2015 ANNUAL REPORT

CONTRA COSTA
MOSQUITO
& VECTOR
CONTROL
DISTRICT

Protecting Public Health Since 1927

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Healthy people...

who can live, work, and play in a healthy environment is the vision of the Contra Costa Mosquito & Vector Control District.

The District exists to reduce the risk of vector-borne disease or discomfort to the residents of Contra Costa County. Besides being nuisances by disrupting human activities including the use and enjoyment of public and private areas, certain insects and animals (vectors) may transmit a number of diseases. Most vectors are extremely mobile and cause the greatest hazard or discomfort away from their breeding site. Each potential vector has a unique life cycle and occupies a specific habitat. In order to effectively control these vectors and their related disease(s), the District employs an integrated vector management program. There are seven key elements required to deliver a successful control program for infectious or vector-borne diseases: workforce, laboratory, vector ecology and surveillance, information systems, communication, policy and evaluation, and preparedness and response. The following pages explain these elements in more detail with highlights of activities for the year 2015.

Programs & Services

Most District programs and services are funded by tax dollars and are therefore provided at no charge.

Mosquitoes

Our county's diverse ecological regions create a range of mosquito sources. The District regularly surveys more than 10,000 acres of marshland along the waterfront, acres of irrigated farmland in the eastern portion of the county, and numerous ponds, creeks, and residential sources countywide. Upon request for service, a District employee will inspect residential and commercial property for mosquito problems and provide advice on controlling their populations. With 23 kinds of mosquitoes inhabiting a variety of water sources, we can determine where to look if the homeowner or caller provides our employee with a mosquito sample. Simply swat and kill a mosquito (try not to squish it too much) and save it or tape it to a piece of paper for the District employee. Mosquitoes can transmit a variety of diseases including West Nile virus.

Mosquitofish

FREE mosquitofish are available for private ponds, horse troughs, non-maintained swimming pools and spas, rain barrels, and more. Mosquitofish can eat up to 500 mosquito larvae per day.

Rats & Mice

Homeowners, business owners or any group in Contra Costa County can request a site visit to assist them with rodent issues. District services include identification of rodent problems (rodent need not be present) and advice for prevention and control. District employees do not bait nor set traps, but provide valuable, detailed information, guidance, and recommendations. Rats can transmit various diseases through contamination from their droppings and urine.

Skunks

In an effort to reduce the risk of rabies to humans by reducing the likelihood of skunk and human contact in residential areas, the District works with homeowners to discourage skunks from visiting their property. District employees survey properties, provide guidance and recommendations, and may warrant live-catch skunk traps.

Yellowjackets

The District provides extermination of ground-nesting yellowjackets only. Simply locate the nest and call the District for service. The nest's location must be identified and the location shared with District employees. This can be achieved by drawing a map, pointing a garden tool, or identifying the site with a marker (red sock, garden glove, etc.). Yellowjackets are beneficial insects that eat garden pests and pollinate crops through daily foraging; however, if aggravated, they can bite and sting repeatedly and painfully and their stings can be dangerous for those people allergic to their venom.

Ticks & Lyme Disease

The District surveys public parks and other areas for the ticks that transmit Lyme disease. The District also provides tick identification services to the public and doctors. People who are concerned about possible Lyme disease infections should contact their physician. Information on Lyme Disease testing on ticks may be found by visiting our Lyme Disease Q & A. Several commercial laboratories will test ticks for Lyme disease for a fee. Visit Tick Testing Labs for more information.

Public Information & Education

The Public Affairs Department staff work closely with residents and the media to inform and educate about important health topics. Staff provide general and tailored presentations to various groups and school children of 12 or more people. District personnel also participate in social media interaction, a variety of events, workshops, and community discussions.

Principles

Vision

Healthy people who can live, work, and play in a healthy environment.

Mission

To protect and promote public health and welfare through integrated vector management services and programs utilizing best management practices and least toxic components by:

Community Value

Providing essential services to prevent, detect, and suppress public health pests, and to reduce the risk of vector-borne disease transmission to the people who live, work or play within the county

Service Area

Serving all of Contra Costa County

Public Confidence

Delivering accessible, accountable, efficient, transparent and cost effective services

Public Relations

Working closely with all constituents, private and public, to ensure prompt delivery of accurate information, to raise public awareness, and to develop relationships that promote healthy living

Environmental Commitment

Meeting or exceeding federal, state, and local environmental standards, practicing responsible environmental stewardship, enhancing value of wetlands, and considering relevant environmental factors as an integral component of mosquito and vector control

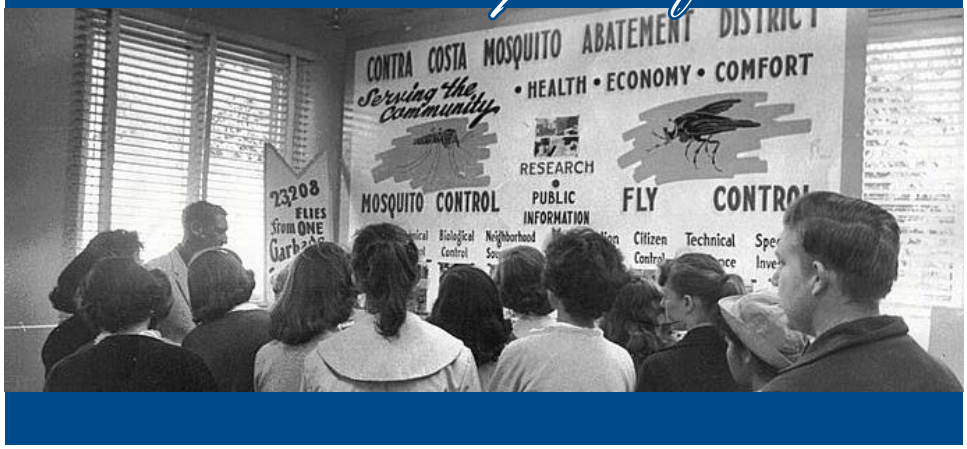
Research

Investigating environmental concerns and developing and/or testing new materials, methods and technologies to ensure quality control oversight on all services and programs, while anticipating resurgent and/or newly introduced vectors or vector-borne diseases

