies

Dead Bird and Tree Squirrel Reporting and Submission Instructions for Local Agencies
California West Nile Virus (WNV) Dead Bird & Tree Squirrel Surveillance Program
California Department of Public Health (CDPH)
Division of Communicable Disease Control

When your agency receives a call from the public about a dead bird (especially recently dead crows, ravens, magpies, jays, or raptors) or dead tree squirrel, or one of your staff finds any dead bird, please immediately refer them to the **CDPH West Nile Virus and Dead Bird Hotline at 1-877-968-BIRD (2473)**.

The Dead Bird Hotline is monitored **8am - 5pm, 7 days a week.** CDPH will assess the suitability of the dead bird or tree squirrel for testing and contact your agency only if the carcass is approved for pickup. Any carcasses sent without prior notification will not be tested.

Only agencies listed under the permit issued to CDPH from the California Department of Fish & Game are authorized to pick up dead birds and tree squirrels. The agencies covered include local mosquito abatement districts, environmental health departments, and other designated agencies.

Members of the public may salvage dead birds found on their property or place of residence. **The public must first call the Dead Bird Hotline and obtain a Dead Bird Number**; a corresponding public salvage submission form will then be faxed to the appropriate agency. The public will be instructed by the hotline staff to double-bag the carcasses and drop them off at the designated agency within 24 hours, between 9 am - 3 pm, Monday – Friday, and **only in areas where local agencies are not picking up dead birds** (e.g., closed zip codes), unless otherwise requested by the local agency. **Note: only dead birds may be brought in by the public to local agencies for shipping. We discourage public salvage of all squirrels because ground squirrels, which could be infected with plague, may be misidentified as tree squirrels.**

***web links*:** bird and tree squirrel ID chart (pdf) tree squirrel surveillance Q&A (pdf)

Once the submission is approved, your agency can ship the carcass to the California Animal Health & Food Safety laboratory at UC Davis (CAHFS Central). CAHFS Central removes specific tissues and forwards the samples to the UC Davis Center for Vectorborne Diseases (CVEC) for WNV testing. Shipping and testing expenses will be paid by CDPH. Carcasses are considered **Category B, Biological Substances.** This replaces the old designation, "Diagnostic Specimen".

To ensure the carcass arrives at CAHFS in a testable condition, to protect your safety, and to comply with shipping regulations, please follow these instructions:

- Only dead birds and tree squirrels can be picked up under our permit.

- Wear rubber or latex gloves when handling all carcasses. If gloves are not available, use a plastic bag -- turned inside out -- over your hand and invert the bag to surround the carcass. Do not touch a carcass with bare hands.

- **Collect fresh carcasses.** Badly decomposed or scavenged carcasses are of limited diagnostic value. Signs that a bird or squirrel has been dead for too long (over 24-48 hours) are the presence of maggots, an extremely lightweight carcass, missing eyes, skin discoloration, skin or feathers that rub off easily, strong odor, or a soft, mushy carcass.

- **If upon pick-up the carcass is found to be unacceptable (e.g. a species your agency or CDPH is not accepting or a badly decomposed specimen), please collect the carcass, double-bag it, and dispose of it in a secure garbage can or dumpster.** California Department of Fish & Game prefers that you burn or bury the carcass, but disposing of it in a dumpster is also acceptable. **Please call CDPH immediately and notify us that the animal will no longer be submitted.**

- Place each carcass into two sealed (zip-locked) plastic bags. **Double-bagging prevents cross-contamination and leakage**. **There should always be two bags separating the carcass from shipping documents.**

- Enclose the shipping documents into a SEPARATE ZIP-LOCK BAG. The primary shipping document is a copy of the dead bird submission form which contains the dead bird number and which is located on the Surveillance Gateway [http://gateway.calsurv.org/] or faxed by CDPH. CAHFS prefers that you put this separate zip-lock bag inside the outer bag containing the dead bird or squirrel.

- **Pack the carcass with blue ice packs.** Please limit the number of ice packs to the number required to keep the carcass fresh, as the weight of extra ice packs add to the shipping charges. In accordance to shipping regulations, an absorbent material such as newspaper must be included in the box to prevent any leakage.

- Ship the carcass in a hard-sided plastic cooler or a styrofoam cooler placed in a cardboard box. Unprotected styrofoam containers cannot be shipped without an outer box or container, as they may break into pieces during shipment. **Contact UPS/GSO directly to arrange for carrier pickup Monday through Thursday; this guarantees arrival at CAHFS before the weekend.**

- Contact **UPS** to pick up carcasses either by web (https://wwwapps.ups.com/pickup/schedule?loc=en_US) or by phone **1-800-PICK UPS** (1-800-742-5877)**. Select "UPS Next Day Air"** and **estimate the weight of the box** (generally 10 lbs for a single large bird packed with ice). Please DO NOT UNDER-ESTIMATE the weight of a package. For billing, the **UPS account number is: 48R89V.**

- Carcasses that need to be stored for an extended time period (over 2 days) should be put on dry ice or stored at -70ºC. If it is not possible to store carcass at -70ºC, a carcass may be stored at 0ºC (regular freezer) for a short period of time. **Refrigerating** the carcass is recommended for **overnight storage only** (this slows virus deterioration, but does not stop it).

- CDPH will provide prepared shipping boxes with appropriate labels. Any empty boxes shipped to your agency from CDPH will have its caution labels covered by a sheet of paper with "EMPTY BOX" printed on it. Please discard this sheet of paper before using the box to ship out a dead bird. If you need additional boxes, please contact VBDS at (510) 412-6251 or email arbovirus@cdph.ca.gov.

- Once West Nile virus is found in an area, agencies may test corvids via VecTest or RAMP assays. While results can be entered directly into the Surveillance Gateway, please **notify CDPH with results by 4:00pm Friday of each week to have results included in reports for the following week's State WNV updates.** Reporting forms can be found at (http://www.westnile.ca.gov/resources.php). **Note: any positive bird must be disposed of as biomedical waste (incineration).**

Dead Bird Shipping List

Please verify that your agency has the following items:

- CAHFS Address (see below)
- UPS preprinted labels
- WNV hotline number (877-968-BIRD; manned 8am - 5pm, 7 days a week)
- Crumpled newspapers or another absorbent material
- Rubber or Latex Gloves
- Packing tape
- Dead Bird Shipping Boxes
  - inner zip-lock bag
  - outer zip-lock bag
  - inner styrofoam box
  - outer cardboard box
  - blue ice packs

California Animal Health & Food Safety (CAHFS) laboratories:

CAHFS Central (530) 754-7372
ATTN: WNV
Jacquelyn Parker
University of California, Davis
West Health Science Drive
Davis, CA 95616

Appendix E: Procedures for Testing Equines and Ratites

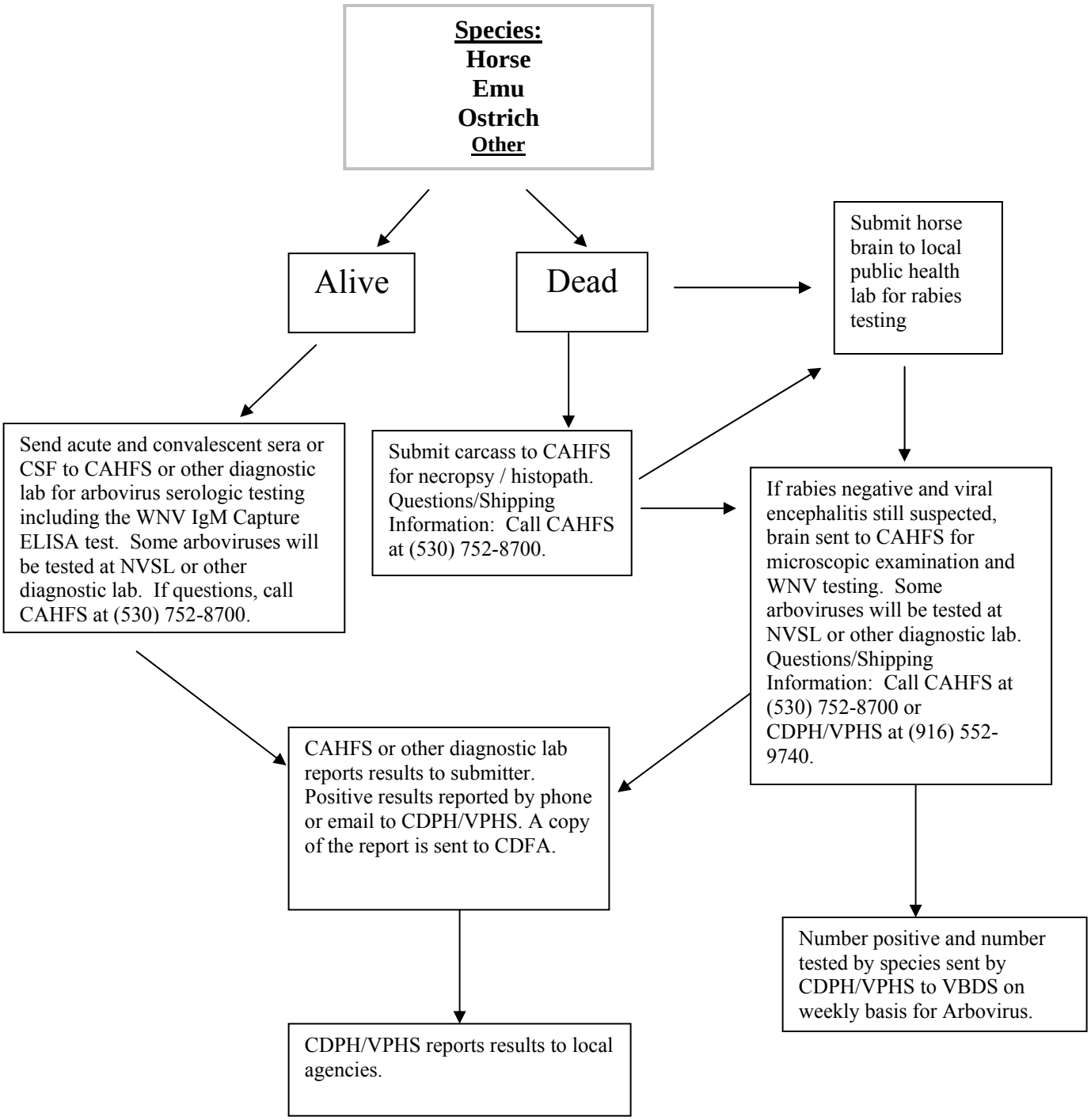
Effective June 1, 2009, the responsibility for equine and ratite West Nile Virus (WNV) surveillance was assumed by The California Department of Public Health (CDPH). The Department of Food and Agriculture (CDFA) was previously the lead agency for WNV surveillance. CDPH and CDFA developed a well-established passive surveillance program for equine and ratite encephalomyelitis. Equine encephalomyelitides are legally reportable to CDFA by veterinarians and diagnostic laboratories pursuant to Section 9101 of the Food and Agricultural Code. Venezuelan equine encephalitis is an emergency animal disease that must be reported to CDFA by telephone within 24 hours. Eastern and Western Encephalomyelitis and West Nile virus (WNV) are a classified as conditions of regulatory importance and must be reported to CDFA within 2 days.

This appendix contains information sent to veterinarians, public health lab directors, local health officers, public health veterinarians, animal health branch personnel, and interested parties every spring to inform them about the California Equine and Ratite Arbovirus Surveillance Program. The mailing includes a case definition for equine encephalomyelitides and instructions for specimen collection and submission for both equine and ratite samples. The information is distributed to approximately 1,200 practitioners, equine organizations, and other interested parties. Specimen submission is coordinated through the California Animal Health and Food Safety Laboratory System's (CAHFS) and its 3 regional branches, and other laboratories or individual veterinarians. Equine WNV serum and cerebrospinal fluid testing is performed by CAHFS, using the ELISA test for WNV IgM. Equine neurologic tissue specimens are also sent to CAHFS for microscopic examination and as dictated by clinical findings, forwarded to the National Veterinary Services Laboratories (NVSL) for further arbovirus testing. All fatal cases of equine encephalitides are first rabies ruled out at the local public health laboratory. An algorithm outlining the protocol for specimen submission and reporting is available for participants in the program and is included in this appendix.

Outreach is an important component of the program. CDPH and CDFA have developed and distributed educational materials concerning the diagnosis and reporting of arboviruses in equines and ratites.

Additional information on WNV for veterinarians, horse owners, and ratite owners, is available from CDFA, Animal Health Branch (916) 654-1447, and at the CDFA website: http://www.cdfa.ca.gov/AHFSS/Animal_Health/WNV_Info.html. Information on submission of laboratory samples is available from CAHFS (530) 752-8700 and at CAHFS website: http://cahfs.ucdavis.edu. A brochure containing facts about California WNV surveillance and general information about prevention and control is available from CDPH (916) 552-9730 and at CDPH's website: http://www.westnile.ca.gov; a special section for veterinarians and horse owners is available at: http://www.westnile.ca.gov/resources.php.

Algorithm for Submission of Specimens from Domestic Animals with Neurologic Symptoms



Key:
CAHFS: California Animal Health and Food Safety Laboratory
NVSL: National Veterinary Services Laboratory
VPHS: CDPH Veterinary Public Health Section
VBDS: CDPH Vector-Borne Disease Section
CDFA: California Department of Food and Agriculture
CDPH: California Department of Public Health

SURVEILLANCE CASE DEFINITIONS FOR WEST NILE VIRUS DISEASE IN EQUINES

NOTE: A HORSE WITH SIGNS OF ENCEPHALITIS MAY HAVE RABIES – TAKE PROPER PRECAUTIONS

CONFIRMED CLINICAL CASE:

A horse with compatible clinical signs including ataxia (stumbling, staggering, wobbly gait, or in-coordination) or at least two of the following: fever, circling, hind limb weakness, inability to stand, multiple limb paralysis, muscle fasciculation, proprioceptive deficits, blindness, lip droop/paralysis, teeth grinding, acute death.

Plus one or more of the following:

- Isolation of West Nile (WNV) virus from tissues[1]
- Detection of IgM antibody to WNV by IgM-capture ELISA in serum or CSF
- An associated 4-fold or greater change in plaque-reduction neutralization test (PRNT) antibody titer to WNV in appropriately timed[2], paired sera
- Positive polymerase chain reaction (PCR)[3] for WNV genomic sequences in tissues[1]
- Positive IHC for WNV antigen in tissue (Note: this test has low sensitivity in equids)

SUSPECT CLINICAL CASE[4]:

- Compatible clinical signs

EXPOSED EQUID:

- Detection of IgM antibody to WNV by IgM-capture ELISA in serum or CSF without any observable or noted clinical signs.

Assumptions on which case definition is based:

- Antibody in serum may be due to vaccination or a natural exposure; additional testing must be done to confirm WNV infection in a vaccinated horse.
- IgM antibody in equine serum is relatively short-lived; a positive IgM-capture ELISA means exposure to WNV or rarely a closely related flavivirus (SLE) has occurred, very likely within the last three months.

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[1] Preferred diagnostic tissue are equine brain or spinal cord; although tissues may include blood or CSF, the only known reports of WNV isolation or positive PCR from equine blood or CSF have been related to experimentally infected animals.

[2] The first serum should be drawn as soon as possible after onset of clinical signs and the second drawn at least seven days after the first.

[3] For horses it is recommended that RT-nested polymerase chain reaction assay be used to maximize sensitivity of the test (Emerg. Infect. Dis. 2001 Jul-Aug; 7(4):739-41)

[4] An equine case classified as a suspect case should, if possible, undergo further diagnostic testing to confirm or rule out WNV as the cause of the clinical illness.

Protocol for Submission of Laboratory Specimens for Equine Neurological Disease Diagnosis and Surveillance

Complete information on specimen collection and submission is available on the CDFA website at: http://www.cdfa.ca.gov/ahfss/Animal_Health/WNV_Lab_Submission.html

1. Specimen collection and submission:

A. Blood

- Acute sample (5-10 ml) / no later than 7 days after onset
- Convalescent sample (5-10 ml) / 14-21 days after onset
  Red top tubes of whole blood or serum (no preservatives or anticoagulants) should be submitted at ambient temperature to the California Animal Health and Food Safety (CAHFS) Laboratory* in your area. Do not freeze whole blood.
- **NOTE**: For WNV, an acute sample only is required since the assay used detects IgM (and vaccine does not interfere). For the other encephalitis viruses, the acute sample should be submitted immediately, and a convalescent sample may be requested later to assist with the interpretation and differentiation of vaccine titers from active infection.

B. Brain

- The local health department and CDFA/Animal Health District Office should be contacted if rabies is suspected.
- All equine specimens submitted to local public health laboratories for rabies testing and found to be negative, should be sent to CAHFS for arbovirus testing.
- Submission of the intact head is preferable because: 1) brain is better preserved (anatomically and virus titer) when left in the skull during transport, 2) specimens will be ruined if removal is not done correctly, and 3) brain removal in field conditions may increase the risk of exposure to rabies.
- **The intact head should be chilled (refrigerated, *not* frozen) immediately after removal. Submit it to a CAHFS Laboratory* in your area as quickly as possible.** Prepare a leak-proof insulated transporting container with "cold packs" to keep the specimen at 4^{o} C while in transit. *When it is impossible for the CAHFS Laboratory to receive the chilled intact head within 48 hours, the submission protocol should be coordinated with the laboratory.*
- Specimens will then be forwarded by CAHFS to: 1) a Public Health Laboratory to confirm or rule out rabies, and 2) The National Veterinary Services Laboratories (NVSL) for arboviral testing. *In addition, brain will be examined microscopically for changes compatible with viral encephalitis or other causes of neurologic disease.*

C. Other specimens for differential neurological diagnoses

- Protocol for submission of serum, CSF or carcasses may be coordinated through CAHFS*. Protocol for submission of these specimens may be coordinated through the CAHFS Laboratory, and may include sampling for

equine herpesvirus, EPM, or other agents associated with clinical neurological presentations.

2. **Submission forms**: Complete and include the transmittal forms supplied by CAHFS. Call 530-752-8700 or visit the CAHFS website at http://cahfs.ucdavis.edu. The submittal form for each specimen should be placed in a leak-proof plastic bag. The specimen is collected in a leak proof plastic tube or bag and then placed in to a secondary leak proof plastic bag. The submission form is then attached to the corresponding container and shipped to CAHFS.
3. **Shipment:** Check with the CAHFS Laboratory in your area for assistance with shipping regulations governing the transportation of infectious materials.

Appendix F: Protocol for Submission of Laboratory Specimens for Human West Nile Virus Testing

West Nile virus (WNV) testing within the regional public health laboratory network (i.e., the California Department of Public Health Viral and Rickettsial Disease Laboratory and participating local public health laboratories) is recommended for individuals with the following symptoms, particularly during West Nile virus "season," which typically occurs from July through October in California:

A. Encephalitis
B. Aseptic meningitis (Note: Consider enterovirus for individuals ≤ 18 years of age)
C. Acute flaccid paralysis; atypical Guillain-Barré Syndrome; transverse myelitis; or
D. Febrile illness*
   - Illness compatible with West Nile fever and lasting ≥ 7 days
   - Must be seen by a health care provider

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* The West Nile fever syndrome can be variable and often includes headache and fever (T ≥ 38°C). Other symptoms include rash, swollen lymph nodes, eye pain, nausea, or vomiting. After initial symptoms, the patient may experience several days of fatigue and lethargy.

Required specimens:

- Acute serum: ≥ 2cc serum
- Cerebral spinal fluid (CSF): 1-2cc CSF <u>if lumbar puncture is performed</u>

If West Nile virus is highly suspected and acute serum is negative or inconclusive, request:

- 2^{nd} serum: ≥ 2cc serum collected 3-5 days after acute serum

Contact your local health department for instructions on where to send specimens.

Appendix G: Surveillance Case Definition for West Nile Virus Infection in Humans

West Nile virus infection (neuroinvasive disease, fever, and asymptomatic infection) is reportable to CDPH under Title 17 of the California Code of Regulations. Below is the summary statement by the Council of State and Territorial Epidemiologists (available at http://www.cste.org/ps/2004pdf/04-ID-01-final.pdf) including the case definition for West Nile neuroinvasive disease, followed by the case definitions for West Nile fever and asymptomatic West Nile virus infection.

CASE DEFINITION: Neurotropic Domestic Arboviral Diseases

Clinical description

Arboviral infections may be asymptomatic or may result in febrile illnesses of variable severity sometimes associated with central nervous system (CNS) involvement. When the CNS is affected, clinical syndromes include aseptic meningitis, myelitis and encephalitis, which are clinically indistinguishable from similar syndromes caused by other viruses. Arboviral meningitis is usually characterized by fever, headache, stiff neck, and pleocytosis in cerebrospinal fluid. Arboviral myelitis is usually characterized by fever and acute limb paresis or flaccid paralysis.
Arboviral encephalitis is usually characterized by fever, headache, and altered mental status ranging from confusion to coma with or without additional signs of brain dysfunction. Less common neurological syndromes can include cranial and peripheral neuritis/neuropathies, including Guillain-Barré syndrome.

Non-neuroinvasive syndromes caused by these usually neurotropic arboviruses can rarely include myocarditis, pancreatitis, or hepatitis. In addition, they may cause febrile illnesses (e.g.,West Nile fever [WNF]) that are non-localized, self-limited illnesses with headache, myalgias, arthralgias, and sometimes accompanied by skin rash or lymphadenopathy. Laboratory-confirmed arboviral illnesses lacking documented fever can occur, and overlap among the various clinical syndromes is common.

Clinical criteria for diagnosis

Cases of arboviral disease are classified either as neuroinvasive or non-neuroinvasive, according to the following criteria:

Neuroinvasive disease requires the presence of fever and at least one of the following, as documented by a physician and in the absence of a more likely clinical explanation:

- Acutely altered mental status (e.g., disorientation, obtundation, stupor, or coma), or
- Other acute signs of central or peripheral neurologic dysfunction (e.g., paresis or paralysis, nerve palsies, sensory deficits, abnormal reflexes, generalized convulsions, or abnormal movements)

- Pleocytosis (increased white blood cell concentration in cerebrospinal fluid [CSF]) associated with illness clinically compatible with meningitis (e.g., headache or stiff neck)

Non-neuroinvasive disease requires, at minimum, the presence of documented fever, as measured by the patient or clinician, the absence of neuroinvasive disease (above), and the absence of a more likely clinical explanation for the illness. Involvement of non-neurological organs (e.g., heart, pancreas, liver) should be documented using standard clinico-laboratory criteria.

Laboratory criteria for diagnosis
Cases of arboviral disease are also classified either as confirmed or probable, according to the following laboratory criteria:

Confirmed case:
• Fourfold or greater change in virus-specific serum antibody titer, or
• Isolation of virus from or demonstration of specific viral antigen or genomic sequences in tissue, blood, CSF, or other body fluid, or
• Virus-specific immunoglobulin M (IgM) antibodies demonstrated in CSF by antibody-capture enzyme immunoassay (EIA), or
• Virus-specific IgM antibodies demonstrated in serum by antibody-capture EIA and confirmed by demonstration of virus-specific serum immunoglobulin G (IgG) antibodies in the same or a later specimen by another serologic assay (e.g., neutralization or hemagglutination inhibition).

Probable case:
• A single or stable (less than or equal to a twofold change) but elevated titer of virus-specific serum antibodies, or
• Serum IgM antibodies detected by antibody-capture EIA but with no available results of a confirmatory test for virus-specific serum IgG antibodies in the same or a later specimen.

Case definition: A case must meet one or more of the above clinical criteria and one or more of the above laboratory criteria.

Comment
Because closely related arboviruses exhibit serologic cross-reactivity, positive results of serologic tests using antigens from a single arbovirus can be misleading. In some circumstances (e.g., in areas where two or more closely related arboviruses occur, or in imported arboviral disease cases), it may be epidemiologically important to attempt to pinpoint the infecting virus by conducting cross-neutralization tests using an appropriate battery of closely related viruses. This is essential, for example, in determining that antibodies detected against St. Louis encephalitis virus are not the result of an infection with West Nile (or dengue) virus, or vice versa, in areas where both of these viruses occur. Because dengue fever and West Nile fever can be clinically indistinguishable, the importance of a recent travel history and appropriate serologic testing cannot be overemphasized. In some persons, West Nile virus-specific serum IgM antibody can wane slowly and be detectable for more than one year following infection. Therefore, in areas where West Nile virus has circulated in the recent past, the co-existence of West Nile virus-specific IgM antibody and illness in a given case may be coincidental and

unrelated. In those areas, the testing of serially collected serum specimens assumes added importance.
The seasonality of arboviral transmission is variable and depends on the geographic location of exposure, the specific cycles of viral transmission, and local climatic conditions. Reporting should be etiology-specific (see below; the six diseases printed in bold are nationally reportable to CDC):

- **St. Louis encephalitis virus disease**
- **West Nile virus disease**
- **Powassan virus disease**
- **Eastern equine encephalitis virus disease**
- **Western equine virus disease**
- **California serogroup virus disease** (includes infections with the following viruses: La Crosse, Jamestown Canyon, snowshoe hare, trivittatus, Keystone, and California encephalitis viruses)

West Nile Fever: West Nile fever is reportable in California. The following definition is used: West Nile fever syndrome can be variable and often includes headache and fever (T≥38˚C or 100.4˚F). Other symptoms include rash, swollen lymph nodes, eye pain, nausea or vomiting. After initial symptoms, the patient may experience several days of fatigue and lethargy. For the purposes of surveillance, an individual is considered to be a West Nile fever case if he or she has a febrile illness compatible with West Nile fever, and laboratory confirmation (as described above).