Interagency Relations

Integrating and communicating District programs and services with other public agencies to ensure cooperative, cohesive, and innovative program delivery

1927-2015 88 Years of Service



History

Contra Costa County encompasses some of the most diverse environments found in one area. This wide range of environments makes our county one of the most desirable places to live in Northern California. The Contra Costa Mosquito & Vector Control District plays a vital role in maintaining this environment while protecting the residents from insects and animals that can carry disease. The District helps to ensure Contra Costa County remains a great place to live where people can enjoy the outdoors.

As early as 1772, hordes of mosquitoes welcomed the first Europeans as they explored the San Francisco Bay Area. According to the explorers' travel log, they saw few signs of indigenous people in the area. The Native Americans were apparently smart enough to avoid the mosquito infested area.

More than 100 years later, thousands of men were dying of an unknown illness while working on the construction of the Panama canal. It was in the late 1800s that Dr. Walter Reed and Associates identified mosquitoes as the vector (carrier) of malaria and yellow fever. This discovery was important to the workers of the canal, as well as Californians because some of them had contracted malaria. Not only were mosquitoes a nuisance, they carried diseases as well.

In California, mosquito abatement activities in the early 1900s focused on controlling the mosquito that carries malaria and reducing the numbers of nuisance salt marsh mosquitoes. Before 1915, mosquito control in the state was financed by subscription and donation. In 1915, a bill was passed through the State Legislature and signed by the governor that provided for the formation, organization, and financing of mosquito abatement districts. Noble Stover, manager for both Marin County Mosquito Abatement District and Three Cities Mosquito Abatement District in San Mateo County coauthored the Act.

Quite often, schools in Contra Costa County had to be closed, waterfront industry was periodically shut down, and recreational areas were abandoned, all due to salt marsh mosquitoes, a severe nuisance mosquito. Periodically, citizens of Pittsburg lined the street curbs with smudge pots (pots that release smoke) in an attempt to drive the mosquitoes away. Realtors found it difficult to attract home buyers into mosquito-infested neighborhoods. So, the citizens of Contra Costa County, together with several waterfront industries, formed a committee in 1926 to address the need for mosquito control.

In 1926, Stover responded to requests from Contra Costa County and directed the first operations of Contra Costa Mosquito Abatement District (CCMAD #1), concurrently with his duties in Marin and San Mateo Counties. The purpose of the District was to control marsh mosquitoes in north central Contra Costa County. CCMAD #1 was formed and work began on April 15, 1927. The District, with two employees, began various engineering projects near the cities of Martinez, Concord, and Pittsburg. Much of the work was contracted out to dredging and construction companies. Stover was a pioneer in drainage and engineering methods, which were his primary approaches to controlling salt marsh mosquitoes. Many of those early projects still exist and are functional now more than 80 years later. Stover served as manager/engineer for CCMAD #1 until his death on September 17, 1935. Ernest Campbell, who had worked for the District since its inception, was appointed manager/engineer by the Board of Trustees upon the death of Stover.

In the summer of 1930 there was an outbreak of a horse plague in the San Joaquin Valley that resulted in the death of 3,000 horses. In 1933, it became known that mosquitoes could transmit what is now called Western equine encephalomyelitis. This virus was isolated from the brain of a dead child in 1938. Human cases of another virus, St. Louis encephalitis, were isolated in California in 1938 as well. Before the early 1940s, people thought that it was only the *Aedes* mosquitoes that transmitted disease. In 1941, *Culex tarsalis* was found to transmit the encephalitis virus.

In its early years, CCMAD #1 relied primarily on engineering methods of control such as creating ditch networks, dredging, building or repairing levees, installing tide gates and pumps. In 1927, the District contracted with Delta Dredging Company to excavate ditches at the cost of $5 per hour. The District supplemented the program by spraying standing water with light oil, such as stove or diesel oil to kill the mosquito larvae. They also stocked various sources with mosquitofish.

Until 1941, the District's jurisdiction only covered the waterfront and marsh areas from Martinez to Antioch. On November 25, 1941, the communities of Saranap, Danville, and the City of Walnut Creek petitioned the CCMAD #1 Board of Trustees, requesting annexation into the District. Annexation took place on

Mosquito Spraying in Contra Costa County. Date unknown.

December 19, 1941. In November 1943, CCMAD #1 annexed the area comprising the Lafayette and Orinda School Districts upon their request. Oak Grove School District was annexed in July 1946 upon their request. In the midst of these events, Ernest Campbell, while serving as District manager/engineer for CCMAD #1, helped found and manage Northern San Joaquin Mosquito Abatement District.

Other portions of Contra Costa County were also in need of mosquito control, which led to the formation of CCMAD #2, CCMAD #3, and Antioch-Live Oak MAD. Under the leadership of Ernest Campbell and the Board of Trustees, CCMAD #1 merged with Antioch-Live Oak MAD, CCMAD #2, and CCMAD #3 in December of 1952. As of January 1953, CCMAD #1 provided mosquito control for the communities of Orinda and Port Costa in the west to the Antioch-Live Oak school District in the east, an area of 509 square miles.

Mosquito control was established in the eastern portion of Contra Costa County by the formation of the Diablo Valley Mosquito Abatement District (DVMAD) in 1952. The Diablo District was 136 square miles in size and encompassed the communities of Oakley, Brentwood and Byron. The Diablo District's headquarters was located in the community of Brentwood. The primary purpose of creating DVMAD was for the control of pasture and irrigation mosquitoes.

Diablo Valley MAD came into existence in time for the largest human outbreaks of Western equine encephalomyelitis the state had experienced. In 1952, there were 375 human cases of Western equine encephalomyelitis and 45 human cases of St. Louis encephalitis in California. There were eight reported human cases of Western equine encephalomyelitis in Contra Costa County that same year. In the 1940s and 1950s, with the introduction of broad spectrum chemicals such as DDT the District changed to other strategies to control mosquitoes in the county. A "flit gun" was used to create a pesticide fog to kill adult mosquitoes. Jeeps were used to gain access to hard-to-reach areas and aircraft were used to spray large areas that were producing mosquitoes. The District hired its first entomologist, James Mallars, in 1952 and soon expanded its focus from mosquito control of the marshes to include treatment of the creeks as well. In 1956, the District treated 1,080 miles of creek at a cost of approximately $5.10 per mile. By the late 1950s, the District began to see mosquitoes developing resistance to DDT.

From 1945 to 1957, CCMAD #1 retained a commercial telephone answering service, utilized part-time secretarial service, owned limited yard facilities for automotive and other equipment, and raised mosquitofish on Berrellessa Street in Martinez. In 1955, the District purchased approximately one acre of land on Concord Avenue in Concord and embarked on building its new headquarters, which opened in January 1957. Prior to that time, the District office was located in the various managers' homes from 1927 until 1957. The Board of Trustees held their board meetings at one of the local oil refineries until the completion of the new headquarters.

Mosquitofish rearing. Date unknown.

In April of 1955, CCMAD #1 expanded its program to include fly control. Contra Costa County in the 1950s was primarily a rural county with commercial rabbitries, poultry ranches, stables, cattle ranches, and orchards. This was the first time CCMAD #1 officially sought to control a disease vector other than mosquitoes. On occasion, the District would also remove or destroy bee hives.

In 1959, the employees joined the County Employees Association. From that date to the present, field employees of the District have been represented by Associations or Public Employee Unions.

In the 1960s, in response to DDT resistant mosquitoes, CCMAD #1 switched to organophosphate pesticides as the primary method for control of mosquitoes. By the 1970s, mosquitoes were beginning to show resistance to these pesticides as well.

Contra Costa County had its most recent reported human cases of St. Louis encephalitis in 1967 and Western equine encephalomyelitis in 1968. The District continued an active source reduction program into the 1970s. In 1970, the District started treating non-structural yellowjacket nests located in the ground.

Ernest Campbell retired in March of 1966 due to poor health. In July of 1966, John Brawley became the new manager. Under John Brawley's tenure the District annexed the Western portion of the county in June of 1969. Before June 1969, West County, which included the City of Richmond and the communities of El Cerrito, Kensington, San Pablo, El Sobrante, Pinole, Hercules, and Crockett, had no organized mosquito control. However, in the 1930s, some ditching was conducted in the Richmond marshes under the supervision of Harold Gray, the manager of Alameda MAD. John Brawley retired in September 1976.

Brawley's replacement was Brad Anderson who became manager in November of 1976. His misfortune was becoming manager just before Proposition 13, which reduced funding for mosquito abatement districts throughout the state. CCMAD #1 lost 50 percent of its revenues. In response, the District's Board of Trustees laid off 13 of the 21 full-time employees in November of 1978. Brad Anderson chose to resign so that his position and the entomologist's position could be combined. Charles Beesley, Ph.D. who was already employed by CCMAD #1 as the entomologist, became the new manager. The Board chose to cease all services to the public except for mosquito and yellowjacket control. The District's source reduction program also ended at this time and equipment was sold to keep the District afloat. After Proposition 13, there were only four of 14 field personnel retained. Employees who worked for the District in 1978 remember it as a lean and depressing time.

Timeline

Early in the century, Northern California suffered through epidemics of encephalitis and malaria, diseases transmitted by mosquitoes. At times, parts of Contra Costa County were considered uninhabitable, with waterfront areas and schools shut down during peak mosquito seasons.

1926 - mosquito control committee formed by Contra Costa County citizens and several waterfront industries

March 31, 1927- Contra Costa Mosquito Abatement District (CCMAD) began operations in Martinez

1950s - CCMAD began using mosquitofish as biological control of mosquitoes

January 15, 1957 - CCMAD relocated to Concord

July 1, 1970 - CCMAD annexed to West County

In 1970 - CCMAD began treating ground-nesting yellowjacket nests

July 1, 1986 - CCMAD consolidated with east county to become countywide

In 1986 - CCMAD expanded services by conducting field surveys and testing ticks for Lyme disease

In 1993 - the District added the rodent control and rabies risk reduction programs previously operated by the county Environmental Health Department. Name changed to Contra Costa Mosquito & Vector Control District

In 1997 - the District began the Africanized Honey Bee ("killer bee") response program

2004 - West Nile virus detected for the first time in dead birds in Contra Costa County

2005 - First West Nile virus human case in Contra Costa County

2006 - Two residents die from West Nile virus in Contra Costa County

Today, the District services 736 square miles in Contra Costa County.