Asymptomatic West Nile Virus Infection: Asymptomatic infection with WNV, which is generally identified in blood donors, is also reportable. WNV-positive blood donors detected by blood banks are reported directly to local health departments. Blood donors who test positive for WNV may not necessarily be ill, nor will they initially have positive IgM or IgG antibody test results. Local health departments should report blood donors who meet the following criteria for being a presumptively viremic donor to CDPH:

A presumptively viremic donor (PVD) is a person with a blood donation that meets at least one of the following criteria:

a) One reactive nucleic acid-amplification (NAT) test with signal-to-cutoff (S/CO) ≥ 17
b) Two reactive NATs

Additional serological testing is not required. Local health departments should follow up with the donor after two weeks of the date of donation to assess if the patient subsequently became ill. If the donor did become ill as a result of WNV infection, an updated case report form should be sent to VRDL so that the blood donor may be reclassified as a clinical case.

Note: Due to the continued risk of unintentional or intentional introduction of exotic arboviruses into the United States (e.g., Venezuelan equine encephalitis virus), or the reemergence of indigenous epidemic arboviruses (e.g., St. Louis encephalitis and western equine encephalitis viruses), physicians and local public health officials should maintain a high index of clinical suspicion for cases of potential exotic or unusual arboviral etiology, and consider early consultation with arboviral disease experts at state health departments and CDC.

Appendix H: Compounds Approved for Mosquito Control in California

Label rates and usage vary from year to year and geographically; consult your County Agricultural Commissioner and the California Department of Fish and Game before application. Examples of products containing specific active ingredients are provided below, but this is not an inclusive list nor constitutes product endorsement. For more information on pesticides and mosquito control, please refer to the Environmental Protection Agency (EPA) Web site:
http://www.epa.gov/opp00001/factsheets/westnile.htm

Larvicides:

1. *Bacillus thuringiensis* subspecies *israelensis* (Bti: e.g. Aquabac 200G, VectoBac® 12AS, Teknar HP-D)
   Use: Approved for most permanent and temporary bodies of water.
   Limitations: Only works on actively feeding stages. Does not persist well in the water column.

2. *Bacillus sphaericus* (Bs: e.g. VectoLex® CG)
   Use: Approved for most permanent and temporary bodies of water.
   Limitations: Only works on actively feeding stages. Does not work well on all species. May persist and have residual activity in some sites.

3. IGRs (Insect Growth Regulators)
   a. (S)-Methoprene (e.g. Altosid® Pellets)
   Use: Approved for most permanent and temporary bodies of water.
   Limitations: Works best on older instars. Some populations of mosquitoes may show some resistance.
   b. Diflurobenzamide (e.g. Dimilin®25W)
   Use: Impounded tail water, sewage effluent, urban drains and catch basins.
   Limitations: Cannot be applied to wetlands, crops, or near estuaries.

4. Larviciding oils (e.g. Mosquito Larvicide GB-1111)
   Use: Ditches, dairy lagoons, floodwater. Effective against all stages, including pupae.
   Limitations: Consult with the California Department of Fish and Game for local restrictions.

5. Monomolecular films (e.g. Agnique® MMF)
   Use: Most standing water including certain crops.
   Limitations: Does not work well in areas with unidirectional winds in excess of ten mph.

6. Temephos (e.g. Abate® 2-BG)
   Use: Non-potable water; marshes; polluted water sites
   Limitations: Cannot be applied to crops for food, forage, or pasture. This material is an organophosphate compound and may not be effective on some *Culex tarsalis* populations in the Central Valley.

Adulticides:

1. Organophosphate compounds
   Note: Many *Culex tarsalis* populations in the Central Valley are resistant at label OP application rates.
   a. Malathion (e.g. Fyfanon® ULV)
      Use: May be applied by air or ground equipment over urban areas, some crops including rice, wetlands.
      Limitations: Paint damage to cars; toxic to fish, wildlife and bees; crop residue limitations restrict application before harvest.
   b. Naled (e.g. Dibrom® Concentrate, Trumpet® EC)
      Use: Air or ground application on fodder crops, swamps, floodwater, residential areas.
      Limitations: Similar to malathion.

2. Pyrethrins (natural pyrethrin products: e.g. Pyrenone® Crop Spray, Pyrenone® 25-5, Evergreen)
   Use: Wetlands, floodwater, residential areas, some crops.
   Limitations: Do not apply to drinking water, milking areas; may be toxic to bees, fish, and some wildlife. Some formulations with synergists have greater limitations.

3. Pyrethroids (synthetic pyrethrin products containing deltamethrin, cyfluthrin, permethrin, resmethrin, sumithrin or etofenprox: e.g. Suspend® SC, Tempo Ultra SC, Aqua-Reslin®, Scourge® Insecticide, Anvil® 10+10 ULV, Zenivex E20, and Duet – which also contains the mosquito exciter prallethrin)
   Use: All non-crop areas including wetlands and floodwater.
   Limitations: May be toxic to bees, fish, and some wildlife; avoid treating food crops, drinking water or milk production.

PESTICIDES USED FOR MOSQUITO CONTROL IN CALIFORNIA

Larvicides

Active Ingredient	Trade name	EPA Reg. No.	Mfgr.	Formulation	Application	Pesticide classification
Bacillus sphaericus, (Bs)	VectoLex CG	73049-20	Valent BioSciences	Granule	Larvae	Biorational
Bacillus sphaericus, (Bs)	VectoLex WDG	73049-57	Valent BioSciences	Water dispersible granule	Larvae	Biorational
Bacillus sphaericus, (Bs)	VectoLex WSP	73049-20	Valent BioSciences	Water soluble packet	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	VectoBac 12AS	73049-38	Valent BioSciences	Liquid	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	VectoBac G	73049-10	Valent BioSciences	Granule	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	VectoBac Tech. Powder	73049-13	Valent BioSciences	Technical powder	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	Aquabac 200G	62637-3	Becker Microbial	Granule	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	Bactimos PT	73049-452	Valent BioSciences	Granular flake	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	Teknar HP-D	73049-404	Valent BioSciences	Liquid	Larvae	Biorational
Monomolecular film	Agnique MMF	53263-28	Cognis Corp.	Liquid	Larvae and pupae	Surface film
Monomolecular film	Agnique MMF - G	53263-30	Cognis Corp.	Granular	Larvae and pupae	Surface film
Petroleum oil	GB-1111	8329-72	Clarke	Liquid	Larvae and pupae	Surface film
Dimilin	Dimilin 25W	400-465	Uniroyal Chemical	Wettable powder	Larvae	IGR
S-Methoprene	Altosid ALL	2724-446	Wellmark-Zoecon	Liquid concentrate	Larvae	IGR
S-methoprene	Altosid Briquets	2724-375	Wellmark-Zoecon	Briquet	Larvae	IGR
S-methoprene	Altosid Pellets	2724-448	Wellmark-Zoecon	Pellet-type granules	Larvae	IGR
S-methoprene	Altosid SBG	2724-489	Wellmark-Zoecon	Granule	Larvae	IGR
S-methoprene	Altosid XR-G	2724-451	Wellmark-Zoecon	Briquet	Larvae	IGR
Temephos	Abate 2-BG	8329-71	Clarke	Granule	Larvae	OP
Temephos	5% Skeeter Abate	8329-70	Clarke	Granule	Larvae	OP

PESTICIDES USED FOR MOSQUITO CONTROL IN CALIFORNIA

Adulticides

Active Ingredient	Trade name	EPA Reg. No.	Mfgr.	Formulation	Application	Pesticide classification
Malathion	Fyfanon® ULV	67760-34	Cheminova	Liquid	Adults	OP
Naled	Dibrom® Concentrate	5481-480	AMVAC	Liquid	Adults	OP
Naled	Trumpet™ EC	5481-481	AMVAC	Liquid	Adults	OP
Prallethrin	Duet Dual Action Adulticide	1021-1795	Clarke	Liquid	Adults	Pyrethroid
Deltamethrin	Suspend® SC	432-763	Aventis	Liquid	Adults	Pyrethroid
Cyfluthrin	Tempo SC Ultra	432-1363	Bayer	Liquid	Adults	Pyrethroid
Permethrin	Aqua-Reslin®	432-796	Bayer	Liquid	Adults	Pyrethroid
Permethrin	Biomist® 4+12 ULV	8329-34	Clarke	Liquid	Adults	Pyrethroid
Permethrin	Permanone® Ready-To-Use	432-1277	Bayer	Liquid	Adults	Pyrethroid
Pyrethrins	Pyrenone® 25-5	432-1050	Bayer	Liquid	Adults	Pyrethroid
Pyrethrins	Pyrenone® Crop Spray	432-1033	Bayer	Liquid	Adults	Pyrethroid
Pyrethrins	Pyrocide® 7396	1021-1569	MGK	Liquid	Adults	Pyrethroid
Resmethrin	Scourge® Insecticide (4%)	432-716	Bayer	Liquid	Adults	Pyrethroid
Resmethrin	Scourge® Insecticide (18%)	432-667	Bayer	Liquid	Adults	Pyrethroid
Sumithrin	Anvil® 10+10 ULV	1021-1688	Clarke	Liquid	Adults	Pyrethroid
Etofenprox	Zenivex E20	2724-791	Wellmark, Intl.	Liquid	Adults	Pyrethroid
Lambda-cyhalothrin	Demand CS	100-1066	Syngenta	Liquid	Adults	Pryethroid

Appendix I: Adult Mosquito Control in Urban Areas

Adult mosquito control via ultra low volume (ULV) application is an integral part of an integrated mosquito management program. This response plan recommends the consideration of adult mosquito control to break local virus transmission cycles and reduce the risk of human infection. The following provides guidelines for local agencies considering ground or aerial ULV control of adult mosquitoes.

Preparatory steps for aerial application contracts

- Send out request for proposals (RFP) to commercial applicators well in advance of any potential need for actual treatment. Specify required equipment and abilities in the RFP such as: 1) application equipment capable of producing desired droplet spectrum and application rate, 2) aircraft availability time frames, and 3) the demonstrated ability to apply the chosen product to the target area in accordance with label requirements.
- Outline the desired capabilities and equipment within the RFP such as: 1) onboard real time weather systems, and 2) advanced onboard drift optimization and guidance software.
- Determine in advance whether the vector control agency or contractor will secure and provide pesticides. If the contractor will supply the pesticide, verify their knowledge of and ability to comply with regulations regarding the transport, use, and disposal of all pesticide and containers.
- Enter into a contingency contract with the commercial applicator.
- Consider acquiring non-owned, multiple engine aircraft insurance with urban application endorsement for added protection.
- Determine product and application rate to be used, along with a contingency plan. The product choice may be subject to change depending on product availability, the determination of resistance, labeling restrictions, environmental conditions, or other unforeseen factors.

Preparatory steps for ground-based applications

- Ensure that application equipment has been properly calibrated and tested for droplet size and flow rate. The vector control agency should have enough equipment, operators, and product available to finish the desired application(s) between sunset and midnight, or within 2-3 hours pre-sunrise (or when mosquitoes are demonstrated to be most active) to maximize efficacy.
- Ensure that vehicles are equipped with safety lighting and appropriate identifying signs; use sufficient personnel.
- Contact local law enforcement and provide them with locations to be treated and approximate time frames.
- Consider using lead and trailing vehicles particularly if the area has not been treated before and personnel are available.

Implementing an aerial application contract

- Contact commercial applicator and determine availability.

- Review long-term weather forecasts. Ideally applications should be scheduled during periods of mild winds to avoid last minute cancellations.

  Contractor should:

  - Contact Local Flight Standards District Office (FSDO) for low flying waiver.
  - Arrange for suitable airport facilities.
  - Contact local air traffic control.
  - Locate potential hazards prior to any application and implement a strategy to avoid those hazards during the application – often in darkness.
  - Provide equipment and personnel for mixing and loading of material (if previously agreed upon in contract).
  - Register with applicable County Agricultural Commissioners office.

  Vector control agency should:

  - Delineate treatment block in a GIS format and send to contractor.
  - Identify areas that must be avoided during an application and include detailed maps of those areas to contract applicators (e.g. open water, registered organic farms, any area excluded by product label).
  - Send authorization letter to FSDO authorizing contractor to fly on the agency's behalf; contractor should provide contact information and assistance.
  - Send map of application area and flight times / dates to local air traffic control; contractor should provide contact information and assistance.
  - Consult with County Agricultural Commissioners office. Commissioner's office can provide guidance on contacting registered bee keepers and help identify any registered organic farms that may need to be excluded from application.
  - If vector control agency is providing material, ensure adequate quantity to complete mission and that the agency has means to transport material.

Efficacy evaluation for aerial or ground based application

- Choose appropriate method(s) for evaluating efficacy of application
  - Determine changes in adult mosquito population via routine surveillance.
  - Conduct three day pre and post-trapping in all treatment and control areas.
  - Set out bioassay cages with wild caught and laboratory reared (susceptible) mosquitoes during application.
- Ensure adequate planning so surveillance staff is available and trained, equipment is available, and trap / bioassay cage test locations are selected prior to application.
- Ensure efficacy evaluation activities are timed appropriately with applications.
- Enlist an outside agency such as CDPH and/or university personnel to help evaluate efficacy of application as appropriate.

Actions at time of application

- Confirm application rate with contractor.

- Confirm treatment block.
- Coordinate efficacy evaluations.

Public notification

Notification of the public prior to a mosquito control pesticide application by a vector control agency signatory to a Cooperative Agreement with CDPH, or under contract for such agency is not a legal requirement in California (California Code of Regulations – Title 3: Food and Agriculture: Division 6. Pesticides and Pest Control Operations: Section 6620a). However, public notification of pending adult mosquito control is recommended as early as possible prior to the treatment event.

Basic notification steps

- Provide notification of pending application as early as possible.
- Post clearly defined treatment block map online or through appropriate media outlet.
- Post product label and material safety data sheet (MSDS) online or through appropriate media outlet.
- Post and/or have available scientific publications regarding the efficacy of aerial or ground based applications (as appropriate), including effects on non-target organisms and risk-assessments.

Public relations considerations

- Ensure staffing is adequate to handle a significant increase in phone calls.
- Ensure website capability is adequate to handle a rapid increase in visitors.
- Train personnel answering phones to address calls from citizens concerned about personal and environmental pesticide exposure.
- Ensure adequate follow-through for calls related to sporting events, concerts, weddings, and other outdoor events that may be scheduled during the application and within the treatment block

Appendix J: Websites Related to Arbovirus Surveillance, Mosquito Control, Weather Conditions and Forecasts, and Crop Acreage and Production in California

Website	URL	Available information
California West Nile Virus Website	http://westnile.ca.gov	Up to date information on the spread of West Nile virus throughout California, personal protection measures, online dead bird reporting, bird identification charts, mosquito control information and links, clinician information, local agency information, public education materials.
UC Davis Center for Vectorborne Diseases	http://cvec.ucdavis.edu/	Frequently updated reports and interactive maps on arbovirus surveillance and mosquito occurrence in California.
Mosquito and Vector Control Association of California	http://www.mvcac.org	News, membership information, event calendars, and other topics of interest to California's mosquito control agencies.
California Vectorborne Disease Surveillance Gateway	http://gateway.calsurv.org	Data management system for California's mosquito control agencies.
California Data Exchange Center	http://cdec.water.ca.gov	Water-related data from the California Department of Water Resources, including historical and current stream flow, snow pack, and precipitation information.
UC IPM Online	http://www.ipm.ucdavis.edu	Precipitation and temperature data for stations throughout California; also allows calculation of degree-days based on user-defined data and parameters.
National Weather Service – Climate Prediction Center	http://www.cpc.ncep.noaa.gov/products/predictions/	Short-range (daily) to long-range (seasonal) temperature and precipitation forecasts. Also provides El Niño-related forecasts.
California Agricultural Statistics Service	http://www.nass.usda.gov/ca/	Crop acreage, yield, and production estimates for past years and the current year's projections. Reports for particular crops are published at specific times during the year – see the calendar on the website.
US Environmental Protection Agency – Mosquito Control	http://www.epa.gov/pesticides/factsheets/skeeters.htm	Describes the role of mosquito control agencies and products used for mosquito control.
US Centers for Disease Control and Prevention – West Nile Virus	http://www.cdc.gov/ncidod/dvbid/westnile/index.htm	Information on the transmission of West Nile virus across the United States, viral ecology and background on WNV, and personal protection measures in various languages.

Reference List

Biggerstaff,BJ. 2003. Pooled infection rate. http://www.cdc.gov/ncidod/dvbid/westnile/software.htm : 1-5.

Photo Courtesy Sacramento-Yolo MVCD

Best Management Practices for Mosquito Control in California

Recommendations of the
California Department of Public Health
and the
Mosquito and Vector Control Association of California

MVC Association of California

August 2010

CDPH California Department of Public Health

BEST MANAGEMENT PRACTICES
FOR MOSQUITO CONTROL IN CALIFORNIA

An electronic version of this manual and the companion document “Best Management Practices for Mosquito Control on California State Properties” are available from the California West Nile Virus website at http://www.westnile.ca.gov/resources. Please see Table 1, page 21, for a list of California mosquito control agencies or visit http://mvcac.org.

For more information, please contact:

Vector-Borne Disease Section
California Department of Public Health
(916) 552-9730
http://www.cdph.ca.gov
http://www.westnile.ca.gov

Purpose of this Manual

This manual provides landowners with Best Management Practices (BMPs) for mosquito control. The term BMP is used to describe actions landowners can take to reduce mosquito production from permanent water sources, reduce or eliminate mosquito production from temporary water sources, and reduce the potential for disease transmission to humans on their property.

General Recommendations

- **Implement universal BMPs**
  - Use personal protective measures
  - Eliminate unnecessary standing water

- **Identify and implement applicable mosquito control BMPs**
  - Reduce stagnation by providing water flow and manage vegetation in ponds or other water bodies.
  - Collaborate with local vector control agencies to develop and implement appropriate Integrated Pest Management (IPM) strategies that are most suitable for specific land-use type(s).

Use personal protective measures when potentially exposed to adult mosquitoes.

Eliminate unnecessary standing water, reduce stagnation by providing water flow, and manage vegetation in ponds or other water bodies.

Collaborate with local vector control agencies to coordinate activities on your property within a larger Integrated Pest Management mosquito control program.

Table of Contents

Executive Summary

The California Department of Public Health (CDPH) in collaboration with the Mosquito and Vector Control Association of California (MVCAC) developed this Best Management Practices (BMPs) plan to promote mosquito control on California properties, and enhance early detection of West Nile virus (WNV).

This plan describes mosquito control BMPs to be implemented by property owners and managers. These recommended practices, when properly implemented, can reduce mosquito populations through a variety of means including: 1) reducing or eliminating breeding sites, 2) increasing the efficacy of biological control, and 3) decrease the amount of pesticides applied while increasing the efficacy of chemical control measures. It is critical that property owners and managers communicate regularly with local vector control agencies regarding control practices on lands that are located within or near a local agency's jurisdiction. Local vector control agencies may have more specific policies regarding the implementation of BMPs and other control operations, which may include use of enforcement powers authorized by the California Health and Safety Code.

There are many different BMPs included in this document and they are intended to provide overall guidance to reduce mosquito production on properties throughout California, though not all mosquito sources and land uses will be addressed in this document. If it is deemed necessary, site-specific BMP plans may be developed in collaboration with CDPH and the respective local mosquito and vector control agency.

Effective mosquito-borne disease surveillance and mosquito control to protect public health are dependent upon factors that may fluctuate temporally and regionally. Such factors include mosquito and pathogen biology, environmental factors, land-use patterns, resource availability; strategies that incorporate BMPs are the most effective means by which mosquito control can be conducted and individualized to specific situations. Best management practices included in this plan emphasize the fundamentals of integrated pest management (IPM) which include:

1. Knowledge of mosquito species composition and corresponding mosquito behavior and habitat, for both immature and adult stages.

2. Detecting and monitoring WNV activity by testing mosquitoes, birds, sentinel chickens, horses, and humans. Identifying the mosquito species present, locations, densities, and disease potential.

3. Managing mosquito populations by source reduction, habitat modification, and biological control (e.g., introduced predators and parasites). Pesticides are used to target immature and, when indicated, adult stages of the mosquito. Mosquito control products are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment.

4. Educating the general public about reducing mosquito production and minimizing their risk of exposure to WNV.

RECOMMENDATIONS FOR PROPERTY OWNERS AND MANAGERS

- Use this plan to identify and implement appropriate Best Management Practices to control mosquitoes.
- Eliminate unnecessary standing water, reduce stagnation by providing water flow, and manage vegetation in ponds or other water bodies.
- Collaborate with local vector control agencies to develop and implement appropriate integrated pest management strategies that are most suitable for specific land-use type(s).
- Ensure individuals use personal protective measures when potentially exposed to adult mosquitoes.

Introduction

Controlling mosquitoes is critical to maintaining both a high quality of life and protecting people from mosquito-transmitted (vectored) diseases such as West Nile virus (WNV). In many parts of California, residents have voted to form local mosquito control programs or agencies. As a result, approximately half the land area and 85% of the population of California are within the boundaries of a mosquito control program. Landowners and land managers have a responsibility to minimize mosquito production on their lands and play a key role in reducing mosquito populations throughout the State, regardless whether their property is inside or outside the jurisdiction of a mosquito control program. Information about mosquito surveillance, mosquito-borne diseases, and mosquito control is available in Appendices A and B.

Best Management Practices (BMPs) are defined as actions landowners can take to reduce or eliminate mosquito production from water sources on their property in an environmentally and fiscally responsible manner, and to reduce the potential for transmission of disease from mosquitoes to humans.

Each property is unique, and the BMPs listed in this manual will apply to some properties, but not others. Landowners should implement universally applicable BMPs and after evaluating their own property, also employ the mosquito control BMPs that are applicable to their situation.

Landowner Responsibility

According to the California Health and Safety Code, landowners in California are legally responsible to abate (eliminate the source of) a public nuisance arising from their property, including mosquitoes [H&S Code Sections 2001 - 4(d); 2002; 2060 (b)]. In areas that are within the jurisdictional boundaries of a mosquito control program, landowners should work with staff to address mosquito problems, particularly in areas where irrigation is used for agricultural purposes. Landowners that are not within the jurisdictional boundary of an established mosquito control program should seek advice from the nearest mosquito control agency or health department. Landowners may also contact the California Department of Public Health (CDPH) or consult the CDPH West Nile virus website for additional information about mosquitoes and mosquito control. http://www.westnile.ca.gov/resources.php.

Mosquito control programs have substantial authority to access private property, inspect known or suspected sources of mosquitoes, abate the source of a mosquito problem, and charge the landowner for work performed and/or charge fees if a landowner is unwilling or unable to address a mosquito problem arising from their property [H&S Code sections 2060-2067, 100170, and 100175]. Applicable sections of the California Health and Safety Code are summarized in Appendix C.

Mosquito Biology

The more than 50 species of mosquitoes in California share one common life history trait: the mosquito life cycle requires standing water. Management of standing water is the key to most of the mosquito control BMPs presented in this manual and is one of the oldest and most cost effective forms of mosquito control.

Mosquito species are broadly separated into two groups according to where they lay eggs, floodwater mosquitoes and standing water mosquitoes. Adult female floodwater mosquitoes lay eggs on mud or previously submerged vegetation. The eggs may remain dormant for days, months, or even years until they are flooded, at which time larvae hatch. Standing water mosquitoes lay eggs on the water surface. The eggs float on the surface for a few hours to a few days until the larvae hatch into the water.

Floodwater mosquito larval development (breeding) sites include irrigated pastures, rice fields, seasonally flooded duck clubs and other managed wetlands, tidal wetlands, riparian corridors, and snowmelt pools. These intermittent or seasonally flooded habitats can be among the most productive sources of mosquitoes because they are often free of natural predators.

Standing water mosquito breeding sites include artificial containers, treeholes, catch basins, open ditches, retention/detention ponds, natural or constructed ponds and wetlands, stormwater management devices, and along the edges of flowing streams. Sources are found everywhere from highly urban areas to natural wetlands and often produce multiple generations of mosquitoes each season. In southern California, urban sources can produce some species of mosquitoes year round.

Landowners or land managers can identify the presence of immature mosquitoes in water on their property. Mosquito larvae breathe air from above the water surface and most hang at an angle from or lay parallel with the surface of the water while consuming small bits of organic matter. When disturbed, larvae swim down into the water column in a serpentine motion. Mosquitoes may live as larvae from a couple of days to more than a month depending on the species, water temperature, and the amount of food available.

Mosquitoes then go through a non-feeding stage called a pupa. During this stage the mosquito changes into the winged adult form. The easily identified comma-shaped pupae hang from the water surface and move down through the water column in a rolling or tumbling motion when disturbed. This life stage typically lasts about a day, with the mosquito emerging from the back of the pupal case (above the water) as a flying adult. (See Figure 1: Mosquito Life Cycle).

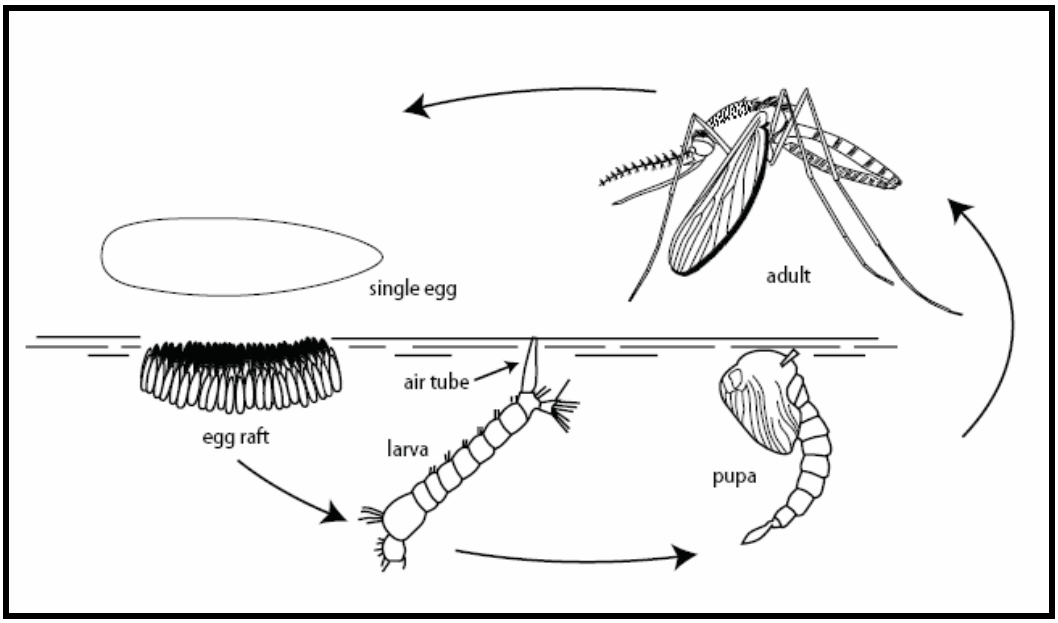


Figure 1. The life cycle of all mosquito species consists of four stages: egg, larva, pupa, and adult.

All adult mosquitoes feed on plant nectar, however blood is essential for female mosquitoes to produce eggs. To take a blood meal, the female's mouth parts pierce the skin, inject saliva, and suck blood out. It is through the injection of saliva that a mosquito causes the typical itchy bump and can infect a person or domestic animal with a disease causing organism. Depending on an individual's immune response, even a single bite can be a significant nuisance.

For more information on mosquito biology and key mosquito species found in California, please see Appendix D.

For additional information on the larval habitats of California mosquitoes, please see Appendix E.

Best Management Practices (BMPs)

Mosquito Control Best Management Practices At-A-Glance

- Eliminate artificial mosquito sources.
- Ensure man-made temporary sources of surface water drain within four days (96 hours) to prevent development of adult mosquitoes.
- Control plant growth in ponds, ditches, and shallow wetlands.
- Design facilities and water conveyance and/or holding structures to minimize the potential for producing mosquitoes.
- Use appropriate bio-rational products to control mosquito larvae.
- Use personal protective measures to prevent mosquito bites.

Each property is unique. Landowners should implement universally applicable mosquito control BMPs, and after evaluating their own property, also employ the mosquito control BMPs that are applicable to their property and circumstances. Using appropriate BMPs is an efficient and effective way to help prevent a mosquito problem.

Universally Applicable Mosquito Control BMPs

Eliminate Artificial Mosquito Breeding Sites and Harborage

- Examine outdoor areas and drain temporary and unnecessary water that may stand longer than 96 hours.
- Dispose of unwanted or unused artificial containers.
- Properly dispose of old tires.
- If possible, drill drainage holes, cover, or invert any container or object that holds standing water that must remain outdoors. Be sure to check for containers or trash in places that may be hard to see, such as under bushes or buildings.
- Clean clogged rain gutters and storm drains. Keep outdoor drains flowing freely and clear of leaves, vegetation, and other debris.
- Aerate ornamental ponds to avoid letting water stagnate.
- Change water in birdbaths, fountains, and animal troughs at least once per week.
- Ensure rain and/or irrigation water does not stand in plant containers, trash cans, boats, or other containers on commercial or residential properties.
- Regularly chlorinate swimming pools and keep pumps and filters operating. Unused or unwanted pools should be kept empty and dry, or buried.
- Maintain irrigation systems to avoid excess water use and runoff into storm drains.
- Minimize sites mosquitoes can use for refuge (harborage) by thinning branches, trimming and pruning ornamental shrubs and bushes, and keeping grass mowed short.

Use Personal Protective Measures

- Apply an EPA-registered mosquito repellent when outdoors; especially around dusk and dawn when mosquitoes are most active (see Appendix F for additional information on insect repellents).
- Wearing loose-fitting protective clothing including long sleeves and pant legs.
- Install and properly maintain fine mesh screens on windows and doors to prevent mosquito entry into homes.

Provide Mosquito Management Related Information to Property Managers

- Off-site landowners should provide property managers with basic information about mosquitoes and appropriate measures to minimize mosquito habitats.

Contact Local Mosquito Control Program

- Contact the local mosquito control program to evaluate your property for mosquito breeding sites and work cooperatively to prevent a mosquito problem on your property. A contact list for mosquito control programs is provided in Table 1.
- Where local mosquito control programs do not exist, landowners may contact CDPH for assistance or consult the California West Nile virus website for additional information about mosquito control: http://www.westnile.ca.gov/resources.php

Mosquito Control BMPs for Residential and Landscaped Properties

Many residential and commercial properties have potential mosquito sources around buildings and grounds associated with excess or poorly managed irrigation, poor drainage, and miscellaneous landscape features. Mosquitoes can develop in the standing water associated with over-irrigation, irrigation breaks and/or runoff, clogged gutters, stormwater management structures, ornamental ponds, swimming pools, trash cans and flower pots, low areas or holes in turf where water collects and stands and low areas underneath pier and beam homes or buildings.

Mosquito sources can be minimized by taking precautions such as regular inspection and proper maintenance of irrigation systems and other water features, and elimination of unwanted standing water.

- Avoid over-irrigating to prevent excess pooling and runoff.
- Routinely inspect, maintain, and repair irrigation system components.
- All underground drain pipes should be laid to grade to avoid low areas that may hold water for longer than 96 hours.

- Back-fill tire ruts or other low areas that hold water for more than 96 hours.
- Improve drainage channels and grading to minimize potential for standing water.
- Keep drainage ditches free of excessive vegetation and debris to provide rapid drainage.
- Check and repair leaky outdoor faucets.
- Report any evidence of standing water to responsible maintenance personnel.
- Use waterfalls, fountains, aerators and/or mosquitofish in ponds and ornamental water features. Land owners must consult with the local mosquito control agencies or California Fish and Game regarding proper use of mosquitofish.
- Prevent mosquito breeding in rain barrels by properly screening all openings, preventing mosquito access to the stored water.
- For ponds and ornamental water features where mosquitofish cannot be used, landowners should use one of several readily available larval mosquito control products to treat water when they see immature mosquitoes.

Landowners should also review the stormwater runoff section of this manual because building rooftops, parking lots, etc. may have associated stormwater management features that produce mosquitoes.

Mosquito Control BMPs for Rural Properties

Mosquito breeding on rural properties is highly variable due to differences in location, terrain, and land use. 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 overall property management plan. Ideally, activities should be coordinated with those of a local mosquito control program.

Flood irrigation is a common practice in rural areas throughout California and always poses the potential for creating mosquito breeding sites. Mosquitoes commonly develop within irrigation infrastructure including in ditches clogged with vegetation, irrigation tail water areas and return sumps, blocked ditches or culverts, vegetated ditches; and leaking irrigation pipes, head gates, pumps, stand pipes, etc. The fields, orchards, and pastures being irrigated may also produce mosquitoes, particularly where natural undulation or poor grading create low lying areas where water collects and stands.

Recommendations for rural properties are based on “Mosquito Control Best Management Practices” produced by the Sacramento-Yolo Mosquito and Vector Control District, and from Lawler and Lanzaro (2005).

Mosquito Control BMPs for Ditches and Drains

- Construct or improve large ditches to a slope of at least 2:1 and a minimum 4 foot wide bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetation growth.
- Keep ditches clean and well-maintained. Periodically remove accumulated sediment and vegetation. Maintain ditch grade and prevent areas of standing water.
- Design irrigation systems to use water efficiently and drain completely to avoid standing water.
- Prevent wet areas associated with seepage by repairing leaks in dams, ditches, and drains.

Mosquito Control BMPs for Irrigated Pastures and Cropland

- Grade to eliminate standing water from pastures and fields. Use Natural Resource Conservation Service (NRCS) guidelines: Laser leveling and periodic maintenance may be needed to allow proper drainage, efficient water flow, and reduce low-lying areas where standing water may accumulate.
- Reuse wastewater through return flow systems to effectively minimize mosquito production and conserve water. Eliminate and reuse excess water that may typically stagnate and collect at lower levels of irrigated fields.
- Irrigate only as frequently as is needed to maintain proper soil moisture. Check soil moisture regularly.
- Drain water as quickly as possible following irrigation. Check slopes may be used to direct water movement and drainage. Drainage ditches may be used to remove water from the lower end of the field.
- Install surface drains to remove excess water that collects at lower levels of irrigated fields.
- Inspect fields for drainage and broken checks to see whether re-leveling or reconstruction of levees is needed. Broken checks create cross-leakage that may provide habitat for mosquitoes.
- If possible, use closed conduits instead of open canals for water conveyance.
- Do not over fertilize. Over-fertilization can leach into irrigation run-off making mosquito production more likely in ditches or further downstream.
- When possible, use sprinklers or drip systems rather than flood irrigation.
- Keep animals off the pasture while the soil is soft. Mosquito habitat is created in irrigated pastures when water collects in hoof prints.

Mosquito Control BMPs for Rice Fields

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. The BMPs presented in this section attempt to balance the needs of the grower with the need to control mosquitoes.

In California there is a long-standing cooperative effort among the Rice Commission, individual growers, and mosquito control agencies to manage mosquitoes on rice lands. Close cooperation between growers and vector control is particularly important with organic rice producers. With severe limits on chemical control options and greater expense for organic-compatible larvicides, organic rice growers should implement as many mosquito control BMPs as possible.

- Wherever feasible, maintain stable water levels during mosquito season by ensuring constant flow of water into ponds or rice fields to reduce water fluctuation due to evaporation, transpiration, outflow, and seepage.
- Inspect and repair levees to minimize seepage.
- Drain and fill in borrow pits and seepage areas external to the fields.
- Wherever feasible, maintain at least 4" – 6" (10-15 cm) of water in the rice field after rice seedlings have begun to stand upright. Any drainage should be coordinated with local vector control (where possible). Restocking of mosquitofish or use of alternative mosquito control measures should be instituted as soon as possible when fields are re-flooded.
- Whenever feasible, remove vegetation on the outer-most portions of field levees and checks, specifically where they interface with standing water.
- Control algae and weed growth as effectively as possible.
- Communicate frequently with your local mosquito control program regarding your crop management activities.
- Wherever feasible, maintain borrow pits (12" – 18" deep) (30-45 cm) on both sides of each check throughout rice fields to provide refuge for mosquitofish during low water periods.
- If a pyrethroid pesticide is to be applied to the fields stocked with mosquitofish, contact your local mosquito control program for advice on minimizing fish mortality.
- If a pesticide is applied, fields should be inspected for mosquitofish afterward and if needed, fish should be restocked as soon as feasible.

Mosquito Control BMPs for Dairies and Animal Holding Operations

Frequently infrastructure associated with dairies, feedlots, or other animal holding facilities can produce mosquitoes. Watering troughs and irrigated fields associated with the operation can create mosquito problems. Animal washing areas may also create mosquito problems, particularly drains and ditches, sumps, ponds, and wastewater lagoons.

The following activities can reduce mosquito production and simplify control activities around dairies and animal holding operations:

- All holding ponds should be surrounded by lanes of adequate width to allow safe passage of mosquito control equipment. This includes keeping the lanes clear of any materials or equipment (e.g. trees, calf pens, hay stacks, silage, tires, equipment, etc.).
- If fencing is used around the holding ponds, it should be placed on the outside of the lanes with gates provided for vehicle access.
- All interior banks of the holding ponds should have a grade of at least 2:1.
- 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 60' (18m) in surface width.
- 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.
- Floating debris should be eliminated on all ponds; mechanical agitators may be used to break up crusts.
- 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.
- Dairy wastewater discharge for irrigation purposes should be managed so it does not stand for more than 4 days.
- 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.

Mosquito Control BMPs for Wetlands

Wetlands are an important source of mosquito production on public and privately owned lands. Under the California Wildlife Protection Act, the term "wetlands" is defined as any lands which may be covered periodically or permanently with shallow water, which include freshwater and saltwater marshes, open or closed brackish water marshes,

swamps, mudflats, fens, and vernal pools (Fish & Game Code Section 2785). Many wetlands are protected by federal and state laws.

By definition, "natural" wetlands are not intensely managed and options for

implementing mosquito control BMPs in these areas are very limited. Even in managed wetlands, not all BMPs listed below may be suitable for use in all wetlands. It is the responsibility of the landowner to become informed on timing and extent of acceptable activities in a given wetland habitat. Intermittently or seasonally flooded wetlands can produce formidable numbers of mosquitoes, whereas well-managed semi-permanent and permanent wetlands usually produce fewer mosquitoes because of their limited acreage, stable water levels, and abundance of natural predators of mosquito larvae.

Due to the delicate and sometimes protected wetlands ecosystems, landowners, biologists, managers, and staff from mosquito control programs should collaborate to control mosquitoes. Source reduction and source maintenance can be combined with the judicious use of specific larvicides to minimize mosquito production from these wetlands.

Information within this section has been partially adapted from Kwasny et al. (2004). Based on the site activities and potential for mosquito production, the existing BMPs may need to be modified or supplemented to address public health risk, goals and management strategy issues, and requirements of California Department of Fish and Game (DFG), the local mosquito and vector control program, and CDPH.

General Mosquito Control BMPs for Wetlands

- Manage vegetation routinely; activities such as annual thinning of rushes and cattails and removing excess vegetative debris enables natural predators to hunt mosquito larvae more effectively in permanent wetlands. Vegetation in shallow, temporary wetlands can be mowed when dry.
- Time flooding of seasonal wetlands to reduce overlap with peak mosquito activity.
- Flood wetlands from permanent-water sources containing mosquito predators (e.g., mosquito-eating fish or invertebrate predators) to passively introduce mosquito predators. Permanent wetlands and brood ponds can be stocked with mosquitofish or native predatory species.
- Maintain permanent or semi-permanent water within the wetland to maintain populations of larval mosquito predators. Discourage the use of broad spectrum pesticides.
- Use fertilizers conservatively and manage irrigation drainage to prevent or minimize fertilizer and/or manure flowing into wetlands. Buffers between agriculture fields and wetlands should be established.
- Comply with all Federal and State Environmental Laws and the California Health and Safety Code to prevent environmental harm while reducing or eliminating mosquito production.

Mosquito Control BMPs for Design and Maintenance of Wetlands

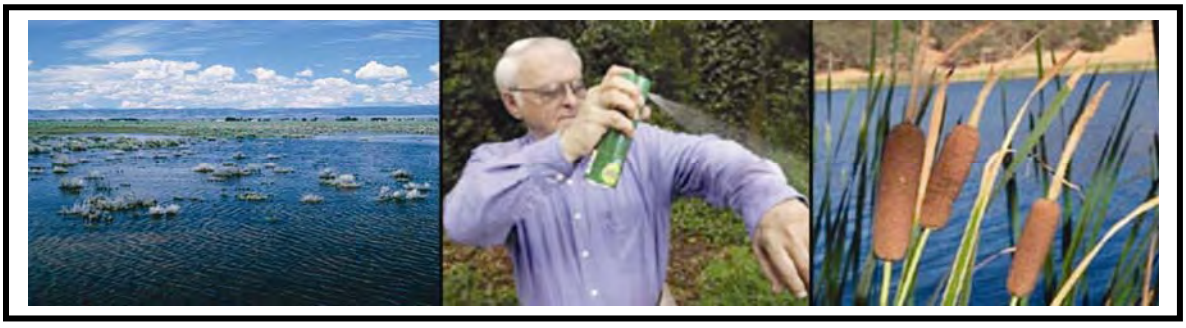
- Provide reasonable access on existing roads and levees to allow for monitoring, abatement, and implementation of BMPs. Make shorelines of natural, agricultural, and constructed water bodies accessible for periodic maintenance, mosquito monitoring and abatement procedures, and removal of emergent vegetation.
- Construct, improve, or maintain ditches with 2:1 slopes and a minimum 4 foot (1.2 m) width at the bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetation growth.
- Construct, improve, or maintain levees to quality standards that ensure stability and prevent unwanted seepage. Ideally build levees with >3:1 slopes and > 80% compaction; consider 5:1 slope or greater in areas prone to overland flooding and levee erosion.
- Provide adequate water control structures for complete draw-down and rapid flooding.
- When possible, include independent inlets and outlets in the design of each wetland unit.
- Construct or enhance swales so they are sloped from inlet to outlet and allow maximum draw-down.
- 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 that can inoculate seasonal wetlands when they are irrigated or flooded.

Wetland Infrastructure Maintenance Mosquito Control BMPs

- Inspect levees at least annually and repair as needed.
- Periodically inspect, repair, and clean water control structures.
    - Remove all debris, including silt and vegetation, which can impede drainage and water flow.
    - Ensure water control structures are watertight to prevent unnecessary water flow or seepage.
- Regularly remove trash, silt and vegetation from water delivery ditches to allow efficient water delivery and drainage.
    - Remove problem vegetation that inhibits water flow using herbicides or periodic dredging.
    - If possible, use closed conduits instead of open canals for water conveyance.
- Periodically test and repair pumps used for wetland flooding to maximize pump output.

Water Management Mosquito Control BMPs for Seasonal Wetlands

- Timing of flooding
    - Delay or “phase” fall flooding of wetlands as long as possible in consultation with local vector control agencies. Fall flooding is known to produce large numbers of mosquitoes and/or those in close proximity to urban areas to minimize late season mosquito production.
    - Strategically locate wetlands identified for early flooding. Wetlands that are flooded in early fall should not be close to urban areas or historically produce great numbers of mosquitoes.
    - When possible, water in managed wetlands should be drawn-down in late March or early April.
    - Use a flood-drain-flood regime to control floodwater mosquitoes; flood to trigger hatching of dormant mosquito eggs, drain water and larvae into an area where they can be easily treated, drowned in moving water, or consumed by predators, and immediately re-flood wetland. This water management regime should be used only when it does not conflict with water quality regulations.
- Speed of flooding
    - Flood wetlands as quickly as possible to reduce the potential for large numbers of mosquitoes. Coordinate flooding with neighbors and/or the water district to maximize flood-up rate.
- Water source
    - Flood wetlands with water from permanent water sources containing mosquito predators (i.e., mosquito-eating fish or invertebrate predators) to passively introduce mosquito predators. Permanent wetlands and brood ponds used as flooding sources can be stocked with mosquito-eating fish or maintained to encourage natural predator populations.
    - Maintain a separate permanent water reservoir that conveys water to seasonal wetlands that provides year-round habitat for mosquito predators that can inoculate seasonal wetlands when they are irrigated or flooded.
- Frequency and duration of irrigation
    - When possible, reduce the number and duration of irrigations to minimize standing water. The need to irrigate should be evaluated based on spring habitat conditions and plant growth. If extended duration irrigation (generally 14-21 days) is considered for weed control (e.g., cocklebur), additional measures to offset the potential for increased mosquito production may be needed.



    - Irrigate managed wetlands before soil completely dries after spring draw-down to discourage floodwater mosquitoes from laying eggs in the dry, cracked substrate.
    - Drain irrigation water into ditches or other water sources with mosquito predators instead of nearby dry fields.
    - Maintain high ground water levels by keeping channels or deep swales permanently flooded for subsurface irrigation to reduce the amount of irrigation water needed during the mosquito season.
- Communicate with your local mosquito control agency (if there is one)
    - Advise your local mosquito control agency when you intend to flood so that they can make timely applications of larvicide if necessary
- Emergency preparedness
    - Whenever feasible, have an emergency plan that provides for immediate drainage into acceptable areas if a mosquito-borne disease related public health emergency occurs.

Vegetation Management Mosquito Control BMPs

- Control floating vegetation conducive to mosquito production (i.e., water hyacinth, water primrose, parrot feather, duckweed, and filamentous algae mats).
- Perform routine maintenance to reduce problematic emergent plant densities to facilitate the ability of mosquito-eating fish to move through vegetated areas and allow good penetration of chemical control agents.
- Manage vegetation based on local land management objectives and associated habitat uses to minimize mosquito production. Methods of vegetation control for managed wetlands include mowing, burning, disking, and grazing.
- Manage the spread and density of invasive, non-native emergent wetland vegetation to increase native plant diversity, increase the mobility of larval mosquito predators, and allow for more efficient penetration of chemical control agents.

Additional Water Management BMPs for Permanent Wetlands

- Maintain stable water levels in wetlands that are flooded during summer and early spring to prevent intermittent flooding of shoreline areas favorable to mosquito production. Water level fluctuation can be minimized by continuing a constant flow of water into the wetland.
- Circulate water to avoid stagnation (e.g., provide a constant influx of water equal to the net loss or discharge of water).
- Maintain water depths as deep as possible (18” – 24” [45-60 cm] or more) during the initial flood-up to minimize shallow habitats preferred by mosquito larvae. Shallow water levels can be maintained outside of the mosquito breeding season.

Additional Mosquito Control BMPs for Saltwater Marsh

- Improving water flow through the wetland system minimizes stagnant water and facilitates movement of fish and other natural predators. For example, mosquitoes in coastal tidal wetlands can be managed by constructing and maintaining ditches that drain off the water when the tide falls.

Mosquito Control BMPs for Stormwater Management and Associated Infrastructure

Federal and state environmental regulations require mitigation of the harmful effects of runoff water from storms, irrigation or other sources prior to entering natural waterways from point and non-point sources. Mitigation may include water capture, slowing flow velocity, reducing volume, and removal of pollutants. The term “stormwater” is used as a generic term for runoff water, regardless of source.

Stormwater infrastructure typically includes conveyance systems (e.g. drain inlets, catch basins, pipes, and channels), storage and infiltration systems (e.g. flood control basins, percolation basins), and more recently, structural treatment devices designed and installed specifically to remove suspended and dissolved pollutants from runoff (e.g., vegetated swales, dry detention basins, ponds and constructed wetlands, media filtration devices, and trash capturing devices). The size and variability of stormwater infrastructure, inconsistent quantity and timing of water flows, and propensity to carry and accumulate sediment, trash, and debris, makes these systems highly conducive to holding areas of standing water ideal for production of mosquitoes. Identification of the potential mosquito sources (often belowground) found within stormwater infrastructure is often more difficult than the solutions needed to minimize mosquitoes. Some of the information within this section has been adapted from Metzger (2004).

General Stormwater Management Mosquito Control BMPs

- Manage sprinkler and irrigation systems to minimize runoff entering stormwater infrastructure.
- Avoid intentionally running water into stormwater systems by not washing sidewalks and driveways, washing cars on streets or driveways, etc.
- Inspect facilities weekly during warm weather for the presence of standing water or immature mosquitoes.
- Remove emergent vegetation and debris from gutters and channels that accumulate water.
- Consider mosquito production during the design, construction, and maintenance of stormwater infrastructure.
- Design and maintain systems to fully discharge captured water in 96 hours or less.

- Include access for maintenance in system design.
- Design systems with permanent water sources such as wetlands, ponds, sumps, and basins to minimize mosquito habitat and plan for routine larval mosquito inspection and control activities with the assistance of a local mosquito control program.

Stormwater Conveyance

- Provide proper grades along conveyance structures to ensure that water flows freely.
- Inspect on a routine basis to ensure the grade remains as designed and to remove accumulations of sediment, trash, and debris.
- Keep inlets free of accumulations of sediment, trash, and debris to prevent standing water from backing up on roadways and gutters.
- Design outfalls to prevent scour depressions that can hold standing water.