In 1986, CCMAD #1 and DVMAD merged to create one countywide agency, Contra Costa Mosquito Abatement District (CCMAD). In 1988, CCMAD purchased land on Mason Circle in Concord and built a new facility that included an indoor mosquitofish rearing greenhouse. The District began modernizing its equipment with the purchase of new vehicles, modern spray equipment, and eight-wheel all-terrain vehicles. The work that took 16 field employees before Proposition 13 (including DVMAD) was now being done by nine. The District expanded services by conducting field surveys and testing the *Ixodes pacificus* tick for the Lyme disease spirochete. Research projects on wetlands was also initiated to determine ways to eliminate mosquito production and enhance wildlife habitat in the county.

In 1993, Contra Costa County transferred its rat and rabies risk reduction programs to CCMAD. Along with the program, three employees and equipment were transferred to CCMAD from the county. Subsequently, the District changed its name to Contra Costa Mosquito & Vector Control District (District). In 1993, the District's mosquito arbovirus surveillance program detected Western equine encephalomyelitis in sentinel chickens and in mosquitoes collected in Contra Costa County. Fortunately, there were no human cases reported. Surveillance and control of *Culex tarsalis* mosquitoes once again became the District's primary focus. In the spring of 1994, the District purchased a custom built landing craft from a boat builder in Seattle, Washington. The landing craft could transport all-terrain vehicles, which allowed for regular inspection and treatment of islands in the Sacramento and San Joaquin Rivers.

In 1993 and 1994, the state of California took 40 percent of the District's property tax revenues to be used to balance the state budget. Due to the leadership of the District manager and the Board of Trustees, the District was prepared for this event, unlike Proposition 13, and enacted a county parcel fee to replace the local property tax revenues that the state had taken.

The District was able to continue tick surveillance and Lyme disease testing while the mosquito control program relied more on "biorational" methods (biopesticides and mosquitofish) that have minimal environmental impact. The District was considered to be in the forefront of wetland restoration and protection of endangered species and the environment. In 1996, the District received an Environmental Achievement Award in marsh management. Due to changing legislation (Proposition 218), the District anticipated the loss of its parcel fee that originated in 1993 and established a benefit assessment fee to ensure sufficient operating funds in 1996 and beyond.

In 1999, West Nile virus was first detected on the East Coast of the United States and the District began preparing for its eventual migration into California.

In 2001, after 27 years of distinguished service, General Manager Charles Beesley, Ph.D., retired. The building at 155 Mason Circle in Concord was dedicated in his honor. Assistant Manager Craig Downs was promoted to general manager. Downs began his career at the District as a vector control technician in 1981, advanced to biologist, superintendent, and assistant manager prior to his appointment to general manager.

By 2003, West Nile virus reached California. The District detected West Nile virus in Contra Costa County for the first time in 2004 in dead birds submitted for testing. The first human cases were in 2005. The virus was also detected that year for the first time in mosquitoes. To date, every year since 2005, West Nile virus has been detected in the county with several human cases. In 2006, two people died from the virus.

District employees continue to serve and protect the public by monitoring and controlling vectors of disease in Contra Costa County. For more than 88 years, the District remains steadfast in protecting public health from vector-borne diseases.

A technician sprays a sedimentation pond for mosquitoes. Date unknown.

Contra Costa Mosquito & Vector Control District

155 Mason Circle
Concord, CA 94520
925-685-9301
www.ContraCostaMosquito.com

Personnel

Administration

General Manager: Craig Downs

Assistant Manager: Ray Waletzko

Accounting & Benefits Specialist: Tina Cox

Administrative Secretary: Allison Nelson

Laboratory

Scientific Program Manager: Steve Schutz, Ph.D.

Vector Ecologist II/GIS Map Coordinator:
Eric Ghilarducci

Vector Ecologist: Damien Clauson

Biologist/Fish Program: Chris Miller

Public Affairs

Public Affairs Manager: Deborah Bass

Community Affairs Representatives:
Andrew Pierce
Nola Woods

Shop & Facility Maintenance

Mechanic II: Tom Fishe

Information Technology

IT Systems Administrator: Wayne Shieh

Operations

Mosquito Control Operations
Program Supervisor: Sheila Currier

Inspectors:
Lawrence Brown
Josefa Cabada
Felipe Carrillo
Jeremy Tamargo
David Wexler

Technicians:
Brandon French

Mosquito Control Operations
Program Supervisor: Greg Howard

Inspectors:
Reed Black
Joe Hummel
Tim Mann
Patrick Vicencio

Technicians:
Christopher Doll
Jeremy Shannon

Vertebrate Vector Control Operations
Program Supervisor: Jonathan Rehana

Inspectors:
Joe Cleope
Jason Descans
Steve Fisher
Dave Obrochta
Danielle Wisniewski

Independent Special District Classification

The Contra Costa Mosquito & Vector Control District is classified as an independent special district and is *not* part of Contra Costa County's governmental system. Contra Costa County encompasses the District's physical jurisdiction for mosquito and vector control. Special districts are:

- Formed by local residents to provide local services
- Sanctioned by the State of California Government Codes
- Often the most economical means of providing public service
- Independent agencies governed by a board of trustees
- Operated as nonprofit organizations
- Responsible directly to the people
- Accountable - Accessible - Efficient

Board of Trustees

Standing Left to Right: Richard Means, Pleasant Hill; Richard Ainsley, Pittsburg; Perry Carlston, Concord; Daniel Pellegrini, Martinez; Warren Clayton, Pinole; Michael Krieg, Oakley; Jim Fitzsimmons, Lafayette; and Randall Diamond, Vice President, Danville