Stormwater Storage and Infiltration Systems (Aboveground)

- Design structures so that they do not hold standing water for more than 96 hours to prevent mosquito development. Features to prevent or reduce the possibility of clogged discharge orifices (e.g., debris screens) should be incorporated into the design. The use of weep holes is not recommended due to rapid clogging.
- Provide a uniform grade between the inlets and outlets to ensure that all water is discharged in 96 hours or less. Routine inspection and maintenance are crucial to ensuring the grade remains as designed.
- Avoid the use of electric pumps. They are subject to failure and often require permanent-water sumps. Structures that do not require pumping should be favored over those that have this requirement.
- Avoid the use of loose rock rip-rap that may hold standing water.
- Design distribution pumping and containment basins with adequate slopes to drain fully. The design slope should take into consideration buildup of sediment between maintenance periods.

Stormwater Structures with Permanent-Water Sumps or Basins (Belowground)

- Where possible, seal access holes (e.g., pickholes in manhole covers) to belowground structures designed to retain water in sumps or basins to minimize entry of adult mosquitoes. If using covers or screens, maximum allowable gaps

of 1/16 inch (2 mm) will exclude entry of adult mosquitoes. Inspect barriers frequently and replace when needed.
- If the sump or basin is completely sealed against mosquitoes, with the exception of the inlet and outlet, the inlet and outlet should be completely submerged to reduce the available surface area of water for mosquitoes to lay eggs (female mosquitoes can fly through pipes).
- Where possible, design belowground sumps with the equipment necessary to allow for easy dewatering of the unit.
- Contact the local mosquito control program for advice with problem systems.

Stormwater Treatment Ponds and Constructed Treatment Wetlands

- Whenever possible, stock stormwater ponds and constructed wetlands with mosquito-eating fish available from local mosquito control programs.
- Design and maintain accessible shorelines to allow for periodic maintenance and/or control of emergent and shoreline vegetation, and routine monitoring and control of mosquitoes. Emergent plant density should be routinely managed so mosquito predators can move throughout the vegetated areas and are not excluded from pond edges.
- Whenever possible, design and maintain deep zones in excess of four feet (1.2 m) to limit the spread of invasive emergent vegetation such as cattails. The edges below the water surface should be as steep as practicable and uniform to discourage dense plant growth that may provide immature mosquitoes with refuge from predators and increased nutrient availability.
- Use concrete or liners in shallow areas to discourage plant growth where vegetation is not necessary.
- Whenever possible, provide a means for easy dewatering if needed.
- Manage the spread and density of floating and submerged vegetation that encourages mosquito production (i.e., water hyacinth, water primrose, parrot's feather, duckweed, and filamentous algal mats).
- If possible, compartmentalize managed treatment wetlands so 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.

General Access Requirements for Stormwater Treatment Structures

- All structures should be easily and safely accessible, without the need for special requirements (e.g., Occupational Safety and Health Administration - OSHA - requirements for "confined space"). This will allow for monitoring and, if necessary, abatement of mosquitoes.
- If utilizing covers, the design should include spring-loaded or lightweight access hatches that can be easily opened.
- Provide all-weather road access (with provisions for turning a full-size work vehicle) along at least one side of large aboveground structures that are less than seven meters wide, or both sides if shore-to-shore distance is greater than seven meters. *Note:* Mosquito larvicides are applied with hand held equipment

at small sites and with backpack or truck mounted high-pressure sprayers at large sites. The effective swath width of most backpack or truck-mounted larvicide sprayers is approximately 20-25 feet (6-7meters) on a windless day.

- Build access roads as close to the shoreline as possible to allow for maintenance and vector control crews to periodically maintain, control and remove emergent vegetation and conduct routine mosquito monitoring and abatement. Remove vegetation and/or other obstacles between the access road and the structure that might obstruct the path of larvicides to the water.
- Control vegetation (by removal, thinning, or mowing) periodically to prevent barriers to access.

Mosquito Control BMPs for Right of Ways and Easements

Right of ways and easements for a variety of infrastructure exist throughout California. Roadways, power lines, pipelines, canals, bike paths, utility access, railroads, etc. have lands associated with them that may produce mosquitoes. It is the responsibility of the company or individual associated with the infrastructure to prevent a public nuisance arising from the property, including a mosquito problem. The lands are as varied as the terrain in California, but the mosquito breeding sites found on these properties will be similar to those found in other sections of this manual.

Inspection of Property and Identification of Mosquito Sources

- Inspect property for standing water or evidence of standing water that may become mosquito sources.

Review and Implement Mosquito Control BMPs as Appropriate

Some rights of way and easements are very long and may have multiple types of mosquito breeding sites that fall within every category listed below, others will have none. After inspecting the property, implement mosquito control BMPs found in the sections below.

- If the property is in an urban area and is managed as commercial property, please refer to the following section:
  - *Residential and landscaped properties*, see page 5.

- If the property is associated with an irrigation canal or similar rural water conveyance, please refer to the following sections:

  - *Rural properties*, see page 6.
  - *Wetlands*, see page 9.

- If the property is associated with a variety of habitats like a railroad or pipeline right of way, please refer to the following sections:
  - *Rural* properties, see page 6.

- *Wetlands*, see page 9.

- If the property is associated with a roadway or other structure that would require management of runoff water, please refer to the following section:
  - *Stormwater management* (associated BMPs), see page 14.

In many instances, right of ways and easements will simply fall to the local mosquito and vector control program or go completely unmanaged because they are very large and it is not possible to determine the responsible party.

Mosquito Control BMPs for Wastewater Treatment Facilities

Wastewater treatment facilities are designed to collect, treat, and release nutrient rich highly organic water. These facilities implement practices appropriate to removing contaminants from wastewater, but which may be in direct conflict with BMPs intended to prevent development of mosquito larvae. Further, managers are under intense pressure to meet water quality standards in effluent water and are frequently concerned that mosquito control BMPs will jeopardize compliance with effluent standards.

Wastewater facilities often include features that can produce mosquitoes. Examples include 1) a series of treatment or evaporation ponds, 2) the use of tules or other emergent vegetation to remove contaminants, 3) aerated and non-aerated ponds with emergent vegetation around the edges or throughout, 4) cracks and openings in crusted waste matter on the surface of treatment ponds, and 5) abandoned or unused pond basins that frequently hold shallow water. Certain activities may also create or enhance mosquito habitat including 1) allowing evaporation of wastewater from treatment ponds for maintenance or as a standard treatment method, 2) release of wastewater into marshes or floodplains for evaporation or infiltration, and 3) distribution of sludge onto irrigated agricultural lands.

For mosquito control around buildings and grounds, consult the *residential and landscape* section of this document. Similarly, many BMPs included in the *wetlands and dairy* sections of this document are pertinent to wastewater management facilities, particularly those sections related to construction and management of treatment ponds and wetlands and the use and distribution of wastewater or sludge onto agricultural lands. For mosquito control related to wastewater collection, conveyance, and distribution consult the *stormwater management* section of this manual.

- Monitor all treatment ponds for mosquito larvae – particularly in areas of emergent vegetation.
- Remove emergent vegetation from edges of aerated ponds.
- Immediately incorporate sludge into soil through plowing or disking.
- Insure all water distributed onto evaporation ponds dries completely in less than 96 hours.
- Check abandoned ponds or tanks weekly to ensure they are completely dry.

- Use mechanical agitation to prevent the formation of any crust on treatment ponds or tanks.
- Work closely with a local vector control program. If there is no local vector control agency, consult the closest vector control program, the local public health officer, or CDPH to prevent or abate a mosquito problem from the facility.

Mosquito Control BMPs for Wildlands – Undeveloped Areas

California encompasses about 100 million acres (40 million hectares) of land. Approximately 75 million acres (30 million hectares) are classified as wildlands, which include all undeveloped and non-cultivated property in the state. In many cases the properties are remote and mosquito control is neither feasible nor warranted. However, if you own a property that is near a town or are aware of a mosquito problem at the property, you may wish to contact the closest vector control program or CDPH to determine what if anything can be done to alleviate the problem.

Mosquito Control BMPs that May be Applicable to Wildlands

- Conduct routine mosquito surveillance by looking for immature mosquitoes in the water. Apply EPA-registered products (typically containing Bti, Bs, or methoprene) to control mosquito larvae.
- Evaluate reports of mosquito annoyance from visitors or the public, and if possible work with a local mosquito control program to be notified if there is an adult mosquito problem on or near your property.
- After a rainfall, pay particular attention to temporary water sources and ponds that rise. Treat sources with mosquito control products if needed.
- Stock ornamental ponds and other water features with mosquitofish available from local mosquito control programs. However, their use is restricted in natural bodies of water or in water features that drain into natural bodies of water. Land managers must consult with the local mosquito control agencies regarding proper use of mosquitofish or other available biological control agents.
  Work closely with a local mosquito control program to accurately identify, map, and monitor areas that may produce mosquitoes; and tailor control measures for each site, contingent on the species of mosquitoes that are present.
- Implement personal protective measures
  - Provide visitors and guests with information regarding the risk of mosquito-borne disease transmission and personal protective measures.
  - Install and maintain tight-fitting window and door screens on buildings.
  - If possible, minimize outdoor activities at dawn and dusk when mosquitoes are the most active.
  - Wear protective clothing such as long-sleeved shirts and long pants when going into mosquito-infested areas.
  - Use mosquito repellent when necessary, carefully following the directions on the label.

Evaluation of the Efficacy of BMPs

Landowners can easily evaluate the efficacy of the mosquito control BMPs they have implemented. You can do a simple evaluation as follows:

- Immature mosquitoes: Look for immature mosquitoes in standing water on your property – if the number is decreasing noticeably or immature mosquitoes can not be found, the BMPs you have implemented are working.
- Adult mosquitoes: Simply be aware of the level of mosquito annoyance you experience and ask guests or employees about their experience with regard to mosquitoes. People become accustomed to a certain level of mosquito activity and commonly notice increases or decreases in that level. If the annoyance level is increasing, you have more work to do; if the number is decreasing or mosquitoes are not noticeable – good job! The BMPs you have implemented are working.

The best way to evaluate the effectiveness of BMPs is through a comprehensive surveillance program of larval dipping and adult mosquito trapping, including species identification. Some important strengths of local mosquito control programs are their ability to evaluate treatment options, estimate treatment costs, recommend and implement those BMPs most appropriate for a property. Local mosquito abatement programs also are familiar with indigenous mosquito species and therefore know the type of habitat those mosquitoes come from, often monitor adult populations, and can identify if there is a mosquito problem in a particular area. Landowners can make substantial progress in solving mosquito problems on their own, but if possible, they should work closely with a local mosquito control program to implement and evaluate mosquito control BMPs.

Local Vector Control Services in California

Table 1: Mosquito Control Agencies in California

COUNTY	AGENCY	WEBSITE or ADDRESS	TELEPHONE
ALAMEDA	ALAMEDA CO MAD	http://www.mosquitoes.org	(510) 783-7744
ALAMEDA	ALAMEDA CO VCSD	http://www.acvcsd.org	(510) 567-6800
AMADOR	AMADOR CO AGRICULTURE DEPT	agriculture@co.amador.ca.us	(209) 223-6487
BUTTE	BUTTE CO MVCD	http://www.bcmvcd..com	(530) 533-6038
BUTTE	DURHAM MAD	PO Box 386, Durham, CA 95938	(530) 345-2875
BUTTE	OROVILLE MAD	PO Box 940, Oroville, CA 95965	(530) 534-8383
CALAVERAS	SADDLE CREEK CSD	http://www.saddlecreekcsd.org	(209) 785-0100
COLUSA	COLUSA MAD	PO Box 208, Colusa, CA 95932	(530) 458-4966
CONTRA COSTA	CONTRA COSTA MVCD	http://www.ccmvcd.dst.ca.us	(925) 771-6100
EL DORADO	EL DORADO CO VCP	http://www.edcgov.us/emd/vectorcontrol/vector_control.html	(530) 573-3197
FRESNO	COALINGA-HURON MAD	P. O. Box 278, Coalinga, CA 93210	(559) 935-1907
FRESNO	FRESNO MVCD	http://www.fresnomosquito.org	(559) 268-6565
FRESNO	FRESNO WESTSIDE MAD	PO Box 125, Firebaugh, CA 93622	(559) 659-2437
FRESNO / KINGS	CONSOLIDATED MAD	PO Box 278, Selma, CA 93662	(559) 896-1085
GLENN	GLENN CO MVCD	165 County Rd. G, Willows, CA 95988	(530) 934-4025
HUMBOLDT	HUMBOLDT CO DEH	http://co.humboldt.ca.us/HHS/PHB/EnvironmentalHealth/VectorControlProgram.asp	(707) 445-6215
IMPERIAL	IMPERIAL CO VCP	http://www.icphd.org/sub.php?menu_id=307	(760) 482-4203
INYO	INYO COUNTY DEPT OF AG OWENS VALLEY MAP	http://www.inyomonoagriculture.com/ovmap.html	(760) 873-7853
KERN	DELANO MAD	PO Box 220, Delano, CA 93216	(661) 725-3114
KERN	KERN MVCD	4705 Allen Road Bakersfield, CA 93314	(661) 589-2744

COUNTY	AGENCY	WEBSITE or ADDRESS	TELEPHONE
KERN	SOUTH FORK MAD	P. O. Box 750, Kernville, CA 93238	(760) 376-4268
KERN	WEST SIDE MVCD	PO Box 205, Taft, CA 93268	(661) 763-3510
KINGS	KINGS MAD	PO Box 907,Hanford, CA 93232	(559) 584-3326
LAKE	LAKE CO VCD	http://www.lcvcd.org	(707) 263-4770
LOS ANGELES	ANTELOPE VALLEY MVCD	http://www.avmosquito.org	(661) 942-2914
LOS ANGELES	COMPTON CREEK MAD	1224 S. Santa Fe Avenue Compton, CA 90221	(310) 933-5321
LOS ANGELES	GREATER LOS ANGELES CO VCD	http://glacvcd.org	(562) 944-9656
LOS ANGELES	LONG BEACH CITY DHHS	http://www.longbeach.gov/health	(562) 570-4130
LOS ANGELES	LOS ANGELES CO DHS, VMP	http://www.publichealth.lacounty.gov/eh/progs/consumer/vecman.html	(626) 430-5450
LOS ANGELES	LOS ANGELES CO WEST VCD	http://www.lawestvector.org	(310) 915-7370
LOS ANGELES	PASADENA CITY HD	http://ww2.cityofpasadena.net/publichealth/environmental_health/enviro_health_home.asp	(626) 744-6062
LOS ANGELES	SAN GABRIEL VALLEY MVCD	http://www.sgvmosquito.org	(626) 814-9466
LOS ANGELES	VERNON CITY HEC	http://www.cityofvernon.org/about_vernon/contact_us.htm	(323) 583-8811
MADERA	MADERA CO MVCD	http://maderamosq.org/	(559) 674-6729
MARIN / SONOMA	MARIN / SONOMA MVCD	http://www.msmosquito.com/	(707) 285-2204
MERCED	MERCED CO MAD	PO Box 909, Merced, CA 95341	(209) 722-1527
MODOC	CA PINES CSD	HCR Box 43002, Alturas, CA 96101	(530) 233-2766
MODOC	CITY OF ALTURAS	http://www.cityofalturas.org	(530) 223-2512
MONO	JUNE LAKE PUD	P. O. Box 99, June Lake, CA 93329	(760) 648-7778
MONO	MAMMOTH LAKES MAD	PO Box 1943, Mammoth Lakes, CA 93546	(760) 924-8240
MONTEREY	NORTHERN SALINAS VALLEY MAD	342 Airport Blvd. Salinas, CA 93905	(831) 422-6438
NAPA	NAPA CO MAD	http://www.napamosquito.org	(707) 553-9610

COUNTY	AGENCY	WEBSITE or ADDRESS	TELEPHONE
NEVADA	NEVADA COUNTY MCP	http://mynevadacounty.com/westnilevirus	(530) 265-1500
ORANGE	ORANGE CO VCD	http://www.ocvcd.org	(714) 971-2421
PLACER	PLACER MVCD	http://www.placermosquito.org	(916) 435-2140
RIVERSIDE	BLYTHE CITY PWD	http://www.cityofblythe.ca.gov/index.aspx?NID=108	(760) 922-6611
RIVERSIDE	COACHELLA VALLEY MVCD	http://www.cvmvcd.org	(760) 342-8287
RIVERSIDE	NORTHWEST MVCD	http://www.northwestmosquitovector.org/Northwest_MVCD/Home.html	(951) 340-9792
RIVERSIDE	RIVERSIDE CITY PWD	http://www.riversideca.gov/pworks/vector-control.asp	(909) 351-6127
RIVERSIDE	RIVERSIDE CO DEH, VCP	http://www.rivcoeh.org/opencms/rivcoeh/ProgServices/Food_Program/Vector.html	(909) 766-9454
SACRAMENTO / YOLO	SACRAMENTO-YOLO MVCD	http://www.fightthebite.net	(916) 685-1022
SAN BERNARDINO	SAN BERNARDINO CO VCP	http://www.sbcounty.gov/dehs/general_information/vector_control.htm	(909) 388-4600
SAN BERNARDINO	WEST VALLEY MVCD	http://www.wvmosquito.org	(909) 627-0931
SAN DIEGO	SAN DIEGO CO DEH, VSC	http://www.sdcounty.ca.gov/deh/pests/vector_disease.html	(858) 694-3595
SAN FRANCISCO	SAN FRANCISCO DPH	http://www.sfdph.org/dph/EH/Vector/default.asp	(415) 252-3988
SAN JOAQUIN	SAN JOAQUIN CO MVCD	http://sjmosquito.org	(209) 982-4675
SAN MATEO	SAN MATEO CO MAD	http://www.smcmad.org	(650) 344-8592
SAN MATEO	SOUTH BAYSIDE SYSTEM AUTHORITY	1400 Radio Road, Redwood City, CA 94065	(650) 594-8411
SANTA BARBARA	SANTA BARBARA COASTAL VCD	http://www.sbcvcd.org	(805) 969-5050
SANTA CLARA	SANTA CLARA CO VCD	http://www.sccgov.org/portal/site/vector	(408) 918-4770
SANTA CRUZ	SANTA CRUZ CO MVCD	http://www.agdept.com/mvc.html	(831) 454-2590
SHASTA	BURNEY BASIN MAD	PO Box 1049, Burney, CA 96013	(530) 335-2133
SHASTA	PINE GROVE MAD	PO Box 328, MacArthur, CA 96056	(530) 336-5740

COUNTY	AGENCY	WEBSITE or ADDRESS	TELEPHONE
SHASTA	SHASTA MVCD	http://www.shastamosquito.org/	(530) 365-3768
SOLANO	SOLANO CO MAD	http://www.solanomosquito.com	(707) 437-1116
STANISLAUS	EAST SIDE MAD	http://www.eastsidemosquito.com	(209) 522-4098
STANISLAUS	TURLOCK MAD	http://mosquitoturlock.com	(209) 634-8331
STATEWIDE	CALIFORNIA DEPARTMENT OF PUBLIC HEALTH VECTOR-BORNE DISEASE SECTION	http://www.westnile.ca.gov/	(916) 552-9730
SUTTER / YUBA	SUTTER-YUBA MVCD	http://www.sutter-yubamvcd.org/	(530) 674-5456
TEHEMA	TEHAMA CO MVCD	PO Box 1005, Red Bluff, CA 96080	(530) 527-1676
TULARE	DELTA VCD	http://www.deltavcd.com	(559) 732-8606
TULARE	TULARE MAD	PO Box 1476, Tulare, CA 93275	(559) 686-6628
VENTURA	MOORPARK CITY VCD	http://ci.moorpark.ca.us/cgi-bin/htmlos.exe/04307.3.13840688497500014305	(805) 517-6248
VENTURA	VENTURA CO EHD	http://www.ventura.org/rma/envhealth/programs/tech_serv/vector/index.html	(805) 654-2818

Appendix A
Mosquito Control and Arbovirus Surveillance

Mosquito Control Practices

Mosquito control agencies and private landowners in California work cooperatively to implement an integrated pest management (IPM) approach to mosquito control. Source reduction (eliminating the places where mosquito larvae hatch and develop) is the most effective way of preventing adult mosquitoes; however, it may be possible to eliminate mosquito production from a source through other modifications of habitat and/or water management. Biological control agents, including native or introduced predators, are often utilized in combination with water management practices. Pesticides are an important part of an IPM program and mosquito specific larval control pesticides are often used to supplement other source reduction activities. When source reduction and larval control have not adequately reduced the mosquito population, the application of pesticides to control adult mosquitoes may be necessary. Personnel working for vector control agencies who apply pesticides in California are certified by California Department of Public Health (CDPH) after demonstrating the knowledge necessary to control mosquitoes safely and effectively using IPM techniques.

Larval Control

Larval control is the foundation of most mosquito control programs in California. Whereas adult mosquitoes are widespread in the environment, larvae must have water to develop; control efforts therefore can be focused on aquatic habitats. Minimizing the number of adults that emerge is crucial to reducing the incidence and risk of disease. The three key components of larval control are environmental management, biological control, and chemical control.

Environmental Management

Manipulating or eliminating potential mosquito breeding sources can provide dramatic reductions in mosquito populations. There are three levels of environmental management.

1. Source elimination: This approach completely eliminates potential habitats for mosquitoes. This strategy is generally limited to artificial habitats created by urbanization. Examples of source elimination include emptying or turning over containers holding water, filling in holes containing water with sand or gravel, cleaning drainage ditches of debris, and covering or inverting structures and vessels that could hold water.

2. Source reduction: This strategy aims to alter and sometimes eliminate available habitat for larvae which substantially reduces mosquito breeding and the need for repeatedly applying pesticides. Unlike source elimination, standing water may exist but the total amount of water, or the time the water is left standing, is greatly

reduced. Source reduction may require some maintenance (see below) to prevent further mosquito breeding. Examples of source reduction include limiting the growth of emergent vegetation in wetlands and ponds, constructing drainage ditches to remove water from areas prone to flooding, and clearing stormwater channels of silt and debris. Routine larval monitoring can indicate whether these efforts are effective or need further action.

3. Source maintenance: When eliminating or significantly altering mosquito breeding sources is prohibited and/or inappropriate, reducing the number of sheltered, predator-free habitats while having minimal impact on the surrounding environment can make an area unsuitable for mosquitoes. Source maintenance can include water management, vegetation management, wetland infrastructure maintenance, and wetland restoration. Strategic, focused plans must be developed for each site.

Biological Control

Biological control uses predators, parasites, or pathogens to reduce populations of mosquito larvae and is often combined with environmental management to enhance results. The mosquitofish (*Gambusia affinis)* has been used to control mosquitoes in California since 1921 and is the most widely used biological control agent in the world. These small fish are effective against mosquito larvae because they grow and reproduce rapidly, feed at the water surface where mosquito larvae are found, and tolerate a wide range of temperature and water quality.

Other fish are occasionally used with mixed success. Fish are most effective in permanent ponds and wetlands, but are also used in rice fields and stormwater canals with permanent water. Many local mosquito control agencies propagate mosquito-eating fish.

Although many other animals have been tested for mosquito control, and in natural wetlands predation is an important factor in reducing mosquito production, biological control by the intentional addition of mosquito predators other than mosquitofish is largely experimental rather than operational.

Chemical Control

Pesticides that control mosquito larvae are called larvicides. Four types of larvicides (bio-rational, surface oil, growth regulating, and chemical products) encompassing seven active ingredients are registered for use in California. Larvicides are applied by hand, from hand-held or vehicle-mounted engine-driven blowers, or by aircraft, depending on the product, the formulation, and the target habitat. Applicators of any of these products must be certified by the CDPH or an appropriate regulatory authority.

1. Bio-rational products

Bio-rational products exploit insecticidal toxins found in certain naturally occurring bacteria. These bacteria are cultured in mass and packaged in various formulations. The bacteria must be ingested by mosquito larvae so the toxin is released. Therefore bio-rational products are only effective against larvae since pupae do not feed. The bacteria used to control mosquito larvae have no significant effects on non-target organisms when applied for mosquito control in accordance with product labels.

Two products that are used against mosquito larvae singly or in combination are *Bacillus thuringiensis israelensis* (Bti) and *Bacillus sphaericus* (Bs). Manufactured Bti contains dead bacteria and remains effective in the water for 24 to 48 hours; some slow release formulations provide longer control. In contrast, Bs products contain spores that in favorable conditions remain effective for more than 30 days. Both products are safe enough to be used in water that is consumed by humans.

2. Surface agents

Mosquito larvae and pupae breathe through tubes called “siphons” that extend above the water surface. Surface agents such as highly refined mineral oils or monomolecular films (alcohol derivatives) can spread across the surface of the water to prevent mosquitoes from breathing. Depending on the product, the film may remain on the water’s surface from a few hours to a few days. Surface films are the only available products that are effective against very late stage larvae and pupae.

3. Insect growth regulators

Insect growth regulators (IGRs) disrupt the physiological development of larvae thus preventing adults from emerging. The two products currently used for controlling mosquito larvae are methoprene and diflubenzuron.

The effective life of these products varies with the formulation. Methoprene can be applied in granular, liquid, pellet, or briquette formulation. Methoprene has minimal non-target effects and no use restrictions. Diflubenzuron is rarely used in California because it may affect growth of non-target aquatic invertebrates. IGRs for mosquito control can be used in sources of water that are consumed by humans.