Kneeling/Seated: Darryl Young, Contra Costa County; Chris Cowen, President, Contra Costa County; Diane Wolcott, Orinda; H. Richard Mank, Secretary, El Cerrito; Sharyn Rossi, San Ramon; Peggie Howell, Clayton; and Rolando Villareal, Brentwood

Not pictured: Sohelia Bana, Ph.D., Richmond; Jeff Bennett, Hercules; Morris Jones, Walnut Creek; Lola Odunlami, Antioch; Myrto Petreas, Ph.D., Moraga; and James Pinckney, Contra Costa County

Steve Schutz, Ph.D., Scientific Program Manager; Sheila Currier, Program Supervisor; Ray Waletzko, Assistant Manager; Allison Nelson, Administrative Secretary; Damien Clauson, Vector Ecologist; Nola Woods, Community Affairs Representative; Andrew Pierce, Community Affairs Representative; Jonathan Rehana, Program Supervisor; Craig Downs, General Manager; Deborah Bass, Public Affairs Manager; and Tina Cox, Accounting/Benefits Specialist *Not pictured: Eric Ghilarducci, Vector Ecologist II; Greg Howard, Program Supervisor; Chris Miller, Biologist; and Wayne Shieh, IT Systems Administrator*

Joe Hummel, VCI; David Wexler, VCI; Jason Descans, VCI; Jeremy Shannon, VCT; Josefa Cabada, VCI; Steve Fisher, VCI; Joe Cleope, VCI; Dave Obrochta, VCI; Patrick Vicencio, VCI; Lawrence Brown, VCI; Tim Mann, VCI; and Reed Black, VCI *Not Pictured: Felipe Carrillo, VCI; Christopher Doll, VCT; Brandon French, VCT; Tom Fishe, Mechanic II; Jeremy Tamargo, VCI; and Danielle Wisniewski, VCI*

Integrated Vector Management

Mosquito and vector control is based on scientifically planned management tactics and control strategies that reduce the abundance of target pests in a timely manner. Integrated vector management is a comprehensive program that incorporates several coordinated activities:

VECTOR SURVEILLANCE
BIOLOGICAL CONTROL
PHYSICAL CONTROL (HABITAT MODIFICATION)
CHEMICAL CONTROL (PESTICIDE APPLICATION)
VEGETATION MANAGEMENT
PUBLIC INFORMATION & EDUCATION
TRAPPING

Service Area

Our service area encompasses Contra Costa County, California, and the islands pertaining to the Military Ocean Terminal Concord that are in Solano County. In addition, the District can take action in bordering areas of Solano County, Sacramento County, San Joaquin County, or Alameda County if needed to provide control of mosquitoes or other vectors for residents of Contra Costa County [California Health & Safety Code Section 2270]. Areas covered by the program include:

1. The incorporated cities of Antioch, Brentwood, Clayton, Concord, Danville, El Cerrito, Hercules, Lafayette, Martinez, Moraga, Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon, and Walnut Creek

2. The unincorporated areas of Contra Costa County

3. Those portions of the Concord Naval Weapons Stations that lie outside Contra Costa County (Roe and Ryer Islands and three small unnamed islands)

4. Other bordering areas in Solano, Sacramento, San Joaquin, or Alameda Counties

Surrounding Land Uses

The service area, which is essentially within the borders of Contra Costa County, has a diverse set of land uses and environmental settings. The District divides the service area into four regions, corresponding roughly to the pattern of vector production found in each. East County is generally hot and dry, with land use dominated by agriculture and new residential communities. North County includes both the coastal marshlands and the established port and industrial cities from Martinez through Pittsburg to Antioch. West County, like the north, includes coastal areas, older cities, and parklands, but is generally cooler and wetter. South Central Contra Costa, on the other hand, is generally warm and dry, with land use dominated by moderate to low-density housing mixed with open space, including some grazing areas, woodlands, and intermittent creeks.

Mosquito production is associated with standing water of all types and sizes. This includes marshes, ponds, creeks, seasonal wetlands, wastewater ponds, storm-water detention basins, irrigated pastures, duck clubs, etc., as well as individual homes or commercial buildings. Other vectors, especially rats, inhabit an even wider range of natural settings, as well as virtually all types of structures. Because of the diversity of mosquito and other vector habitat, almost all land use categories in the District's service areas may be affected by our efforts.

Other Public Agencies Providing Oversight

The District's integrated vector management program as a whole, including the certification and continuing education of state-certified field personnel, is reviewed and approved by the California Department of Public Health through a formal cooperative agreement that is renewed annually.

For work on state lands and riparian zones, wetlands or other sensitive habitats, the District coordinates and reviews activities with the California Department of Fish and Wildlife and the California State Lands Commission as Trustee Agencies.

For minor physical control activities, the District obtains five-year regional permits from the U.S. Army Corps of Engineers (with review by the San Francisco or Central Valley Regional Water Quality Control Boards and/or the U.S. Fish & Wildlife Service, as appropriate), and from the San Francisco Bay Conservation & Development Commission.

For chemical control activities, the District reports to and is reviewed, at least annually, by the Contra Costa County Agricultural Commissioner.