4. Chemical larvicides

Chemical pesticides are rarely used to control mosquito larvae. Organophosphate larvicides are used infrequently because of their potential non-target effects and label restrictions. Temephos is currently the only organophosphate registered for use as a larvicide in California. This product can be safely and effectively used to treat temporary water or highly polluted water where there are few non-target organisms

and/or livestock are not allowed access. The efficacy of temephos may be up to 30 days depending on the formulation.

Adult Control

IPM mosquito control programs initiate adult mosquito control when action levels or thresholds are reached or exceeded. Thresholds are based on local sampling of the adult mosquito population and/or when the risk of mosquito-borne disease increases above levels established by a local agency, often following guidelines established in the California Mosquito-borne Virus Surveillance and Response Plan. Thresholds are an integral component of mosquito control because they provide a range of predetermined actions based on quantified data. Thresholds also establish expectations and boundaries for responses that ensure appropriate mosquito control activities are implemented at the appropriate time. The threshold for adult mosquito control depends on several factors including:

- How local citizens tolerate nuisance mosquitoes by evaluating public service requests.
- Overall mosquito abundance.
- Presence of mosquito-borne disease in the region.
- Abundance of mosquito species that are vectors of disease.
- Local acceptance of adult mosquito control activities.
- Climate data.

Adult mosquitoes can only be controlled with adulticides. Many mosquito control programs in California include adulticiding as an integral component of their IPM program. Adulticiding falls into two categories – barrier applications and ultra-low volume (ULV) applications. Barrier applications target resting mosquitoes by applying pesticides to vegetation and structures. Barrier applications typically cover relatively small areas and are applied to alleviate specific problems rather than an area wide adult mosquito problem.

ULV applications are used to control adult mosquitoes over large areas. An “ultra-low volume” (typically less than 2 oz / acre [140 ml / ha] total volume) of tiny oil or water droplets carrying an insecticide are emitted from specialized equipment mounted to trucks or aircraft. The droplets kill adult mosquitoes on contact. ULV applications are made after sunset or before sunrise to coincide with the time that mosquitoes are most active, when non-target insects are least active, and when temperature inversions are most likely to occur. These applications are employed when mosquito populations must be reduced immediately to halt disease transmission. Multiple applications in a particular area may be utilized when the objective is to kill a high enough proportion of older adult mosquitoes to break a disease transmission cycle.

Adverse effects from ULV applications are rare; however, people with health problems should be aware when and where the applications are being conducted. This information can be obtained by contacting the local vector control agency. Chemicals

currently registered for ULV applications against mosquitoes in California (as of June, 2010) include organophosphates (e.g., malathion and naled), pyrethrins, (e.g., pyrethrum) and pyrethroids (e.g., resmethrin, sumithrin, permethrin, and etofenprox). With the exception of the active ingredient etofenprox, formulations of both pyrethrins and pyrethroids include the synergist piperonyl butoxide (PBO), which increases their activity against mosquitoes.

1. Organophosphates

   Malathion and naled are neurotoxins that act by inhibiting neurologic transmission. Malathion may be used early and late in the season as a pesticide resistance control measure.

2. Pyrethrins

   Pyrethrins and pyrethroids are neurotoxins that act by causing uncontrolled firing of neurons. Pyrethrum is a natural insecticide derived from chrysanthemums flowers. Adult mosquitoes are rapidly paralyzed and killed on contact. Pyrethrins are degraded rapidly by sunlight and chemical processes. Residual pyrethrins from ULV applications typically remain less than one day on plants, soil, and water.

3. Pyrethroids

   Pyrethroids are manufactured pyrethrins. They have very low toxicity to birds and mammals but are toxic to fish if misapplied.

Compounds currently approved for larval and adult mosquito control in California are listed in Appendix B.

Mosquito Surveillance

Mosquito and Mosquito-Borne Disease Monitoring

Monitoring mosquito populations and mosquito-borne disease levels provides the necessary data to make informed management decisions.

The application of any pesticide to control mosquitoes in an IPM program is done after establishing the need to do so through mosquito population monitoring (surveillance).

Larval mosquito surveillance is the process of identifying and checking likely larval developmental sites for immature mosquitoes and treating the water to kill the mosquitoes prior to them emerging as flying, biting adults.

Adult mosquito surveillance is accomplished through a network of traps and through mosquito annoyance reports. Adult mosquito surveillance is a critical component of determining where mosquitoes are coming from, the potential for disease transmission in an area, and the need for adult mosquito control. Districts also use adult surveillance as a feedback or quality control mechanism to determine how effective the overall program is in reducing mosquito populations. Trapping adult mosquitoes and submitting those mosquitoes to test for diseases is often one component of a mosquito-vectored disease surveillance program. Collecting baseline data on mosquito populations and mosquito-borne disease also helps target educational efforts.

Mosquito Surveillance Techniques

1. Larval surveillance

   Larval surveillance is the routine sampling of aquatic habitats for developing mosquitoes. The primary tool is the “dip count” which indicates whether a habitat is producing mosquitoes and estimates larval density. A one-pint cup attached to a long handle is used to collect a standard volume of water (“dip sample”). The “dip count” may be expressed as the number of immature (larvae and pupae) mosquitoes per dip, per unit volume, or per unit surface area of the site.

2. Adult surveillance

   Several types of traps are used for adult surveillance, because mosquitoes are attracted to different traps depending on their species, sex, and physiological condition. The most common traps use light, carbon dioxide, water for egg laying, and a resting area. Trapped adults provide information about local distribution, density, and identity. The size of an adult mosquito population can also be assessed by the number and distribution of service requests from the public. Data are used to help locate new sources of mosquitoes or known sources with a recurrent problem.

Annoyance Biting

Many species of mosquitoes are not important as vectors of disease, but can cause serious injury and discomfort to humans and animals. Each time a female mosquito pierces the skin to take blood, she contaminates the wound with her saliva, creating the potential for a mild allergic reaction. The common symptom of mosquito bites is irritated and swollen skin surrounding the bite with persistent itching for several days. Scratching these bites to alleviate the itching can result in secondary bacterial infections. In addition, when mosquito populations explode, the sheer number of mosquitoes attempting to bite can make life miserable.

Mosquitoes as Disease Vectors

Mosquitoes are the most important insect vectors of disease worldwide, causing millions of human deaths every year. Mosquito-borne pathogens are typically transmitted or "vectored" when a mosquito ingests a disease causing organism, the organism reproduces inside the mosquito, and is subsequently injected along with saliva into another animal or human host. The potential or "competence" to vector any particular disease causing organism varies greatly among mosquito species.

California has a long history of mosquito-borne disease. Mosquito control programs were first developed in the early 1900s to combat malaria, and other diseases and to reduce populations of nuisance mosquitoes. Currently, there are 12 mosquito-borne viruses recognized in California, however only West Nile virus (WNV), western equine encephalomyelitis (WEE), and Saint Louis encephalitis (SLE) are significant threats to public health. Global trade and travel will continue to provide an avenue for introducing or re-introducing other mosquito-borne pathogens and their vectors into California and the United States. The diseases of greatest concern include Japanese encephalitis, dengue, yellow fever, Rift Valley fever, chikungunya, Venezuelan encephalitis, and malaria.

Virus Surveillance

In 2000, CDPH collaborated with the University of California, Davis, the California Department of Food and Agriculture, local mosquito and vector control agencies, and other state and local agencies to develop a comprehensive statewide surveillance program to detect and monitor WNV activity. More than 70 local mosquito and vector control districts and agencies, environmental health agencies, and county public health departments throughout California routinely contribute to the program. Surveillance includes testing for WNV infections in humans, horses, mosquitoes, wild birds, and "sentinel" chicken flocks located throughout California. The program also includes testing dead birds reported by the public for infections with WNV. A special website (http://www.westnile.ca.gov/) and toll-free hotline (877-WNV-BIRD) were created and are maintained by CDPH to support this surveillance program. The information from the program allows CDPH and local agencies to identify conditions conducive to WNV transmission and areas with elevated risk. This information is used by local mosquito control agencies to reduce the threat of WNV transmission to humans.

Mosquito Transmitted Diseases

Landowners throughout California, mosquito and vector control agencies, health departments, and CDPH work together to protect Californians from mosquito-borne diseases. Work to minimize the risk of disease transmission includes 1) comprehensive mosquito surveillance and control efforts on private and public lands, 2) agencies providing technical guidance and information to the medical and veterinary communities, and 3) educating the public about mosquitoes, the diseases they carry, and personal protective measures.

Encephalitis

Several mosquito-borne viruses that occur in California can cause encephalitis. The majority of human infections with these viruses have no symptoms. Those with so-called mild symptoms can still have significant illness and face prolonged recovery, and severe cases can be fatal or cause permanent neurological damage. There are several species of mosquitoes in California that can transmit WNV, SLE, and WEE viruses to people and animals. The most important species belong to the genus *Culex*. Specifically *Cx. tarsalis*, *Cx. pipiens*, and *Cx. quinquefasciatus* are significant public health concerns because of their widespread distribution throughout the state, their proximity to humans, and their capacity as very efficient vectors.

West Nile Virus

West Nile virus has become an endemic disease in California and like other encephalitic viruses, can cause serious illness. Many people who are infected do not get sick or may have a variety of symptoms that can include fever, head and body aches, nausea, vomiting, swollen lymph glands, and skin rash. Only about one in 150 infected people will develop a serious illness that may require hospitalization. Elderly people are at highest risk of developing the severe form of WNV and are at an increased risk of long-lasting physical and mental disorders. The severe form of the disease can be fatal.

Malaria

Malaria is caused by four species of protozoa. The parasites destroy red blood cells causing severe fever and anemia. Left untreated, malaria can cause kidney failure, coma, and death. Malaria was once a common public health threat in California and much of the southern United States, but it was eradicated by intensive mosquito control efforts and the discovery of anti-malarial drugs. However, the disease still occurs in many other countries worldwide, creating a perpetual risk of re-introduction, especially from infected travelers and immigrants. The *Anopheles* mosquitoes capable of transmitting malaria still occur in many areas of California.

Canine Heartworm

Canine heartworm occurs worldwide. It is caused by a filarial nematode transmitted by *Aedes* and some *Culex* mosquitoes that can infect domestic dogs, wild canines (e.g., foxes, coyotes, wolves), and cats. The tiny worms migrate through the body to the heart and cause thickening and inflammation of the heart, which can lead to difficulty in breathing, chronic cough, and vomiting, and can sometimes be fatal.

Appendix B
Compounds Approved for Mosquito Control in California

Pesticides used for mosquito control have been evaluated for this purpose by the U.S. Environmental Protection Agency (EPA) and found to pose minimal risks to human health and the environment when used according to label directions. For updated information on specific products approved for use in California, please refer to the California Department of Pesticide Regulation website: http://www.cdpr.ca.gov/docs/label/labelque.htm

The components of this appendix have been adapted from the California Mosquito-Borne Virus Surveillance and Response Plan; please refer to the following website for more information: http://www.westnile.ca.gov/.

The use of pesticides to control mosquitoes should be the last resort after BMPs outlined in this manual have been implemented. Individuals considering applying a pesticide must be adequately trained and always apply pesticides according to label directions. In California, local mosquito control agency employees must pass a testing and certification process through CDPH before they can apply pesticides to control mosquitoes. Similarly, commercial pesticide applicators must be appropriately certified by the California Department of Pesticide Regulation. Private landowners applying general use pesticides to control mosquitoes solely on their own property are not required to be certified, however landowners have the same legal responsibility with regard to pesticide and environment related laws. Private citizens considering using pesticides should consult their County Agricultural Commissioner and the California Department of Fish and Game before application.

Examples of products containing specific active ingredients are provided below, but this is not an inclusive list nor constitutes product endorsement. For more information on pesticides and mosquito control, please refer to the U.S. EPA website: http://ww.epa.gov/pesticides/health/mosquitoes/mosquito.htm

Larvicides

1. *Bacillus thuringiensis*, subspecies *israelensis* (Bti: e.g., Aquabac 200G, VectoBac® 12AS, Teknar HP-D)
   Use: Approved for most permanent and temporary bodies of water.
   Limitations: Only works on actively feeding stages. Does not persist well in the water column.

2. *Bacillus sphaericus* (Bs: e.g., VectoLex® CG)
   Use: Approved for most permanent and temporary bodies of water.
   Limitations: Only works on actively feeding stages. Does not work well on all species. May persist and have residual activity in some sites.

3. Spinosad (bacteria derived natural insecticide: e.g., Natular G)

Use: Approved for most permanent and temporary bodies of water.
Limitations: Only works on mosquito larvae.

4. IGRs (Insect Growth Regulators)
   a. (S)-Methoprene (e.g., Altosid® Pellets)
   Use: Approved for most permanent and temporary bodies of water.
   Limitations: Works best on older instars. Some populations of mosquitoes may show some resistance.
   b. Diflurobenzamide (e.g., Dimilin®25W)
   Use: Impounded tail water, sewage effluent, urban drains and catch basins.
   Limitations: Cannot be applied to wetlands, crops, or near estuaries.

5. Larviciding oils (e.g., Mosquito Larvicide GB-1111)
   Use: Ditches, dairy lagoons, floodwater. Effective against all stages, including pupae.
   Limitations: Consult with the California Department of Fish and Game for local restrictions.

6. Monomolecular films (e.g., Agnique® MMF)
   Use: Most standing water including certain crops.
   Limitations: Does not work well in areas with unidirectional winds in excess of 10 mph.

7. Organophosphate compounds
   Temephos (e.g., Abate® 2-BG)
   Use: Non-potable water; marshes; polluted water sites
   Limitations: Cannot be applied to crops for food, forage, or pasture. This material may not be effective on some *Culex tarsalis* populations in the Central Valley.

Adulticides

1. Organophosphate compounds
   Note: Many *Culex tarsalis* populations in the Central Valley are shown resistance to OP pesticides at approved label rates.
   a. Malathion (e.g., Fyfanon® ULV)
      Use: May be applied by air or ground equipment over urban areas, some crops including rice, wetlands.
      Limitations: Paint damage to cars; toxic to fish, wildlife and bees; crop residue limitations restrict application before harvest.
   b. Naled (e.g., Dibrom® Concentrate, Trumpet® EC)
      Use: Air or ground application on fodder crops, swamps, floodwater, residential areas.
      Limitations: Similar to malathion.
   c. Chlorpyrifos (e.g., Mosquitomaster 412)
      Use: Air or ground application in urban or recreational areas

Limitations: Not registered for use over agricultural commodities, or grazing lands and may be toxic to bees, fish, and some wildlife.

2. Pyrethrins (natural pyrethrin products: e.g., Pyrenone® Crop Spray, Pyrenone® 25-5, Evergreen®)
   Use: Wetlands, floodwater, residential areas, some crops.
   Limitations: Do not apply to drinking water, milking areas; may be toxic to bees, fish, and some wildlife. Some formulations with synergists have greater limitations.

3. Pyrethroids (synthetic pyrethrin products containing deltamethrin, cyfluthrin, permethrin, resmethrin, sumithrin, or etofenprox: e.g., Suspend® SC, Tempo Ultra SC, Aqua-Reslin®, Scourge® Insecticide, Anvil® 10+10 ULV, and Duet, which also contains the mosquito exciter prallethrin)
   Use: All non-crop areas including wetlands and floodwater.
   Limitations: May be toxic to bees, fish, and some wildlife; avoid treating food crops, drinking water or milk production.

PESTICIDES USED FOR LARVAL MOSQUITO CONTROL IN CALIFORNIA

LARVICIDES

For updated information on specific products approved for use in California, please refer to the California Department of Pesticide Regulation website: http://www.cdpr.ca.gov/docs/label/labelque.htm

Active Ingredient	Trade name	EPA Reg. No.	MFG	Formulation	Application	Pesticide classification
Bacillus sphaericus, (Bs)	VectoLex CG and WSP	73049-20	Valent BioSciences	Granule and Water soluble packet	Larvae	Biorational
Bacillus sphaericus, (Bs)	VectoLex WDG	73049-57	Valent BioSciences	Water dispersible granule	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	VectoBac 12AS	73049-38	Valent BioSciences	Liquid	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	VectoBac G	73049-10	Valent BioSciences	Granule	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	VectoBac Tech. Powder	73049-13	Valent BioSciences	Technical powder	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	Aquabac 200G	62637-3	Becker Microbial	Granule	Larvae	Biorational
Bacillus thuringiensis var. *israelensis* (Bti)	Teknar HP-D	73049-404	Valent BioSciences	Liquid	Larvae	Biorational
Bs and Bti	Vectomax G, CG, WSP	73049-429	Valent BioSciences	Granule and Packet	Larvae	Biorational
Spinosad	Natular G	8329-80	Clarke	Granule	Larvae	Biorational
Spinosad	Natular 2EC	8329-82	Clarke	Liquid	Larvae	Biorational
Spinosad	Natular XRG	8329-83	Clarke	Granule	Larvae	Biorational
Spinosad	Natular XRT	8329-84	Clarke	Tablet	Larvae	Biorational
Monomolecular film	Agnique MMF	53263-28	Cognis Corp.	Liquid	Larvae and pupae	Surface film
Monomolecular film	Agnique MMF G	53263-30	Cognis Corp.	Granule	Larvae and pupae	Surface film
Petroleum oil	GB 1111	8329-72	Clarke	Liquid	Larvae and pupae	Surface film
Diflubenzuron	Dimilin 25W	400-465	Uniroyal Chemical	Wettable powder	Larvae	IGR
S-Methoprene	Altosid ALL	2724-392	Wellmark-Zoecon	Liquid concentrate	Larvae	IGR
S-methoprene	Altosid Briquets	2724-375	Wellmark-Zoecon	Briquet	Larvae	IGR
S-methoprene	Altosid Pellets	2724-448	Wellmark-Zoecon	Pellet-type granules	Larvae	IGR
S-methoprene	Altosid SBG	2724-489	Wellmark-Zoecon	Granule	Larvae	IGR
S-methoprene	Altosid XR-G	2724-451	Wellmark-Zoecon	Briquet	Larvae	IGR
Temephos	Abate 2-BG	8329-71	Clarke	Granule	Larvae	OP
Temephos	5% Skeeter Abate	8329-70	Clarke	Granule	Larvae	OP

PESTICIDES USED FOR ADULT MOSQUITO CONTROL IN CALIFORNIA

ADULTICIDES

For updated information on specific products approved for use in California, please refer to the California Department of Pesticide Regulation website: http://www.cdpr.ca.gov/docs/label/labelque.htm

Active Ingredient	Trade name	EPA Reg. No.	MFG	Formulation	Application	Pesticide classification
Malathion	Fyfanon® ULV	67760-34	Cheminova	Liquid	Adults	OP
Naled	Dibrom® Concentrate	5481-480	AMVAC	Liquid	Adults	OP
Naled	Trumpet™ EC	5481-481	AMVAC	Liquid	Adults	OP
Deltamethrin	Suspend® SC	432-763	Bayer	Liquid	Adults	Pyrethroid
Cyfluthrin	Tempo Ultra SC	432-1363	Bayer	Liquid	Adults	Pyrethroid
Permethrin	Aqua-Reslin®	432-796	Bayer	Liquid	Adults	Pyrethroid
Permethrin	Biomist® 4+12 ULV	8329-34	Clarke	Liquid	Adults	Pyrethroid
Permethrin	Permanone® Ready-To-Use	432-1277	Bayer	Liquid	Adults	Pyrethroid
Pyrethrins	Pyranone® 25-5	432-1050	Bayer	Liquid	Adults	Pyrethroid
Pyrethrins	Pyrenone® Crop Spray	432-1033	Bayer	Liquid	Adults	Pyrethroid
Pyrethrins	Pyrocide® 7396	1021-1569	MGK	Liquid	Adults	Pyrethroid
Resmethrin	Scourge® Insecticide (4%)	432-716	Aventis	Liquid	Adults	Pyrethroid
Resmethrin	Scourge® Insecticide (18%)	432-667	Aventis	Liquid	Adults	Pyrethroid
Sumithrin	Anvil® 10+10 ULV	1021-1688	Clarke	Liquid	Adults	Pyrethroid
Prallethrin Sumithrin	Duet	1021-1795	Clarke	Liquid	Adults	Pyrethroid
Etofenprox	Zenivex E20	2724-791	Wellmark, Intl.	Liquid	Adults	Pryethroid
Lambda-cyhalothrin	Demand CS	100-1066	Syngenta	Liquid	Adults	Pryethroid

Appendix C
Health and Safety Codes Pertinent to Mosquito Control

In California, mosquito and vector control agencies are regulated by sections of the California Health and Safety (H&S) Code, Food and Agriculture Code, California Code of Regulations, and others. The following components of this appendix have been adapted from the Overview of Mosquito Control Practices in California, California Department of Public Health: http://www.westnile.ca.gov/resources.php.

Governing laws and regulations

Many federal and state laws govern the activities of vector control agencies, including the Clean Water Act (CWA), the Endangered Species Act (ESA), and the Federal Insecticide Fungicide and Rodenticide Act (FIFRA). Pesticide application by vector control agencies in California is regulated under FIFRA. FIFRA is administered through the U.S. Environmental Protection Agency, and regulates the registration, labeling, and sales of pesticides in the United States.

The California H&S Code encourages the formation of local mosquito control programs to protect the public health, safety, and welfare (H&S Code Section 2001-b) Website link: http://leginfo.ca.gov/cgi-bin/displaycode?section=hsc&group=01001-02000&file=2000-2007. The legal responsibility of landowners in California to avoid causing a public nuisance, including mosquitoes is implied in the section. The potential consequences of failing to prevent a public nuisance are described in the Code sections listed below.

Under the H&S Code, local vector control agencies have the authority to conduct surveillance for vectors, prevent the occurrence of vectors, and legally abate production of vectors or 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.”(H&S Code Section 2002(j) and 2040). Vector control agencies also have authority to participate in review, comment, and make recommendations regarding local, state, or federal land use planning and environmental quality processes, documents, permits, licenses, and entitlements for projects and their potential effects with respect to vector production. (H&S Code Section 2041) Website link: http://caselaw.lp.findlaw.com/cacodes/hsc/2040-2055.html

Additionally, agencies have broad authority to influence landowners to reduce or “abate” the source of a vector problem. Actions may include imposing civil penalties of up to $1000 per day plus costs associated with controlling the vector. Agencies have authority to “abate” vector sources on private and publicly owned properties. (H&S Code Sections 2060-2065). Website link: http://caselaw.lp.findlaw.com/cacodes/hsc/2060-2067.html

Mosquito and vector control programs that enter into a cooperative agreement with the California Department of Public Health are exempted from some pesticide related laws

under Title 3 of the California Code of Regulations Section 6620. Specifically, these agencies are exempted from “Consent to Apply” (Title 3, California Code of Regulations, Section 6616), “Notice” (Title 3, California Code of Regulations, Section 6618), and the “Protection of Persons, Animals, and Property” (Title 3, California Code of Regulations, Section 6614). Essentially, these provisions obviate the vector control agency from having to notify or get permission from landowners prior to applying a pesticide to their property in the interest of preserving the public health. Website link: http://www.cdpr.ca.gov/docs/inhouse/calcode/030201.html

A vector control technician working at a vector control agency must be a “certified technician” or work under the direct supervision of a “certified technician” to apply pesticides. Vector control technicians achieve certification through an examination process administered by the California Department of Public Health.

Vector control agencies cannot use any pesticide not registered for use in California, and are required to keep detailed records of each pesticide application, including date, location, and amount applied. All pesticides must be applied in accordance with the labeling of the product as registered with the U.S. EPA.

Appendix D
Mosquitoes of California

The biology and key characteristics of the four major mosquito genera in California are described below.

Aedes

There are about 80 species of *Aedes* mosquitoes in the continental United States; 24 species occur in California. Certain species are widespread, may occur in very large numbers, and are among the worst biting pests. *Aedes* mosquitoes do not lay their eggs directly on the surface of standing water. Instead, they lay single eggs on intermittently flooded surfaces such as the damp soil around irrigated pastures and fields, along the edges of coastal tidal marshes, and inside dry treeholes and containers. Eggs are extremely resistant to drying and will lie dormant on dry surfaces until flooding occurs (eggs of *Ae. vexans* have been documented to lie dormant for up to three years). This can lead to many generations of eggs in a given habitat if female mosquitoes lay successive batches of eggs before the area is flooded. When flooding occurs, large numbers of eggs hatch spontaneously and develop rapidly to adults. Although larval developmental sites vary greatly, the most productive include transient ground pools, flooded areas along overflowing streams, flood and stormwater control basins, intermittently flooded agricultural lands, and container habitats such as tree holes, wheel ruts, and discarded tires.

Aedes are primarily summer-breeding mosquitoes. Because of their rapid larval development in newly-flooded habitats, adults often emerge before predators can colonize the water source. Most *Aedes* complete two to several generations per year depending on the frequency of habitat flooding from natural and artificial events. Adults cannot survive in colder weather and therefore the majority of *Aedes* overwinter as eggs.