Description of Services

The integrated vector management program of the Contra Costa Mosquito & Vector Control District is an ongoing program of surveillance and control of mosquitoes and other vectors of human disease and discomfort. The program essentially consists of eight types of activities:

- **Surveillance** for vector populations, vector habitats, disease pathogens, and public distress including trapping and laboratory analysis of vectors to evaluate populations and disease threats, direct visual inspection of known or suspected vector habitats, the use of all-terrain vehicles, maintenance of paths, and public surveys.
- **Public Education**— Encouraging and assisting reduction or prevention of vector habitats on private and public property.
- **Physical Control**— Managing vector habitat, especially through water control and maintenance or improvement of channels, tide gates, levees, and other water control facilities.
- **Vegetation Management—**Applying herbicides and other forms of vegetation management to improve surveillance or reduce vector populations.
- **Biological Control**—Rearing, stocking, and provision to the public of the "mosquitofish" *Gambusia affinis;* and possible use of other predators or pathogens of vectors.
- **Chemical Control—**Applying bacterial products *Bacillus thuringiensis israelensis* (Bti), Bacillus sphaericus (Bs), and Spinosad. Applying non-persistent selective insecticides to reduce populations of larval or adult mosquitoes and other invertebrate threats to public health, and rodenticides to control rats and other rodent threats to public health.
- **Trapping**—Trapping and euthanizing skunks that pose a threat to public health and welfare.

Descriptions of these activities, including their typical annual frequency and intensity, and general District policies and procedures to ensure that they result in no significant environmental impact are provided in the following pages.

Purpose and Need

The District exists to reduce the risk of vector-borne disease or discomfort to the residents of our service area. Besides being nuisances by disrupting human activities and the use and enjoyment of public and private areas, certain insects and animals may transmit a number of diseases. The diseases of most concern in the service area are West Nile virus, Western equine encephalomyelitis, St. Louis encephalitis, dog heartworm, and malaria, which are transmitted by mosquitoes; rabies transmitted by skunks; plague and murine typhus transmitted by fleas; leptospirosis and hantavirus pulmonary syndrome associated with rats and other rodents; and Lyme disease, babesiosis, and ehrlichiosis transmitted by ticks.

The California Health and Safety Code defines a vector as "any 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, other insects, ticks, mites, and rats, but not including any domesticated animal". The District undertakes activities through its integrated vector management program to control the following vectors of disease and/or discomfort in the service area:

MOSQUITOES

Certain species of mosquitoes found in Contra Costa County can transmit malaria, West Nile virus, St. Louis encephalitis, Western equine encephalomyelitis, and potentially other encephalitis viruses. Another species of mosquitoes is also capable of transmitting dog heartworm. Although some of the 23 species of mosquitoes found in our county have not been shown to transmit disease, most species can cause human discomfort when the female mosquito bites to obtain blood. Reactions range from irritation in the area of the bite to severe allergic reactions or 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.

Upon request for service, technicians will inspect residential property for mosquito problems and provide recommendations to control their populations. With so many varieties of mosquitoes that inhabit a variety of water sources, it's important that the homeowner or caller provides a mosquito sample to the technician. The technician is then able to determine what type of mosquito is present and where the mosquito may be originating. Mosquito sources located outside the residential property are treated appropriately.

MOSQUITOFISH

Mosquitofish (*Gambusia affinis*) are used throughout the world for effective mosquito control. They are capable of eating enormous amounts of mosquito larvae daily. Mosquitofish are an important, natural mosquito control tool.

Mosquitofish are available to the public free of charge at the District's Concord office for private ponds, horse troughs, non-maintained swimming pools and spas, rain barrels and more.

GROUND-NESTING YELLOWJACKETS

Ground-nesting yellowjackets can bite, have a painful sting, can fly moderate distances, and are found throughout Contra Costa County. A single nest can lead to loss of use of public recreational areas, and loss of the enjoyment of property. More significantly, yellowjacket stings can result in anaphylactic shock and rapid death for the approximately 0.5 percent of the public with severe allergies.

The District provides extermination of ground-nesting yellowjackets since these species are aggressive toward people. The District does not provide a service for other species of yellowjackets, nor those that make their nest on or in structures. For ground-nesting yellowjackets, simply locate the nest and call the District for service. The nest's location must be identified and the location shared with the technician.

AFRICANIZED HONEY BEES

Africanized honey bees (AHB) were first detected in California on October 24, 1994 and were detected and successfully intercepted in Contra Costa County (Crockett) in 1997 and 2008. AHB are not known to transmit disease and are no more venomous than European honey bees (EHB); however, AHB respond to threats more rapidly than EHB and will defend their hive with greater numbers of bees which could result in a massive number of stings to an individual. Although persons have died as a result of 100 - 300 stings, it is estimated that the average lethal dose of venom for an adult human is 1,100 bee stings; for a child it can be substantially less. Normal reaction to a bee or wasp sting includes redness, itching, swelling, and pain at the site of the sting. Some individuals are allergic to all bee and wasp stings. Allergic reactions may include swelling of an entire extremity, abdominal cramps, vomiting, diarrhea, upper respiratory distress, and constriction of the throat and chest. Bee stings, like yellowjacket stings, can result in anaphylactic shock and death within 15 to 30 minutes for the approximately 0.5 percent of the public with severe allergies.

RATS AND MICE

Two introduced species of rats, the Norway rat and the roof rat, and the house mouse are present in the service area and are subjects of District action. In addition to being unsanitary, rats and mice can transmit a variety of organisms that infect humans. Rats are hosts to the worm that causes trichinosis in humans. Humans may become infected when they eat poorly cooked meat from a pig that has eaten an infected rat. Rat and mouse urine may contain the bacteria that cause leptospirosis, and their feces may contain Salmonella bacteria. Bubonic plague and murine typhus may be transmitted by infected rat fleas. Rat bites may cause bacterial rat-bite fever or infection. Gnawing by rats and mice causes damage to woodwork and electrical wiring, resulting in shorted circuits and potential fires. Additionally, an abundance of rats and mice can cause economic losses, loss of use of public recreational areas, and loss of the enjoyment of property.

Homeowners, business owners or any group in Contra Costa County can request a site visit to assist them with rat and mouse issues. District services include rat and mouse identification (rat or mouse need not be present) and advice for prevention and control. District employees do not bait nor set traps, but provide valuable, detailed information, guidance and recommendations. They also issue a formal, detailed report.

SKUNKS

The two primary reservoirs and vectors of rabies in California are skunks and some species of bats. Because of extensive residential development near natural areas and their ability to live in close proximity to people, skunks pose a potential health risk.

In an effort to reduce the incidence of rabies by suppressing skunk populations, the District works with homeowners to discourage skunks from visiting their property. District employees survey properties, provide guidance and recommendations and may warrant live catch skunk traps if specific criteria are met.

TICKS

There are three species of common human-biting ticks in the District's service area. Of these three, only the Western black-legged tick (*Ixodes pacificus*) is known to transmit Lyme disease in California.

The District periodically surveys public parks and other areas for the ticks that transmit Lyme disease to monitor the risk to people. The District also provides tick identification services to the public and medical personnel.

OTHER ANIMALS OF IMPORTANCE

Although certain animal species such as bats, ground squirrels, fleas, and opossums will not be regularly controlled, these animals play important roles in the transmission of rabies, plague, murine typhus, hantavirus, or Lyme disease and may be surveyed for diseases. The District may provide education and consulting services to the public about disease risk associated with these vectors and appropriate measures to protect human health. In extreme cases where the transmission of disease is likely, as with the other District integrated vector management activities, control efforts may be employed. Control of these animals is done in consultation with the California Department of Public Health, Contra Costa County Department of Health Services, Contra Costa County Animal Control Department, Contra Costa County Agricultural Commissioner's Office and other state and local agencies.

Most of the vectors mentioned above are extremely mobile and cause the greatest hazard or discomfort away from their breeding site. Each of these potential vectors has a unique life cycle and most of them occupy different habitats. In order to effectively control these vectors, an integrated vector management program must be employed. District policy is to identify those species that are currently vectors, to recommend techniques for their prevention and control, and to anticipate and minimize any new interactions between vectors and humans.

General Vector Management Strategy

The District's activities address two basic types of vectors— mosquitoes and other insects; and rats, mice, and skunks— but both share general principles and policies including identification of vector problems; responsive actions to control existing populations of vectors, prevent new sources of vectors from developing, and manage habitat to minimize vector production; education of land-owners and others on measures to minimize vector production or interaction with vectors; and provision and administration of funding and institutional support necessary to accomplish these goals. In order to accomplish effective and environmentally sound vector management, the manipulation and control of vectors must be based on careful surveillance of their abundance, habitat (potential abundance), pathogen load, and/or potential contact with people; the establishment of treatment criteria (thresholds); and appropriate selection from a wide range of control methods. This dynamic combination of surveillance, treatment criteria, and selection between multiple control activities in coordinated programs is generally known as integrated pest management. Due to the specific nature of our programs, we refer to this as integrated *vector* management.

The District's integrated vector management program, like any other integrated pest management program, by definition involves procedures for minimizing potential environmental impacts. The District's program employs integrated pest management principles by first determining the species and abundance of vectors through evaluation of public service requests and field surveys of immature and adult pest populations; and then, if the populations exceed predetermined criteria, using the most efficient, effective, and environmentally sensitive means of control. For all vector species, public education is an important control strategy, and for some vectors (rats, mice, ticks) it is the District's primary control method. In certain situations, water management or other physical control activities (historically known as "source reduction" or "permanent control") can be instituted to reduce vector breeding sites. The District also uses biological control such as the placing of mosquitofish in some settings. When these approaches are not effective or are otherwise inappropriate, then microbial or chemical pesticides are used to treat specific vector-producing or vector-harboring areas or vector populations.

In order to maximize familiarity by the operational staff with specific vector sources in the service area, the District is divided into mosquito and other arthropod zones and also into vertebrate vector zones (currently five). Each mosquito and other arthropod zone is assigned a full-time vector control technician, and sometimes an aide, whose responsibilities include minor physical control, inspection and treatment of known vector sources, finding and controlling new sources, and responding to service requests from the public. Each vertebrate vector zone is also assigned one or more vector control technicians and sometimes aides; responsibilities in these zones include control of skunks, rats, mice, and potentially other vertebrate vectors.

Vector control activities are conducted at a wide variety of sites throughout the District's service area. These sites can be roughly divided into those where activities may have an effect on the natural environment either directly or indirectly (through drainage), and sites where the potential environmental impacts are negligible. Examples of "Environmental Sites" in the service area include tidal marshes, duck clubs, other diked marshes, lakes and ponds, rivers and streams, vernal pools and other seasonal wetlands, stormwater detention basins, flood control channels, spreading grounds, street drains and gutters, wash drains, irrigated pastures, or agricultural ditches. Examples of "non-environmental sites" include animal troughs, artificial containers, tire piles, fountains, ornamental fish ponds, swimming pools, animal waste detention ponds, and non-natural harborage, such as wood piles, residential and commercial landscape, trash receptacles, etc.

The intensity of chemical, biological, or physical control activities in the District service area in general, or in any particular vector source, varies seasonally and from year to year because of weather conditions, size and distribution of vector populations, disease patterns, prevention of pesticide resistance, and other variables. Therefore, the scope of work discussed in the sections below is illustrative of typical District activity levels, but in the future these activities are expected to show continuing variation.