Typically, *Aedes* mosquitoes found in California will not enter buildings and homes; however, they are strong fliers and are known to travel many miles from their aquatic developmental sites to search for hosts. *Aedes* mosquitoes are diurnal (i.e., active during the day) during mild weather, especially around shaded areas, but will also bite at dusk. Most *Aedes* females feed on large mammals like cattle and horses, but will readily feed on humans. *Aedes* mosquitoes are aggressive and persistent biters causing people and animals to avoid areas where their numbers are great. One example is the species *Ae. nigromaculis*, which are currently not known to vector disease, but are considered a serious pest because they will seek out human hosts and bite during the day when people are most likely to be outdoors and active.

Anopheles

Approximately 22 species of *Anopheles* are found in the continental United States and of these, 5 occur in California. When feeding, *Anopheles* adults rest with their abdomens positioned at a distinct angle to the surface of the skin, whereas other species orient their bodies parallel. Females lay single floating eggs directly on the

surface of permanent or semi-permanent standing water. A female can lay successive batches of up to 300 eggs during the breeding season. Eggs are not resistant to drying and typically hatch within two-three days, although hatching may take up to two-three weeks in colder climates. Larvae develop in 12 to 20 days, but can take longer in cooler weather. Preferred larval habitats include clear, fresh seepage water in sunlit or partly shaded pools, wetlands, roadside ditches, rice fields, and poorly maintained water troughs.

Adult females bite at dusk and dawn and prefer to feed on mammals. Many *Anopheles* mosquitoes prefer to feed on rabbits, but will also feed on large mammals such as livestock and humans. In California, *Anopheles* species may undergo two or more generations per year. Most species over-winter in protected areas as mated females, resuming activity the following spring. These are among the first mosquitoes to emerge and bite humans each year.

Historically, *Anopheles freeborni*, the western malaria mosquito, was a vector of malaria in California. Currently, with the disease eradicated from California and the United States, it is considered a nuisance mosquito. This species is widespread throughout California and females will lay their eggs in any standing fresh water, although it is abundant in rice fields or other wetlands during late summer. While most adult mosquitoes stay within a few miles of their breeding source, they will migrate further when seeking hibernation sites in fall. This can lead to a large influx of mosquitoes from uncontrolled areas to residential areas during September and October.

Culiseta

Only eight species of *Culiseta* mosquitoes occur in the continental United States, of which four are found in California. Females lay clusters of floating eggs (rafts) on the surface of standing water. *Culiseta* mosquitoes are moderately aggressive biters, attacking in the evening hours or in shade during the day. Peak populations occur during the cooler months. These mosquitoes prefer to feed on larger domestic animals such as cattle and horses, but will also feed on humans. The distribution of *Cs. inornata*, an unusually large mosquito, is widespread and can be found at elevations of up to 10,000 feet. Larvae of *Cs. inornata* develop in permanent water habitats, including shallow marshes, peat bogs, roadside ditches, abandoned gravel pits, and in standing water in soil cavities left by fallen trees. The common name of this mosquito—the Large Winter mosquito—reflects that it is most active in cool weather habitats.

Culex

Culex, with 11 species found throughout the state is the second largest genus of mosquitoes in California, second only to *Aedes*. Females can lay up to seven rafts of eggs over a two-month life span; each raft contains from 100-300 eggs which are laid on the surface of standing water. *Culex* larvae occur in a broad range of aquatic sites ranging from containers such as discarded tires, water barrels, and flower pots to clogged gutters, catch basins, and water for irrigation and urban wastewater. During summer and periods of drought, areas without regularly flowing water, street drainage systems, and contaminated streams, ponds and pools become productive larval

habitats. *Culex* larvae are known for thriving in polluted sources of water with a high organic content

Culex mosquitoes prefer to take blood meals at dusk or after dark and can be painful and persistent biters. *Culex* preferably feed on birds but also feed on mammals including humans and horses. They readily enter houses and buildings in search of a suitable host. Two or more generations of *Culex* can occur per year. Females that emerge in late summer will mate and overwinter until the following spring or mid-summer.

Several species of *Culex* can transmit viruses that can cause encephalitis (i.e., inflammation of the brain), including WNV, SLE, and WEE. These mosquitoes are efficient and effective vectors of these diseases among birds, humans, horses and many other wild and domestic animals.

Culex tarsalis

Culex tarsalis, the Western encephalitis mosquito, is one of California's most important and efficient vectors of WNV, SLE, and WEE. This species is widespread in California. *Cx. tarsalis* prefer to lay their eggs on fresh or lightly polluted standing water such as rice fields, ditches, pastures, waste water ponds, and seasonal wetlands. Other more urban freshwater sources include ornamental ponds, storm drains, and flood control channels. Larvae usually develop into adults in approximately 8-14 days; warmer water can shorten the developmental period. *Cx. tarsalis* are active from spring through fall; however the population in the Central Valley peaks in June to July with a secondary, smaller peak in September coinciding with flooding of seasonal wetlands. *Cx. tarsalis* survive through the winter as adults in barns, culverts, caves, and similar dark, protected places.

Adult *Cx. tarsalis* can disperse a great distance up to 10-15 miles (16-24 km) in search of blood meals, generally traveling along riparian corridors, but most stay close to the site where they emerged. Adults rest by day in shaded areas such as animal burrows and treeholes. Females prefer feeding between dusk and dawn but may bite during the day in deep shade. Females obtain blood meals from birds or mammals and can transmit diseases between these groups.

Culex pipiens* and *Culex quinquefasciatus

Culex pipiens (the northern house mosquito) and *Culex quinquefasciatus* (the southern house mosquito) appear to be identical. *Cx. quinquefasciatus* occurs in Southern California, whereas *Cx. pipiens* is found along the coastal regions and in Northern California and is the most widely distributed mosquito species in the world. Both species can transmit encephalitis viruses. They are common in and around households and prefer to lay eggs in polluted water that is high in organic content such as dairy runoff, wastewater catchment basins, stormwater ponds, dirty flower pots, bird baths, or any drainage systems where standing water exists.

In California, *Cx. pipiens* and *Cx. quinquefasciatus* typically do not disperse from where they emerged. Females feed at dusk or after dark, readily enter homes and prefer avian hosts but will also feed on large mammals including humans. *Cx. pipiens* and *Cx. quinquefasciatus* are vectors of WNV and SLE virus, and have also been implicated in transmitting canine heartworm.

Other *Culex* mosquitoes.
Culex stigmatosoma, the foul water mosquito, and *Cx. erythrothorax* can also be infected with WNV, but their distributions are limited (e.g., *Cx. erythrothorax* is mainly found close to bodies of water with tules).

Appendix E
Typical Larval Habitats of California Mosquitoes*

Riparian	Vernal Pools	Foul Water	Salt Marsh	Treehole
Aedes atropalpus	*Aedes bicristatus*	*Culex pipiens*	*Aedes dorsalis*	*Aedes deserticola*
Aedes washinoi	*Aedes campestris*	*Culex restuans*	*Aedes squamiger*	*Aedes purpureipes*
Aedes pullatus	*Aedes fitchii*	*Culex stigmatosoma*	*Aedes taeniorhynchus*	*Aedes sierrensis*
Aedes sticticus	*Aedes hemiteleus*	*Culex tarsalis*	*Anopheles occidentalis*	*Orthopodomyia signifera*
Aedes vexans	*Aedes increpitus*	*Culiseta impatiens*	*Culex tarsalis*	
Anopheles franciscanus	*Aedes niphadopsis*	*Culiseta incidens*	*Culiseta incidens*	
Anopheles occidentalis	*Aedes ventrovittis*	*Culiseta inornata*	*Culiseta inornata*	
Anopheles punctipennis	*Aedes washinoi*			
Culex apicalis	*Culex tarsalis*			
Culex boharti	*Culiseta incidens*			
Culex reevesi	*Culiseta inornata*			
Culex tarsalis	*Psorophora columbiae*			
Culex territans	*Psorophora signipennis*			
Culex thriambus				
Culiseta impatiens				
Culiseta incidens				
Culiseta particeps				
Culiseta inornata				
Small Container	**Freshwater Marsh**	**Rock Pools**	**Pools and Ponds**	**Snow Melt Pools**
Aedes sierrensis	*Aedes flavescens*	*Aedes sierrensis*	*Aedes sierrensis*	*Aedes cataphylla*
Culex pip/quinq	*Anopheles freeborni*	*Anopheles punctipennis*	*Culex pip/quinq*	*Aedes clivis*
Culiseta incidens	*Anopheles hermsi*	*Culex tarsalis*	*Culex stigmatosoma*	*Aedes communis*
	Anopheles occidentalis	*Culiseta impatiens*	*Culex tarsalis*	*Aedes hexodontus*
	Coquillettidia perturbans	*Culiseta incidens*	*Culiseta impatiens*	*Aedes increpitus*
	Culex erythrothorax		*Culiseta incidens*	*Aedes pullatus*
	Culex tarsalis		*Culiseta inornata*	*Aedes schizopinax*
	Uranotaenia anhydor		*Culiseta particeps*	*Aedes sticticus*
				Aedes tahoensis
				Aedes ventrovittis
				Culiseta incidens
Woodland Pools	**Irrigated Pastures**	**Permanent Ponds**		
Aedes bicristatus	*Aedes dorsalis*	Aedes niphadopsis		
Aedes increpitus	*Aedes melanimon*	*Aedes schizopinax*		
Aedes washinoi	*Aedes nigromaculis*	*Anopheles occidentalis*		
Aedes punctipennis	*Aedes thelcter*	*Culex anips*		
Culex apicalis	*Aedes vexans*	*Culex erythrothorax*		
Culex tarsalis	*Anopheles freeborni*	*Culex reevesi*		
Culex thriambus	*Culex tarsalis*	*Culex tarsalis*		
Culiseta incidens	*Culiseta inornata*	*Culiseta impatiens*		
Culiseta inornata	*Psorophora columbiae*	*Culiseta incidens*		
Culiseta particeps	*Psorophora signipennis*	*Culiseta particeps*		
		Culiseta inornata		
		Coquillettidia perturbans		
		Uranotaenia anhydor		

*Compiled from: Identification of the Mosquitoes of California. Rev. 1998. Mosquito and Vector Control Association of California.

Appendix F
Insect Repellents

A number of products have been developed and registered by the Environmental Protection Agency for human use that repel adult mosquitoes and thus reduce the chances of mosquito bites. The most commonly used mosquito repellents contain the active ingredient DEET (N,N-diethyl-meta-toluamide), which has been formulated and sold under a variety of trade names. Repellents are available in a variety of concentrations and are formulated as aerosol sprays (most commonly at 15%), lotions, and solids (up to 100%). Spray repellents can be used on outer clothing as well as sparingly on the skin to ensure complete coverage. Repellents should not be used under clothing. The percentage of DEET in the repellent reflects the approximate length of time the product will repel mosquitoes (e.g., 23.8% DEET = about five hours of protection, 20% = about four hours, and 6.6% DEET = about two hours).

Topical repellents that contain picaridin, IR-3535, and oil of lemon eucalyptus are similar in efficacy to those with DEET, but often require more frequent application. Clothing and others materials impregnated with permethrin during manufacture are also available. It is important to always carefully read and understand the benefits and limitations of repellents listed on the product label before use. By law, all repellent products must be used according to their labels.

Appendix G
Additional Resources and Information

Mosquito Biology

Additional information on mosquitoes and mosquito-borne diseases is easily obtainable from a variety of reputable sources. More information on mosquito biology and ecology is available on the American Mosquito Control Association (AMCA) and the Mosquito and Vector Control Association of California (MVCAC) websites. Local mosquito and vector control agencies and their respective websites can provide detailed information about local mosquito species. Information on mosquito-borne diseases is available from the Centers for Disease Control and Prevention (CDC) and the CDPH websites. Contact information for local mosquito and vector control agencies in California can be found through the CDPH website by entering the zip code of the location of interest under "**Locate Your Local Mosquito and Vector Control Agency**" at http://www.westnile.ca.gov/; more information is available on the MVCAC website.

Monitoring Mosquitoes and Diseases

More information about reporting dead birds and WNV surveillance in California can be found at westnile.ca.gov/.

- Methods for sampling adult mosquitoes and guidelines for designing, operating, and processing of traps are discussed in Guidelines for Integrated Mosquito Surveillance (Meyer et al. 2003) and are summarized in Appendix B of the California Mosquito-Borne Virus Surveillance and Response Plan which can be found at: http://www.westnile.ca.gov/resources.php

- The Centers for Disease Control and Prevention, Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention and Control http://cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-aug-2003.pdf

- Walton WE. 2005. Protocol for Mosquito Sampling for Mosquito Best Management Practices on State of California-Managed Wildlife Areas. University of California.

Health Department Websites

California Department of Public Health West Nile virus (WNV) website: http://www.westnile.ca.gov

United States Center for Disease Control and Prevention website: http://cdc.gov

US Centers for Disease Control and Prevention – West Nile Virus website: http://cdc.gov/ncidod/dvbid/westnile/index.htm

Disease Surveillance Websites

UC Davis Center for Vectorborne Diseases website: http://cvec.ucdavis.edu

California Vectorborne Disease Surveillance Gateway website: http://www.calsurv.org/

Best Management Practices

- Best Management Practices for Mosquito Control on California State Properties: http://www.westnile.ca.gov/resources.php

- For additional information on personal protective measures and the use of chemical repellents, go to the Centers for Disease Control and Prevention (CDC) web site at: http://www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm.

- For more information on evaluating the efficacy of BMPs on state of California-managed Wildlife Areas, see Walton 2005.

Mosquito Control

American Mosquito Control Association website: http://www.mosquito.org

Mosquito and Vector Control Association of California website: http://www.mvcac.org

University of California at Davis Center for Vectorborne Diseases website: http://cvec.ucdavis.edu

University of California IPM Online website: http://www.ipm.ucdavis.edu/

Additional Online Resources

Climate Information

National Weather Service – Climate Prediction Center website: http://www.cpc.ncep.noaa.gov/products/predictions

Water Related Information

California Data Exchange Center website: http://cdec.water.ca.gov

Pesticide and Insect Repellent Information

National Pesticide Telecommunications Network website: http://npic.orst.edu/factsheets/DEETgen.pdf

National Pesticide Information Center website: http://npic.orst.edu/

Agriculture and Crop Related Information

California Agricultural Statistics Service website: http://www.nass.usda.gov/ca

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California Department of Transportation. 2006 Right-of-Way Property Management and Airspace Storm Water Guidance Manual. http://www.dot.ca.gov/hq/row/rwstormwater/index.htm

California Environmental Resources Evaluation System and the California Wetlands Information System. http://ceres.ca.gov/wetlands/

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Sacramento-Yolo Mosquito and Vector Control District. 2005. Mosquito and Mosquito-Borne Disease Management Plan. Elk Grove, CA: Sacramento-Yolo MVCD. www.Fightthebite.net

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United States Environmental Protection Agency. 2004. The Use of Best Management Practices (BMPs) in Urban Water Sheds. National Risk Management Research Laboratory. http://www.epa.gov/nrmrl/pubs/600r04184/600r04184.pdf

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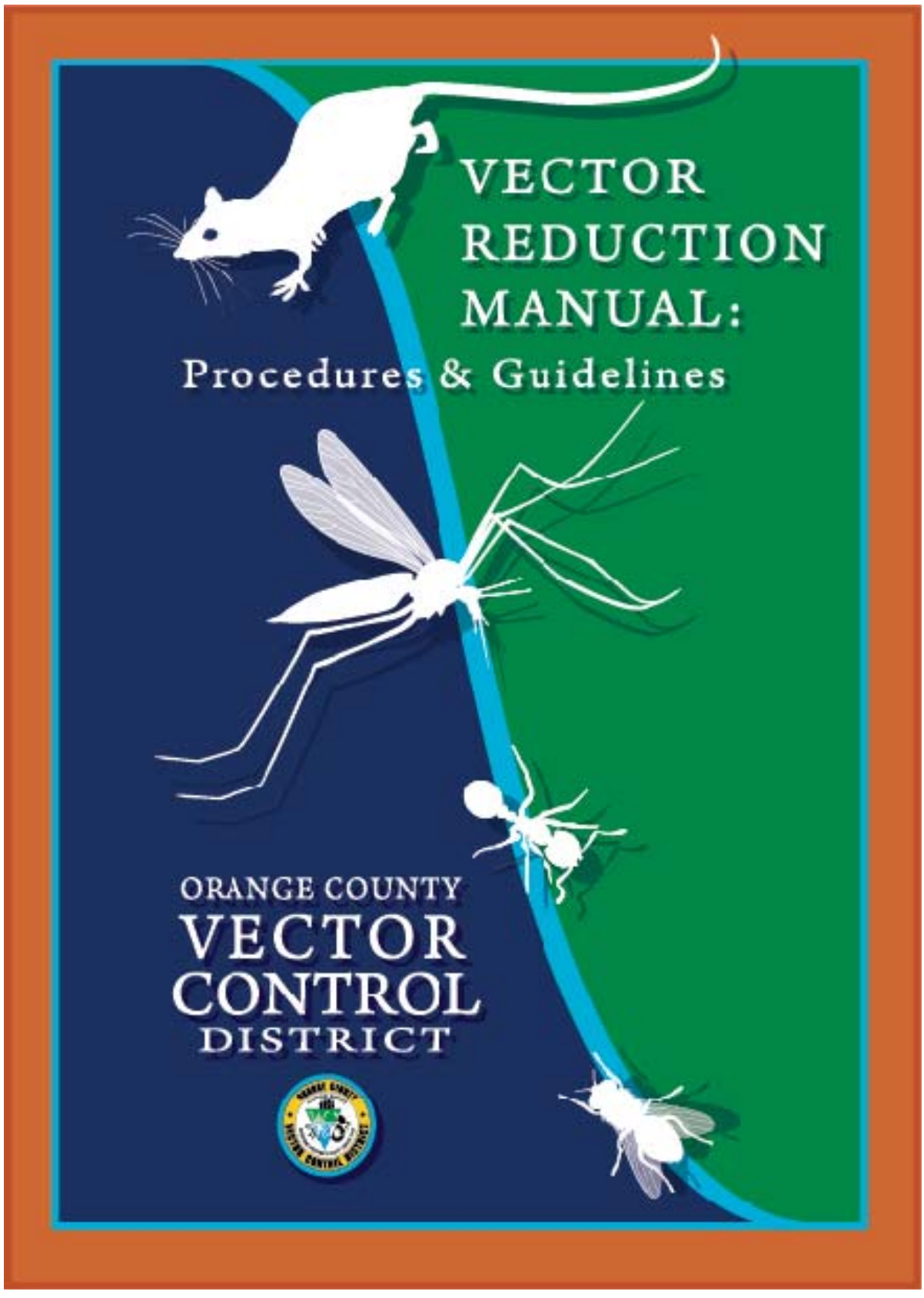
List of Acronyms

AMCA	American Mosquito Control Association
BMP	Best Management Practices
Bs	*Bacillus sphaericus*
Bti	*Bacillus thuringiensis israelensis*
CDC	Centers for Disease Control and Prevention
CDPH	California Department of Public Health
CVEC	Center for Vectorborne Diseases (UC Davis)
DFG	California Department of Fish and Game
CDPR	California Department of Pesticide Regulation
EPA	Federal Environmental Protection Agency
H&S Code	California Health and Safety Code
MVCAC	Mosquito and Vector Control Association of California
SLE	St. Louis encephalitis virus
UCD	University of California, Davis
WEE	Western equine encephalomyelitis virus
WNV	West Nile virus


VECTOR
REDUCTION
MANUAL:
Procedures & Guidelines
ORANGE COUNTY
VECTOR
CONTROL
DISTRICT

Vector Reduction Guidelines

The Vector Reduction Guidelines contained in this manual are assembled from a number of sources including scientific literature, state and inter-agency documents, pesticide label and use requirements, and from experienced vector control professionals. The intended use of this document is to provide general guidance, not site-specific requirements. The Vector Reduction Guidelines that are most applicable to a specific vector-breeding source may be selected from the list and incorporated into a specific Vector Management Plan for a specific source in consultation with District personnel.

Vector Reduction Program

VECTOR REDUCTION PROGRAM POLICIES

The Orange County Vector Control District (the District) recognizes that cooperative land management practices can reduce vector[1] populations. Long-term costs are reduced because smaller populations require less staff time and lower pesticide use. These practices help to protect public health and are an integral part of the District's Integrated Vector Management (IVM) approach to mosquito and vector control.

Integrated Vector Management is a process that focuses on site-specific, scientifically sound strategies to manage vector populations. These policies and procedures have been adopted by the District as effective control measures for vectors. Landowners and land managers can use these guidelines to address vector control problems that are identified by the District.

Integrated Vector Management techniques vary at each site depending on the conditions found at the site. These techniques are commonly grouped into four categories:

1. Cultural Control – Change the behavior of people so that their actions prevent the development of vector populations or the transmission of vector-borne disease.
2. Source Reduction or Physical Control – Environmental manipulation that results in a reduction of vector development sites.
3. Biological Control – Use of biological agents to limit vector populations
4. Chemical Control – Pesticides that target different life stages of vector populations

The Vector Reduction Guidelines referred to in this document are the recommended land management practices that can provide a reduction in vector populations by various means including: reducing or eliminating breeding areas, or harborages, increasing the efficacy of biological controls, increasing the efficacy of chemical controls, and improving access for control operations. These Vector Reduction Guidelines have been developed based on the District's experiences with stakeholder groups including landowners, land managers, regulatory agencies, and other interest groups. As a result of this process, the District is prepared to offer practical and appropriate Vector Reduction Guidelines for the variety of land uses that exist in Orange County. Not all vector reduction guidelines included in this document will apply equally to all vector sources; however, they serve as a starting point in the cooperative development of a site-specific Vector Management Plan.

The District encourages those responsible for Significant Vector Sources on properties under their control to develop and implement a cooperative Vector Management Plan with the District

[1] A vector means any insect or other animal capable of transmitting the causative agent of human disease or capable of producing human discomfort or injury including, but not limited to, mosquitoes, flies, red imported fire ants, and rats.

to avoid the need for the formal enforcement actions authorized under the California Health and Safety Code (HSC). In some situations, the District must employ the HSC in order to ensure safe conditions and to carry out its public responsibilities. However, it has been the District's experience that a cooperative approach to source reduction results in effective and long-lasting vector management.

The Vector Reduction Guidelines are designed to address vector sources including, but not limited to, managed wetlands, stormwater structures, wastewater facilities, residential properties, cemeteries, and golf courses. Many of these sources provide favorable habitats for vectors and produce significant vector populations.

Vector populations in Orange County can be reduced through the widespread implementation of vector reduction strategies and techniques. The policies and procedures outlined in this document specifically target Significant Vector Sources, but can be applied to any vector sources.

In circumstances where the implementation of a Vector Management Plan would cause economic hardship or technical difficulties, the District may choose to offer assistance in the form of technical advice, or other resources. Vector reduction projects can be planned in stages to provide time for budgeting considerations and obtaining any necessary regulatory permits. The level of assistance offered will be determined on a case-by-case basis.

SIGNIFICANT VECTOR SOURCES

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

- Vector production from the source is more than similar land uses, and exceeds treatment thresholds outlined in the Vector Management Plan;
- 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
- Vector Reduction Guidelines exist to address the land management practices and can be reasonably utilized to reduce vector production, harborage, or other vector favorable conditions.

If left untreated, a Significant Vector Source would be considered a public nuisance as defined in the California Health and Safety Code (HSC) §2002(j). Sources adjacent to and within population centers will be selected for inclusion in the Vector Reduction Program. Other factors, such as treatment costs, vector-borne disease status, vector species produced, and the efficacy of available treatment options will be considered when evaluating a Significant Vector Source, as defined above.

Surveillance data will be used to determine vector abundance prior to, and after implementation of, the Vector Management Plan for a Significant Vector Source. When mosquitoes are the problem, a combination of larval dip data and adult mosquito surveillance data will be used to assess vector abundance. When rats are the problem, signs of a rodent infestation, such as feces and gnawing, availability of food sources, and potential harborage will be used. If Red Imported Fire Ants (RIFA) are the cause of a Significant Vector Source, mound counts and presence of foraging workers will be used to assess Vector Management Plan success. Adult flies and presence of larval fly sources will be used to assess a significant fly source. In cases where existing data or current sampling methods are not sufficient to determine the efficacy of a particular Vector Management Plan, a specific monitoring plan will be established to meet the needs of the Significant Vector Source.

Management practices that contribute to increased vector production include, but are not limited to, poor water management, lack of emergent vegetation control, buildup of debris that restricts water conveyance, poor condition of water conveyance or drainage structures, practices that impede access to the source, and lack of notification of practices that would affect vector control operations.

VECTOR MANAGEMENT PLAN

Once the District has identified a Significant Vector Source, staff will present a draft Vector Management Plan to the responsible party, in consultation with state and federal biologists, if appropriate, proposing a course of action based on one or more Vector Reduction Guidelines that, if implemented, can reduce or eliminate the Significant Vector Source.

The draft Vector Management Plan will contain at least the following:

- Justification for requested actions.
- Description of the proposed Vector Reduction Guidelines, including specific guidance regarding method and timing of implementation.
- District resources available to assist with Vector Reduction Guideline 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 will proceed to the legal Vector Abatement Process under the California Health and Safety Code

§2060-2067 and District Resolution No. 340: Orange County Vector Control District's Nuisance Abatement Procedures (see Appendix 1).

CHARGES FOR TREATMENT COSTS

The District is authorized by the Health and Safety Code to recover treatment costs for vector control operations. Since properties in the District pay for a base level of vector control through the payment of property taxes, the District would consider charging for treatment costs that are above and beyond the normal level of treatment required by a similar vector source with a similar land use. Since one of the primary goals for the Vector Reduction Program is to reduce pesticide use in Orange County, the District would only consider accepting charges for additional treatment in lieu of implementing Vector Reduction Guidelines on a case-by-case basis for a limited time. As new Vector Reduction Guidelines are developed and efficacy of existing Vector Reduction Guidelines are researched further, the expectation would be that the charges for pesticide treatment would be replaced by non-pesticide based, long-term Vector Management Plans.

APPEAL PROCESS

The responsible party may submit comments in writing to the Director of Operations before the implementation deadline indicated on the draft Vector Management Plan presented to the responsible party in Step #2 on Figure 1 (Flow Chart). After review, the Director of Operations will issue a determination which may include; 1) no change in the content of the draft Vector Management Plan; 2) an extension of the implementation deadline; 3) a waiver of fees; or 4) other appropriate action, such as the implementation of an abatement process leading to civil action (see Appendix 1).

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

VECTOR REDUCTION PROGRAM IMPLEMENTATION PROCESS FOR SIGNIFICANT VECTOR SOURCES

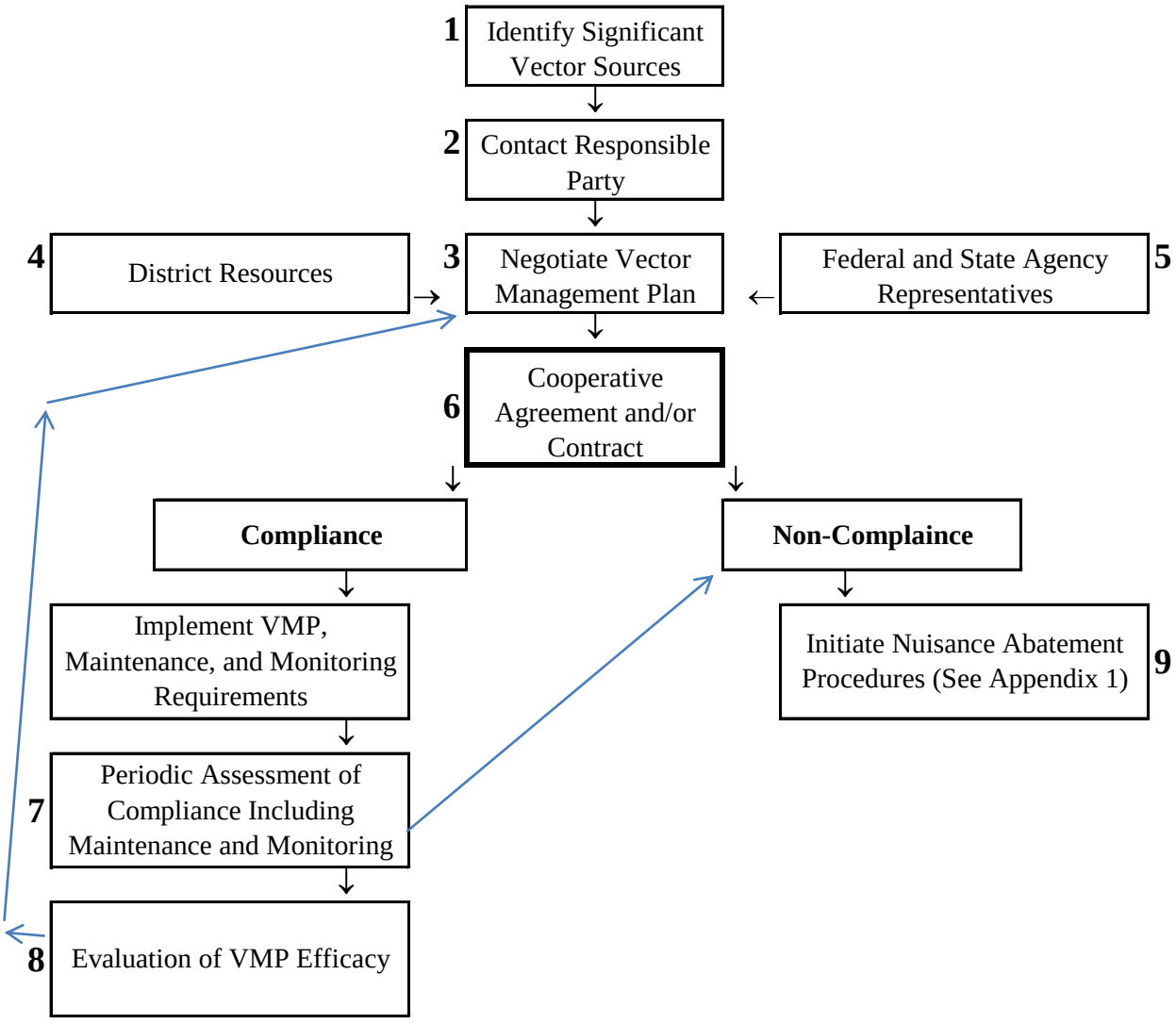
The following items represent a chronological progression of the Vector Reduction Program actions after a Significant Vector Source is identified.

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

1. **Identify a Significant Vector Source** – The District will identify Significant Vector Sources based on the previously defined criteria.
2. **Contact Responsible Party** – The District will contact the responsible party (as defined in the California Health and Safety Code §2060) of properties in Orange County that have been identified as a Significant Vector Source, that if untreated, would become a public nuisance. The District will also contact state and federal agencies that have a vested interest in the property, such as a conservation easement, habitat management plan, or other habitat maintenance agreement. A draft Vector Management Plan will be provided to the responsible parties. This plan will include an explanation of why the site was determined to be a Significant Vector Source, including vector surveillance data, if requested.
3. **Negotiate Vector Management Plan** – The District will work with the responsible party to determine a course of action to address the vector source including specific Vector Reduction Guidelines, implementation timeline, maintenance requirements, and monitoring plan. A defined negotiation period will be designated at the start of the negotiations.
4. **District Resources** – At the discretion of the District, resources may be made available to assist in complying with the Vector Management Plan 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. In some cases, the District will use a Vegetation Agreement or Source Reduction Agreement to establish a contract with the property owner. The 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. These agreements shall be subject to the same requirements as any other agreement covered by these policies.
5. **Coordinate and Assist with Other Regulatory Agencies** – Coordinate with other local, state, federal, and conservation agencies during the negotiation process to avoid or address any potential regulatory conflicts with the draft Vector Management Plan.
6. **Cooperative Agreement and/ or Contract** – A cooperative agreement and/or contract will formalize the relationship between the District and the responsible party. This document will also outline the consequences of non-compliance with the Vector Management Plan under the California Health and Safety Code.
7. **Monitoring** – After successful implementation of the requirements, regular inspections of the property will be conducted to assess continued maintenance and compliance with the site's Vector Reduction Guidelines as identified in the Vector Management Plan. The District reserves the right to renegotiate the Vector Management Plan if it is determined that adequate vector 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.

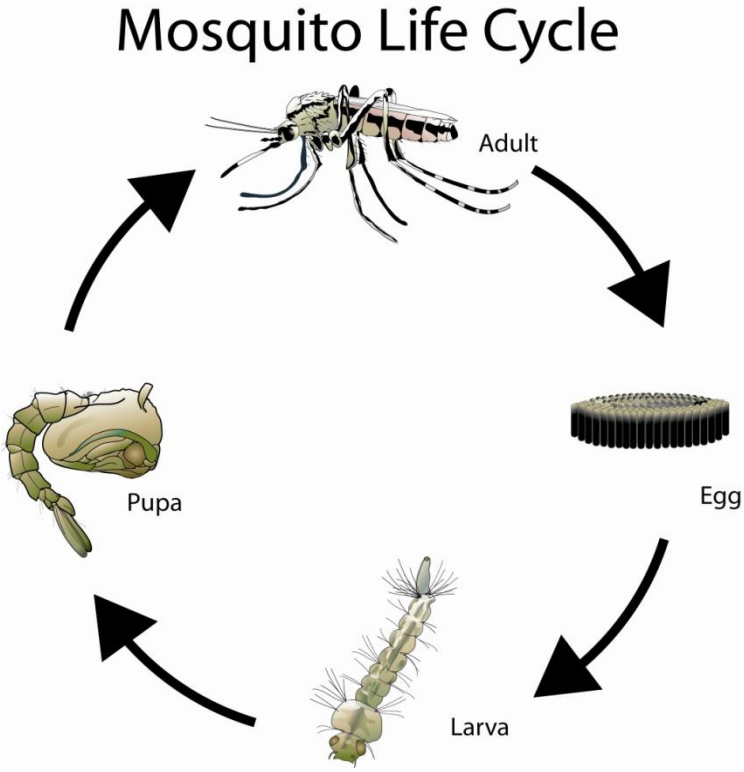
8. **Evaluation of Vector Management Plan Efficacy** – An effective vector control plan requires regular assessment and adaptive management to address changing conditions or unforeseen effects. The District will evaluate each Vector Management Plan to determine if the Vector Reduction Guidelines are meeting the needs of both the responsible party and the District. Based on this evaluation, either party may initiate a review of the Vector Management 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 Manager pursuant to the District's Nuisance Abatement Procedures (see Appendix 1) to begin the Formal Abatement process as defined in HSC §2061.

Figure 1. Vector Reduction Program Implementation Process Flow Chart



MOSQUITO REDUCTION GUIDELINES

There are over 20 species of mosquitoes that occur in Orange County. Fortunately, only 13 species 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 Vector Reduction Guideline.



Mosquito Biology

All mosquitoes share a similar life cycle with an aquatic stage (larvae) and an aerial stage (adult). Nearly all Vector Reduction Guidelines focus on managing the aquatic stage of the mosquito by creating conditions that are 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 situations 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 understand how a particular mosquito reduction guideline reduces the population.

To understand mosquito reduction guidelines, it is useful to think of mosquitoes as belonging to one of the following three categories.

Standing –Water Mosquitoes prefer water commonly found in ornamental ponds, unmaintained swimming pools, freeway drains, stormwater systems, natural waterways, and flood control channels.

Common Mosquito Reduction Guidelines:

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. mosquito fish).
d. Contact the District to coordinate mosquito prevention with other mosquito control operations.

Container Mosquitoes prefer contained areas of water, such as tree holes, buckets, tires, etc. Some standing water mosquitoes will also develop in containers.

Common Mosquito Reduction Guidelines:

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

Salt Water Mosquitoes lay their eggs on moist soil. When they become submerged, due to tidal fluctuations, the eggs hatch.

Common Mosquito Reduction Guidelines:

a. Flood when air temperatures do not encourage rapid mosquito development (late fall rather than summer).
b. Reduce or eliminate emergent vegetation.
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.

RESIDENTIAL AND COMMERCIAL MOSQUITO SOURCES

Common Mosquito Development Sites

- Backyard Sources
- Low Impact Developments (e.g., Rain Barrels)
- Pools & Spas
- Ornamental Ponds & Water Features
- Tire storage
- Unmaintained 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
- Small Drains

Common Mosquito Species

- Cleaner water sources: *Culex tarsalis.*
- Water with more organic material*: Culex quinquefasciatus, Culex stigmatosoma,* and *Culiseta incidens.*

Special Concerns

Urban and suburban mosquito sources are especially problematic because they produce mosquitoes in areas of high population density where many people live and work. This can quickly lead to vector–borne disease transmission since the vector (mosquito) and host (human) are often in close proximity. These sources may be in and around private residences which are not easily seen or accessed by District staff. Economic or social changes in a neighborhood can result in an increase in mosquito sources, such as unmaintained swimming pools and spas. Fortunately, many of the Mosquito Reduction Guidelines 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 96 hours.
2. Maintain irrigation systems to avoid excess water use and runoff into storm drains.
3. Maintain water features such as ponds and fountains to circulate water with pumps that run at least eight hours a day. If the feature has no pump, water should be changed every 96 hours to prevent mosquito breeding and/or pesticide treatment may be necessary.

4. Maintain access for District staff to monitor and treat mosquito breeding sources.
5. Contact District staff for technical guidance or assistance in implementing Vector Reduction Guidelines for large mosquito breeding sources.
6. If unable to control mosquito breeding contact, the District for advice and help.

Residential and Commercial Mosquito Reduction Guidelines

RC-1 Drain all containers of standing water, including pet dishes, potted plant drip trays, boats, birdbaths, and tires and buckets at least once per week. Mosquitoes can develop in as little as a 1/8" of standing water. Be aware of containers and objects that are subject to collecting water. If possible, drill drainage holes, cover, or invert any container, or object, that holds standing water and must remain outdoors. Be sure to check for containers or trash in places that may be hard to see, such as under bushes or buildings.

RC-2 Dispose of unwanted or unused artificial containers, and properly dispose of old tires.

RC-3 Maintain pools and spas. Use skimmers and filter systems to remove egg rafts and mosquito larvae.

RC-4 If a pool or spa is not going to be operational for any reason, notify the District so that the pool or spa can be inspected regularly and treated with an appropriate larvicide and/or stocked with mosquito fish, if needed. These services are provided at no additional charge and are supported by property taxes.

RC-5 Notify the District of any ponds or water features (including ponds with ornamental fish such as Koi or goldfish) with permanent water. Allow District Inspectors to inspect and periodically stock mosquito fish or other biological control, as necessary, for the control of mosquito larvae.

RC-6 Landscape irrigation drainage should be managed such that no water stands for more than 96 hours.

RC-7 All underground drain pipes should be laid to grade to avoid low areas that may hold water for longer than 96 hours.

RC-8 Maintain rain gutters and other gutter structures by removing leaves, debris, and standing water from these features, as necessary, following rain events.

RC-9 Provide safe access for District staff to all pools, spas, ponds, landscape irrigation structures, catch basins, storm drains, drainage pipes, sewer cleanouts, or any other potential mosquito breeding source.

RC-10 Repair leaks or damaged drainage system components to prevent standing water for more than 96 hours.

RC-11 Notify District staff of any condition that may produce mosquitoes on the property such as flooding, broken pipe, damaged septic tank cover, or a leaking outdoor faucet if it results in standing water for more than 96 hours.

RC-12 Small Drains – screen and keep free of water and debris.

Low Impact Developments (e.g., Rain Barrels)

RB-1 Prevent mosquito breeding in rain barrels by properly screening all openings to prevent mosquito access to the stored water. If larvae are observed in a rain barrel, contact the District.

Ornamental Ponds and Water Features

P-1 All ponds should be surrounded by land of adequate width to allow safe passage of District staff and/or equipment.

P-2 Banks should be steeply sloped and lined to three feet below the water level with a suitable material such as concrete or clay, or be regularly treated with residual herbicides to ensure permanent weed prevention[2].

P-3 To minimize invasive emergent vegetation in ponds, use a slope angle of at least 2:1. Bank slopes of 2.5:1 to 4:1 (vertical: horizontal) and minimum depths of four to five feet to significantly reduce bottom-rooted aquatic plants.

P-4 Large ponds and lakes should have raised embankments a minimum width of 12 feet and be adequately constructed to support maintenance vehicles.

P-5 Ponds or ornamental water features should be stocked with mosquito fish when possible. Contact the District for an assessment.

P-6 Vegetation should be controlled regularly to prevent overgrowth of emergent vegetation and vegetative barriers for District access. This includes vegetation control to maintain access to lanes and paths, interior pond embankments, and any weed growth that might become established within the pond.

Tire Storage

TS-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 accumulation of water.

[2] Per National Pollutant Discharge Elimination System (NPDES) authorization, or other approval if needed.

TS-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.

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

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

TS-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.

TURF AND LANDSCAPE

Common Mosquito Development Sites

- Sprinklers & Irrigation Systems
- Small Drains
- Nurseries
- Cemeteries
- Golf Courses
- Equestrian Facilities
- Parks
- Agriculture

Common Mosquito Species

- Cleaner water sources: *Culex tarsalis.*
- Water with more organic material*: Culex quinquefasciatus, Culex stigmatosoma,* and *Culiseta incidens.*

Special Concerns

Turf and landscape sources are especially important because they occur near areas of high population density and contain vector sources (e.g., ponds, vases, plant containers) that may not be easily accessible to the District. These sources occur in areas where people recreate and/or work during dusk and dawn which are periods of high mosquito activity. Additionally, these sources can add significant water to the underground storm drain system, thereby increasing vector habitat.

General Mosquito Reduction Principles

1. Prevent or eliminate unnecessary standing water that remains for more than 96 hours.
2. Maintain irrigation systems to avoid excess water use and runoff into storm drains.
3. Maintain water features, such as ponds and fountains, to circulate water with pumps avoid stagnate water conditions. If the feature has no pump, water should be changed every 96 hours to prevent mosquito breeding and/or pesticide treatment may be necessary.
4. Maintain access for the District to monitor and treat mosquito breeding sources.
5. Contact the District for technical guidance or assistance in implementing mosquito reduction strategies for larger mosquito breeding sources.
6. If unable to control mosquito breeding, contact the District.

Sprinkler & Irrigation Systems

SL-1 Landscape irrigation drainage should be managed such that little or no water enters the stormwater system.

SL-2 Avoid over-irrigation to prevent accumulation of wastewater that results in pooling and runoff.

SL-3 All underground drain pipes should be laid to grade to avoid areas that may hold water.

SL-4 Repair leaks or damaged drainage system components to prevent standing water.

Nurseries

N-1 Follow all recommendations for mosquito breeding reduction in sprinkler and irrigation sources.

N-2 Inspect to ensure that all containers drain properly and contain no standing water, including potted plants and potted plant bases.

N-3 Inspect plants imported from outside of Orange County for standing water and/or mosquito eggs (e.g., *Aedes albopictus*).

N-4 Notify the District immediately if employees are being bitten by mosquitoes.

N-5 Back-fill tire ruts and other low areas that hold water for more than 96 hours.

N-6 Keep drainage ditches free of excessive vegetation and debris to promote rapid drainage.

N-7 Repair and seek to improve irrigation systems to increase water use efficiency.

Cemeteries

C-1 Empty all flower vases weekly.

C-2 Seek alternatives to in-ground or mounted flower vases which hold water for more than 96 hours.

C-3 Switch flower vases to wire stands that hold flowers or plants above ground surface.

C-4 Notify District staff immediately if employees or visitors are bitten by mosquitoes.

Golf Courses

GC-1 Land grades should have sufficient fall to prevent mid-field ponding, especially in soils with high clay content.

GC-2 Irrigate only as frequently as is needed to maintain proper soil moisture. Check soil moisture regularly.

GC-3 Manage irrigation to prevent ponding of water.

GC-4 Drains should have gradients from 1 in 40 to 1 in 110 to provide good water flow and be maintained free of clogs and vegetation.

GC-5 Do not over fertilize. Over-fertilization can leach into irrigation run-off which may facilitate mosquito production in ditches and/or become contamination further downstream.

GC-6 Keep equipment off soil when the ground is soft. Mosquito habitat is created when water collects in tire ruts.

GC-7 Refer to Pond section for information regarding reduction of mosquito breeding in water hazards.

Equestrian Facilities

EF-1 Identify areas on the property where water can accumulate and remain standing for more than 96 hours. Mark these areas on a site map and assess them after rainfall or irrigation.

EF-2 Eliminate containers that accumulate and hold water for more than 96 hours. When containers cannot be eliminated, drain standing water every 96 hours, or place mosquito fish.

Agriculture

A-1 Water allotments to farming operations should be limited to reasonable needs for the size of fields, type of soil, and crop requirements.

A-2 Plantings watered by drip irrigation should be checked to ensure that the system is not over watering and causing standing water that could produce mosquitoes.

A-3 Land grades should have sufficient fall to prevent mid-field ponding, especially in soils with high clay content, except where drip irrigation is being used.

A-4 Graded ditches should be located at the low ends of fields for draining and proper management of rainwater runoff and tail water.

A-5 Remove vegetation and other blockages from V ditches on the property on a regular basis to prevent stagnant water from pooling and becoming a mosquito breeding site.

A-6 Provisions should be made to drain irrigation ditches, pipelines, and other features of water after each use to prevent mosquito breeding habitats.

A-7 Animal confinement operations should be designed with sloped loafing and feeding corrals for proper drainage. If water troughs are being used, they should be monitored to detect potential mosquito production.

A-8 Inform the District of organic agriculture practices so that the District can provide control.

STORMWATER SYSTEMS AND URBAN RUNFOFF

Common Mosquito Development Sites

- Detention/retention basins
- Treatment wetlands
- Catch basins/storm drains
- Underground water storage devices
- Underground drain systems
- Clogged sediment screens
- Blocked culverts
- Roadside ditches

Common Mosquito Species

- Above ground/clean–water sources: *Culex tarsalis.*
- Underground/polluted or nutrient rich water*: Culex quinquefasciatus, Culex stigmatosoma,* and *Culiseta incidens.*

Special Concerns

Management of mosquitoes and other vectors in stormwater management structures, such as flood control basins and other structural stormwater Best Management Practices (BMPs) is critical for protecting public health. With careful planning, such structures can be designed, built, operated, and maintained in a manner that minimizes opportunities for the proliferation of vectors. The District stresses the importance of identifying and resolving potential mosquito sources in stormwater structures at the planning stages of new development.

General Mosquito Reduction Principles

1. Maintain access for District staff to monitor and treat mosquito breeding sources.
2. Consider mosquito reduction standards during the design and construction of stormwater infrastructure and allocate funds to maintenance of the infrastructure.
3. Manage sprinkler and irrigation systems to minimize runoff entering stormwater infrastructure.
4. Avoid intentionally running water into stormwater systems (e.g., washing sidewalks and driveways, washing cars on streets, etc.).
5. Minimize emergent vegetation and surface debris in the water.
6. Provide the District access to accumulated water allowing for mosquito treatment and control.

Above Ground Structures

AG-1 Build shoreline perimeters as steep and uniform as practicable to discourage excessive plant growth.

AG-2 Whenever possible, maintain stormwater ponds and wetlands at depths in excess of four feet to limit the spread of invasive emergent vegetation, such as cattails (*Schoenoplectus* spp.) and bulrush (*Typha* spp.).

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

AG-4 Perform routine maintenance to reduce and contain emergent plant densities to facilitate the ability of mosquito predators (i.e., fishes) to move throughout vegetated areas.

AG-5 Keep or make shorelines accessible for periodic maintenance, control, and removal of emergent vegetation, as well as for routine mosquito monitoring and abatement procedures, if necessary.

AG-6 Design in drainage systems and obtain necessary approvals for all stormwater ponds and wetlands to allow for complete draining when needed for periodic maintenance and silt removal.

AG-7 The effective swath width of most backpack or truck–mounted larvicide sprayers is approximately 20 feet 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 wide.

AG-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 application of larvicides to the water. Access roads and paths need to be maintained and free of vegetation overgrowth.

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

AG-10 Design structures so they do not hold standing water for more than 96 hours. Special attention to groundwater depth is essential to prevent groundwater seepage and permanent standing water.

AG-11 Allow water to flow by gravity through the structure by use of a hydraulic grade line. Pumps are not recommended, are subject to failure, and often require sumps that hold water.

AG-12 Avoid the use of loose riprap or concrete depressions that may create and hold standing water.

AG-13 Avoid barriers, diversions, or flow spreaders that may retain standing water.

AG-14 Use concrete or liners in shallow areas to discourage unwanted plant growth where vegetation is not necessary.

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

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

AG-17 Design distribution piping and containment basins with adequate slopes to drain fully and prevent standing water. The design slope should take sediment accumulation into consideration between maintenance periods. Compaction during grading may also be needed to avoid slumping and settling.

AG-18 Catch Basins, drop inlets, storm drains, and other structures originally designed to fully drain water should be regularly checked and maintained to function as designed.

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

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

AG-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, driveway sump drains)

US-1 Completely seal structures that retain water permanently or longer than 96 hours to prevent entry of adult mosquitoes.

US-2 Stormwater structures utilizing covers should be tight fitting, with maximum allowable gaps 1/16 inch, to exclude entry of adult mosquitoes.

US-3 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 long distances through pipes to access water).

US-4 Design structures with the appropriate pumping, piping, valves, or other necessary equipment to allow for easy dewatering of the unit.

Flood Channels

FC-1 Provide proper grades to ensure that water flows freely.

FC-2 Low-flow channels should be maintained free of debris.

FC-3 Perform regular maintenance to remove vegetation, debris, trash, and sediment accumulated inside the channel to ensure that water flows freely.

FC-4 Remove or trim vegetation that overhangs the channel to minimize the amount of material that naturally falls into the channel.

FC-5 Avoid the use of loose rock riprap that may create and hold standing water.

FC-6 Maintain clear access along the entire length of the channel for the District to conduct surveillance and control activities.

Natural Watercourses

NW-1 Perform frequent maintenance as needed to trim or remove vegetation, debris, trash, and sediment accumulated inside the natural watercourse to ensure that water flows freely.

NW-2 Perform routine maintenance to reduce emergent plant densities to facilitate the ability of mosquito predators (e.g., fishes) to move throughout vegetated areas.

NW-3 Assure accessibility to maintenance and vector control crews for periodic maintenance, control, and trimming or removal of emergent vegetation, as well as for routine mosquito monitoring and abatement procedures, if necessary.

NW-4 Coordinate with Orange County Flood Control Division on areas under their jurisdiction for maintenance. Report blockages and problematic vegetation to Orange County staff to perform needed maintenance.

Freeway Drains

FD-1 Provide proper grades to ensure that water flows freely and does not stand for more than 96 hours.

FD-2 Perform frequent maintenance as needed to remove vegetation, debris, trash, and sediment accumulated inside the drain to ensure water flows freely.

FD-3 Remove or trim vegetation that overhangs the freeway drain to minimize the amount of material that naturally falls into the structure.

FD-4 Avoid the use of loose rock riprap that may hold standing water.

FD-5 Maintain clear access along the entire length of the freeway drain for District staff to conduct surveillance and control activities.

Wastewater Management

WM-1 Monitor all treatment ponds for mosquito larvae – particularly in areas of emergent vegetation.

WM-2 Remove emergent vegetation from edges of aerated ponds.

WM-3 Immediately incorporate sludge into soil through plowing or disking.

WM-4 Ensure all water distributed onto evaporation ponds dries completely in less than 96 hours.

WM-5 Check abandoned ponds or tanks weekly to ensure they are completely dry.

WM-6 Prevent the formation of any crust on treatment ponds or tanks.

WETLANDS

Common Mosquito Development Sites

- Permanent wetlands for habitat or species conservation
- Constructed vernal pools and other wetlands
- Seasonal wetlands
- Tidal marshes

Common Mosquito Species

- Permanent wetlands: *Culex tarsalis, Culex erythrothorax, and Culiseta incidens*.
- Seasonal wetlands: *Aedes* species.

Special Concerns

Wetlands vary depending on the management goals for the habitat, and may be subject to additional regulations, including state and federal conservation easements and policies, and habitat mitigation or management plans. Vector Reduction Guidelines attempt to balance the management goals of land managers, land owners, and other regulatory agencies with the ultimate goal of creating and maintaining habitat that is least-suitable for mosquito breeding. The District is committed to working with wetland managers and state and federal regulatory agencies to implement mosquito control practices in a proactive and 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 vector reduction guidelines, or to coordinate flood/treatment schedules with mosquito control operations.

Design and Maintenance

DM-1 Maintain all open ditches by regularly removing trash, silt, and vegetation, including roots to maintain efficient water delivery and drainage.

DM-2 Provide reasonable access along existing roads and levees to allow the District access for monitoring, and control activities. Make shorelines of natural, agricultural, and constructed water bodies accessible to crews for periodic maintenance, control, and removal of emergent vegetation.

DM-3 Inspect, repair, and clean water-control structures of debris. Remove silt and vegetation build–up in front of structures that impede drainage or water flow. Completely close, board, or fill in to prevent unnecessary water flow, except where water circulation is necessary.

DM-4 Perform regular pump efficiency testing and make any necessary repairs to maximize output, if pumps are required.

DM-5 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.

DM-6 Inspect and repair roads and levees, at least annually.

DM-7 Design managed wetland projects to include independent inlets and outlets for each wetland unit.

DM-8 Construct or enhance swales so they are sloped from inlet to outlet and allow the majority of the wetland to be drawn down.

DM-9 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.

Vegetation Management

VM-1 Control floating vegetation conducive to mosquito production (e.g., water hyacinth, water primrose, parrot's feather *Eichhornia* spp., duckweed *Lemna* and *Spirodela* spp., and filamentous algal mats).

VM-2 Perform routine maintenance to reduce problematic emergent plant densities and to remove dead top-killed vegetation from periodic freezing weather conditions to facilitate the ability of mosquito predators (e.g., fishes) to move throughout vegetated areas and allow good penetration of pesticides.

Water Management

WM-1 Maintain stable water level by ensuring constant flow of water into pond or wetland to reduce water fluctuation due to evaporation, transpiration, outflow, and seepage.

WM-2 Delay fall flooding to avoid increasing late–season mosquito production (Kwasny et. al., 2004).

WM-3 Flood managed wetlands as fast as possible and as deep as possible (18–24”). Shallow water levels can be maintained during winter months.

WM-4 Maintain permanent or semi–permanent water where mosquito predators can develop. Discourage the use of broad spectrum pesticides.

WM-5 Where feasible, have an emergency plan that provides for immediate drainage into acceptable areas, if a public health emergency occurs.

Coordination with District

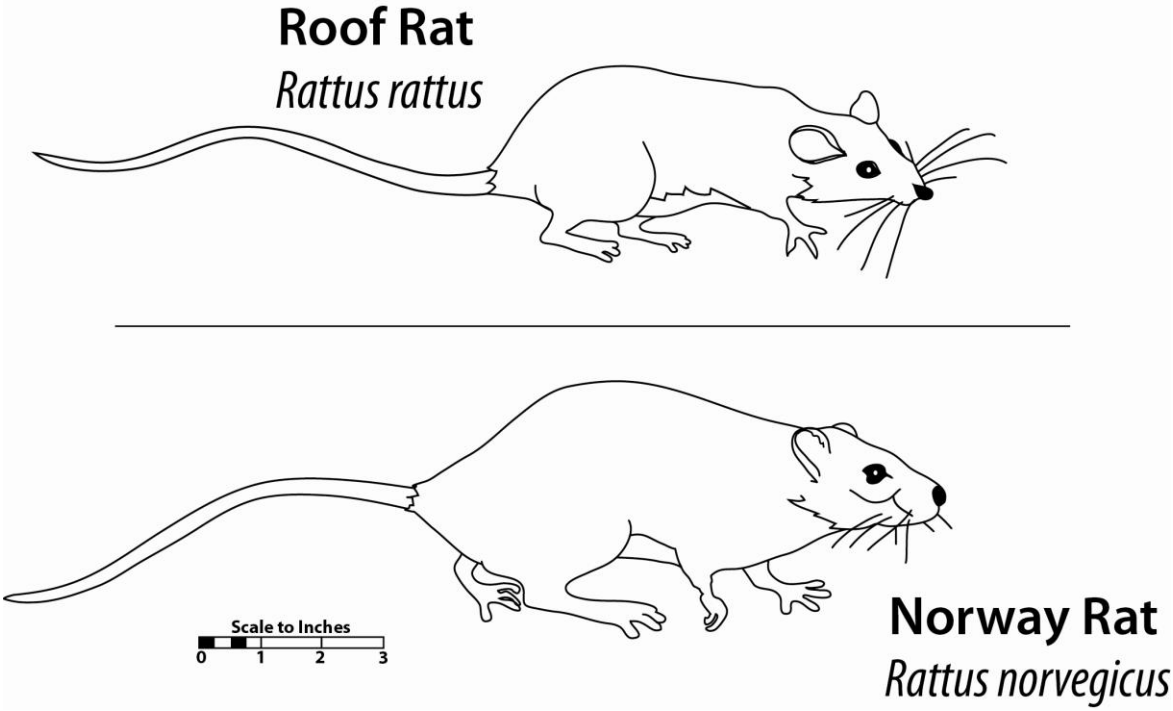
CD-1 Consult with the District on agency-sponsored habitat management plans on private lands (and on the timing of wetland flooding on public and private lands); urge private landowners to do the same.

CD-2 Identify problem locations that produce mosquitoes, with the aid of the District, and work to implement mosquito reduction guidelines. Identify potential cost–share opportunities prior to implementing mosquito reduction guidelines.

CD-3 Consult with the District on the design of restoration and enhancement projects that have the possibility of affecting mosquito production or control operations.

RAT REDUCTION GUIDELINES

Rat Species:
Norway rat: *Rattus norvegicus*
Roof rat: *Rattus rattus*



Rat Biology

Rats are mostly active at night. They have poor eyesight, but they make up for this with their keen senses of hearing, smell, taste, and touch. Rats constantly explore and learn about their environment, memorizing the locations of pathways, obstacles, food and water, shelter, and other elements in their domain. They quickly detect and tend to avoid new objects placed into a familiar environment. Thus, objects, such as traps and baits often are avoided for several days or more following their initial placement. Both Norway and roof rats may gain entry to structures by gnawing, climbing, jumping, or swimming through sewers and entering through the toilet or broken drains.

Roof rats *(Rattus rattus)*, sometimes called ship rats or house rats, are the most common rat in Orange County. Unlike Norway rats, sometimes called brown or sewer rats, their tails are longer than their heads and bodies combined. Roof rats are very agile climbers and usually live and nest above ground in shrubs, trees, and dense vegetation such as ivy. In buildings, they are most often found in enclosed or elevated spaces in attics, walls, false ceilings, and cabinets.

Norway rats *(Rattus norvegicus)* are stocky burrowing rodents that dig burrows into the ground or take advantage of existing burrows of other animals. The burrows are found along building

foundations, beneath rubbish or woodpiles, and in moist areas in and around gardens and fields. While Norway rats are more powerful swimmers, roof rats are more agile and are better climbers. Rats may grab food and carry it off to feed elsewhere. Rats of either species, especially young rats, can squeeze beneath a door with only a 1/2-inch gap. If the door is made of wood, the rat may gnaw to enlarge the gap, but this may not be necessary.

Norway rats eat a wide variety of foods but mostly prefer cereal grains, meats, fish, nuts, and some fruits. When searching for food and water, Norway rats usually travel an area of about 100 to 150 feet in diameter; seldom do they travel any further than 300 feet from their burrows or nests. Roof rats eat a wide variety of foods, but prefer fruits, nuts, berries, slugs, and snails. The average female Norway rat has four to six litters per year and may successfully wean 20 or more offspring annually. The average number of litters a female roof rat has per year depends on many factors, but generally is three to five with from five to eight young in each litter.

Roof rats are especially fond of avocados and citrus and often eat fruit that is still on the tree. When feeding on a mature orange, they make a small hole through which they completely remove the contents of the fruit, leaving only the hollowed out rind hanging on the tree. Their favorite habitats are attics, trees, and overgrown shrubbery or vines. Roof rats prefer to nest in locations off the ground and rarely dig burrows.

Roof rats routinely travel up to 300 feet for food. They may live in the landscaping of one residence and feed at another. They can often be seen at night running along overhead utility lines or fence tops. They have an excellent sense of balance and use their long tails for balance while traveling along overhead utility lines. They may live in trees or in attics and climb down to a food source.

Special Concerns

The roof rat is the major pest species in Orange County. This agile rat frequently enters buildings and moves about neighborhoods using utility lines and fences as runways. They prefer to feed on wild bird seed, pet food, and many of the fruits and nuts (including those that people do not eat) commonly found in residential backyards. Rats and their fleas are capable of transmitting a variety of human diseases making them vector species. Among the diseases transmitted by rats, plague is perhaps the best known and the most serious. The potential of a plague outbreak increases as rat populations increase. Rats can also transmit a variety of bacteria, including rat bite fever and food-borne illness. Rats have no control over their bowels so the presence of droppings is a sure sign of rat activity, as is gnaw marks on food sources, and ingress and egress into buildings.

Guidelines for the Prevention of Rat Infestations

1. Eliminate food and water sources (e.g., pet food, bird food, snails, bird bath, and close garbage cans).
2. Exclude rats from structures.
3. Control rat populations through trapping and rodenticide bait use.
4. Remove rat harborage (e.g., overgrown plants, wood piles, abandoned sheds, old furniture).

Elimination of Food & Water Sources

RF-1 Remove potential food sources from the premises. This includes pet foods, bird seed left out for birds, snails, and dog and cat feces that can be eaten by rats.

RF-2 Maintain fruit trees and fruiting ornamentals. Routinely harvest ripe fruit and dispose of all fruit that has fallen to the ground

RF-3 Maintain vegetable gardens. Routinely harvest produce from gardens.

RF-4 Store pet food in metal containers with tight sealing lids indoors and do not leave uneaten pet food, or water, outdoors overnight.

RF-5 Keep trash cans closed at all times with tightly fitted lids.

RF-6 Repair leaky faucets and eliminate any other unnecessary standing water

Rat Control

RC-1 Trap rats if they are inside a residence or building. Poisoning with rodenticide bait indoors is not recommended because a rat may die inside an inaccessible area of the structure and create an odor and fly problem.

RC-2 Place traps near nesting areas, or where rats are likely to hide. Do not place traps where children or pets will disturb or be harmed by them.

RC-3 Use the following guidelines when placing poison baits outside; 1) Use tamper-resistant bait stations; 2) Secure bait stations so they cannot be carried away or moved and so bait will not spill out; 3) Place bait stations in areas where rats are found, such as behind shrubbery. These formulations are *POISONOUS* and must be placed where pets and children cannot reach them.

Remove Harborage

RS-1 Remove harborage and nesting areas after the rats have been controlled. It is important to wait until after the rats have been eliminated because they will disperse into the surrounding area when the harborage is disturbed during removal.

RS-2 Periodically thin, trim or eliminate completely Algerian ivy, palm trees, yucca, bougainvillea, and other dense shrubbery away from roofs, walls, fences, utility poles, and trees and/or eliminated completely.

RS-3 Stack firewood and lumber piles at least 18" off the ground and 12" away from fences and walls.

RS-4 Close off all openings to potential harborage areas that cannot be removed (like structures), with 1/4 inch hardware cloth screen or stainless steel scrubbing pads. Harborage areas can include barbecues, pool heaters, air conditioners, old furniture, block wall fences, pool sheds, water heater closets, hose storage, crawl areas, attics, and vents.

Excluding Rats From Structures

RP-1 Screen all access openings with 1/4 inch galvanized hardware cloth and inspect at least once a year for condition. Common rat access points to structures include gaps under doors, turbine vents, roof openings, attic louvers and wire openings, pipe openings, gaps between roof and chimney, warped or missing shingles, air conditioning pipe openings, air ducts, and missing or torn vent covers.

RP-2 Seal gaps around pipes and electrical conduits, and weatherproof cracks around doors and windows.

RP-3 Keep tree limbs away from the eaves, roof, and exterior walls of the house.

Maintaining a Rat Free Property

RF-1 Eliminate harborage and food and water sources after rats have been exterminated.

Proper Disposal of a Rat Carcass

CD-1 Using a plastic bag, place your hand in the bag like a glove, pick up the carcass with the bag, invert the bag or turn bag inside out, tie a knot at the end of the bag, place bag in another bag, and dispose of rat in a trash container with a secure lid.

RED IMPORTED FIRE ANT REDUCTION GUIDELINES

Ant Species: *Solenopsis invicta*

Red Imported Fire Ant (RIFA) Biology

The life span of RIFA workers depends on their size. Minor workers may live 30 to 60 days, media workers 60 to 90 days, major workers 90 to 180 days, and queens may live two to six years. Complete life cycle from egg to adult takes between 22 and 38 days. Mating flights are the primary means of colony propagation, secondarily, budding can occur in which a portion of a split off satellite colony becomes an autonomous unit. After the colony reaches one year of age, reproductive alates are produced. Six to eight mating flights consisting of up to 4,500 female or queen alates each occur between the spring and fall. Mating flights usually occur midday on a warm (>74ºF/24ºC), sunny day following rain. Mating occurs during flight and the males die soon after mating with females. In the southern United States, as many as 97,000 queens may be produced per acre of infested land per year. By six months the colony has reached several thousand workers and the mound can be seen in a field or lawn. Colonies of this size generally contain a few large workers (major workers), many medium sized workers (media workers), and a majority of small workers (minor workers). The queen is the single producer of eggs and is capable of producing as many as 1,500 eggs per day. Mature RIFA colonies may contain as many as 240,000 workers with a typical colony consisting of 80,000 workers. The food collection of foraging workers consists mostly of insects and earthworms. RIFA have also been known to attack immobile and dead vertebrates. Workers also collect honeydew and will forage for sweets, proteins, and fats in homes. Fire ants will attach to the skin using their mandibles and will subsequently lower the tip of their abdomen to inject the stinger into the victim. Thus, fire ants both bite and sting, but only the sting is responsible for the painful burning and pustule.

Special Concerns

The RIFA is a quarantined pest in California and is subject to various federal and state laws and regulations. A native of South America, this imported fire ant was first introduced in the southeastern United States and eventually found its way into Orange County. The colony or nest is very distinctive and easily recognized as a loosely compacted, finely granular dome (18 inches in diameter and six to ten inches high) of soil that somewhat resembles wet coffee grounds. This mound will become hardened as rain and sprinkler waters dries on its surface. Lawn mowing often chops and spreads the mound so be aware that it may take many shapes. Gopher mounds may be similar in size to a RIFA mound but have larger (coarser) soil particles and rocks than RIFA mounds. This ant is considered a vector because, unlike most ants, it delivers a venomous sting that produces immediate pain, a burning/ itching sensation, and raised pustules that often last for several days. The venom is relatively toxic and potentially lethal to pets, wildlife, and sensitized humans. Because of the number and severity of their stings, residents of Orange County should be aware of the existence of RIFA on their property and the potential hazards posed by accidental contact.

Guidelines for Red Imported Fire Ant Pre and Post Treatments

Before Survey and/or Pesticide Ant Bait Treatment for RIFA

BR-1 Do not disturb nests and/or foraging workers. RIFA is an aggressive and defensive pest that will bite and sting to defend its self and the colony. Disturbing a mound prior to, or during, a treatment can cause treatments to fail and distract the foraging ants from collecting the bait.

BR-2 Provide the District access to the property for treatment of the fire ant mounds, and/or, if required, the entire property.

BR-3 Sprinkler systems must be turned off the night before the RIFA treatment and not turned on until the day after treatment is complete. The treatment area must be dry for the pesticide ant bait to work effectively.

BR-4 Keep people, pets, and/or companion animals away from the area being treated during the application. People and animals can return to the area immediately after treatment.

After Pesticide Ant Bait Treatment for RIFA

AR-1 Do not irrigate the property for 24 hours after treatment.

AR- 2 Do not apply pesticides to the treated area for one week following treatment.

AR- 3 Do not mow or disturb the area for 24 hours after treatment. Do not use blowers or mowers that may move bait from the treated area, especially within close proximity to a pond or other water feature. The pesticide ant bait is not to come into contact with water, and/or

conditions that favor runoff, areas where surface water is present, or to intertidal areas below the mean high water mark.

Coordination with District

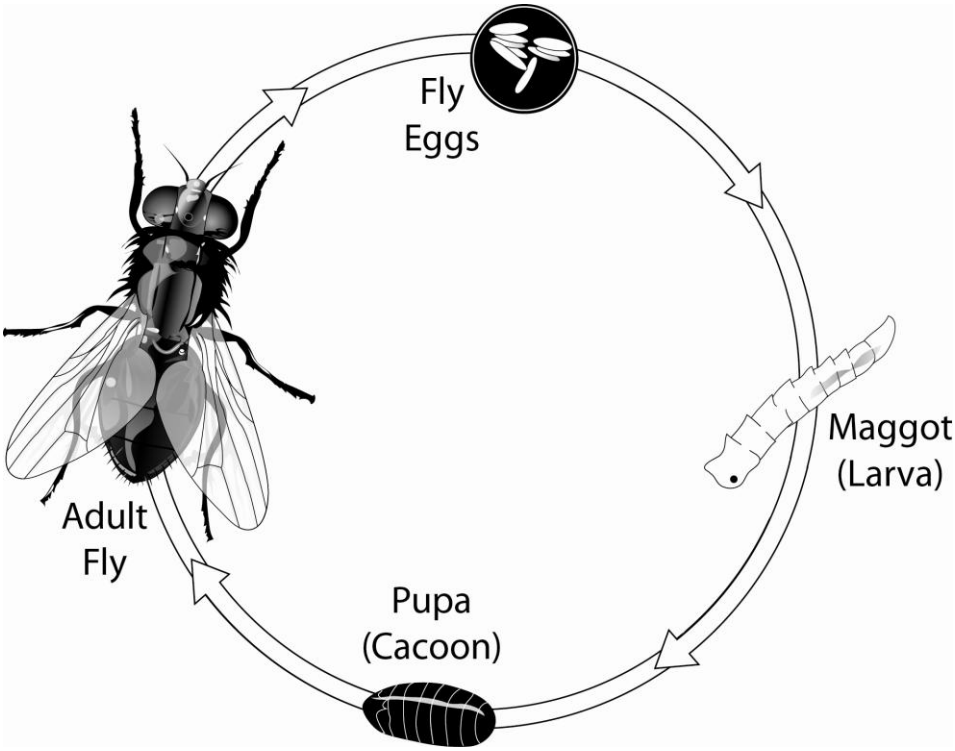
CD-1 Consult with the District on special concerns regarding RIFA and provide access for the District to monitor and treat the site.

CD-2 Working with the District, identify RIFA locations and work to implement the RIFA Reduction Guidelines. Identify potential cost–share opportunities to implement the RIFA Reduction Guidelines.

CD-3 Consult with the District on projects that have the possibility of affecting RIFA populations or control operations.

FLY REDUCTION GUIDELINES

Fly Species:
House Fly: *Musca domestica*
Little House Fly: *Fannia canniculari*s
Blow Flies: *Phormia* spp., *Calliphora* spp., *Phaenicia* spp.
Black Garbage Fly: *Ophyra* spp.
Stable Fly: *Stomoxys calcitrans*
False Stable Fly: *Muscina stabulans*
Flesh Fly: *Sarcophagidae* spp.
Oriental Latrine Fly, *Chrysomyia megacephala*



Fly Biology

Flies undergo complete metamorphosis that includes development from an egg, larva, pupa, and adult. Larval stages of flies are uniquely adapted to living in various sources. Some flies do not lay eggs but deposit live larvae directly to the food source. Eggs deposited by egg laying species usually hatch in one to two days and subsequently grow and molt depending on the existing environmental conditions like temperature, nutrient availability, and competition from other species. The larval development stage usually includes five instars. The final instar eventually ceases feeding and seeks a sheltered area near the source for pupation. When the adult is fully

developed, it emerges from the puparium and crawls to a site to expand its wings and cure the cuticle. The fly then mates and begins laying eggs. Fly populations can reach large numbers quickly, depending on the previously listed environmental conditions. Different species of adult flies are able to fly varying distances from the original source. Often flies are seen resting on southern facing surfaces to warm themselves in the morning. They rest at night in sheltered areas like bushes, trees, and eaves of buildings.

Special Concerns

Flies and fly larva feed on a wide range of food sources including blood, flesh, carrion, fecal material, organic waste products, and decomposing vegetable matter to include composting materials. Because flies feed on these foods, they have the ability to mechanically transmit pathogens and vector-borne diseases to humans. Flies found inside of food establishments are a violation of the California Retail Food Code and can be reported to the Orange County Health Care Agency. Flies have an amazing reproductive capacity that allows them to produce tremendous populations when optimal environmental conditions are present. In situations where flies are breeding prolifically, their populations can reach such high numbers as to become nuisance pests at parks, schools, and in residential neighborhoods. Some fly species are attracted to methane gas and may congregate in an area with a natural gas leak.

Guidelines for the Prevention of Fly Problems

1) Remove or eliminate fly breeding sources.
2) Exclude flies from structures.

Eliminate Fly Breeding Sources

F-1 Place garbage in plastic bags inside of trash receptacles. Keep trash receptacle lids closed.

F-2 Dispose of trash every seven days.

F-3 Pick up pet droppings and place in a sealed plastic bag at least once every seven days. Dog droppings should be picked up daily, while pet birds kept in outdoor aviaries should be cleaned weekly. Cat litter boxes should be changed weekly.

F-4 Do not leave pet food outside, as it can attract flies and serve as a larval fly source.

F-5 Quickly dispose of small animal carcasses such as rats, opossums, and birds by placing them in a plastic bag in the trash. An alternative may be to bury the carcass if space is available and

allowed by local ordinance. Contact the local animal care agency for information on disposing of large animal or pet carcasses.

F-6 Dispose of fruits and vegetables that drop from gardens and trees at least once per week by placing them in a plastic bag in the trash.

F-7 Remove animal manure from property every three days, according to local ordinances.

F-8 Compost decaying vegetable matter in a way that minimizes fly breeding, such as deep burial, tilling, or rapid drying of fruit and vegetable culls.

F-9 Contact the District for an inspection if flies are found on a property.

Exclusion

F-10 Keep the lids on garbage containers closed. Check to make sure there are no openings for fly entry.

F-11 Screen all windows and doors.

F- 12 Keep things that attract flies, such as pet food, bright colors, and attractive scents, away from unscreened doorways.

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