VECTOR SURVEILLANCE

The District's responsibility to protect public health and welfare involves monitoring the abundance of vectors, vector habitat, vector-borne pathogens, and interactions between vectors and people over time and space. Collectively, these monitoring activities are termed vector surveillance. Vector surveillance provides the District with valuable information on what vector species are present or likely to occur, when they occur, where they occur, how many there are, and if they are carrying disease or otherwise affecting humans. Vector surveillance is critical to an integrated vector management program because the information it provides is evaluated against treatment criteria to decide when and where to institute vector control measures. Equally important is the use of vector surveillance in evaluating the efficacy, cost effectiveness, and environmental impacts of specific vector control actions.

The District routinely uses a variety of tools and methods to conduct vector surveillance including specialized traps to collect adult mosquitoes, regular field investigation of known vector sources, flocks of sentinel chickens to detect arboviruses, public service requests for vertebrate pests, adult mosquitoes, and other insect pests; and low ground pressure all-terrain vehicles to access these potential vector sites.

The District's vector and disease surveillance activities are conducted in compliance with accepted federal and state guidelines. These guidelines recognize that local conditions vary, and are thus flexible in the selection of specific application methods. Therefore, the District's specific activities and their potential environmental impacts are described herein.

PHYSICAL CONTROL (HABITAT MODIFICATION)

Dredging, installation of culverts or alternative engineering works, as well as other physical changes to the land can reduce mosquito production directly by improving water circulation or drainage. Mosquito production can also be reduced indirectly by improving habitat values for predators of larval mosquitoes, including fish and many invertebrates, or by otherwise reducing a site's habitat value for mosquito larvae. The District performs these physical control activities in accordance with all appropriate environmental regulations (wetland fill and dredge permits, endangered species review, water quality review, etc.), and in a manner that generally maintains or improves habitat values for desirable species. Major physical control activities or projects (beyond the scope of the District's five-year regional wetlands permits with the U.S. Army Corps of Engineers and the San Francisco Bay Conservation and Development Commission) receive individual California Environmental Quality Act reviews. Minor physical control activities are covered by the regional wetlands permits. These vary substantially from year to year, but typically consist of up to 2,000 feet of ditch maintenance.

VEGETATION MANAGEMENT

The District periodically applies herbicides to reduce the mosquito habitat value of sites by improving water circulation or access by fish and other predators, or to allow access to standing water for inspections and treatment. Herbicides used by the District include Roundup® and Rodeo®, which are both based on the active ingredient glyphosate. Herbicides are applied in strict conformance with label requirements.

The District did not apply any herbicides during 2014. Some vegetation management was done using hand tools ("brushing") to improve access to inspection and treatment areas.

BIOLOGICAL CONTROL

The District uses the mosquitofish *Gambusia affinis* in some types of mosquito larval habitat to provide biological control of mosquitoes through direct predation of larvae. Fish stocking conducted by District personnel complies with strict guidelines designed to ensure that no significant impacts can occur to native species. District staff are also conducting research on several California native fish species as alternative biological control agents.

CHEMICAL CONTROL

MOSQUITO LARVICIDES

Depending on time of year, water temperature, organic content, mosquito species present, larval density, proximity to human settlements, presence of predators, and other factors, pesticide applications may be repeated at any site at recurrence intervals ranging from weekly to annually. District staff apply public health pesticides to the site in strict accordance with the pesticide label instructions.

The District uses several natural bacterial products for control of larval mosquitoes. These include Bti (*Bacillus thuringiensis israelensis*), a bacterium that is ingested by larval mosquitoes and disrupts their gut lining, leading to death before pupation. Bti is applied by the District as a liquid or bonded to inert substrate (sand, corn cob granules) to assist penetration of vegetation. Persistence is low in the environment and efficacy depends on careful timing of application relative to the larval growth stage. Therefore, use of Bti requires frequent inspections of larval sources during periods of larval production, and may require frequent applications of material. Application can be by hand, All-terrain vehicle (ATV), or helicopter. Bs (*Bacillus sphaericus*) is similar to Bti but has the additional capability of natural re-cycling, providing a longer duration of control. Bti and Bs have very low toxicity to non-target organisms. Spinosad ("Natular") is a bacterial fermentation product which acts on the nervous system of mosquito larvae and is available in several liquid and solid formulations.

Chemical larvicides routinely used by the District include Methoprene (Altosid), larvicidal oils, and Agnique. Methoprene, or Altosid, is a synthetic insect hormone designed to disrupt the transformation of a larval mosquito into an adult. It is applied either in response to observed high populations of mosquito larvae at a site, or as a sustained-release product that can persist for up to about four months. Application can be by hand, ATV, or helicopter. While highly effective against mosquitoes, it has very low toxicity to non-target organisms. Larvicidal oil is a petroleum distillate (mineral oil) with low toxicity to plants and fast environmental breakdown that forms a thin film on water and kills larvae through suffocation and/or direct toxicity. It is typically applied by hand, ATV, or truck. Unlike most other larvicides, this material is also effective against mosquito pupae. Agnique is the trade name for a monomolecular (one molecule thick) surface film larvicide, comprised of ethoxylated alcohol. It works by disrupting the surface tension of water, preventing mosquito larvae and pupae from being able to remain at the surface to breathe air. Sustained winds tend to disrupt the film, so this material is most useful in enclosed areas like swimming pools and other artificial containers.

MOSQUITO ADULTICIDES

In addition to chemical control of mosquito larvae, the District also makes aerosol applications of pesticides for control of adult mosquitoes if specific criteria are met, including species composition, population density (as measured by landing count or other quantitative method), proximity to human populations, and/or human disease risk. As with larvicides, adulticides are applied in strict conformance with label requirements. Adulticides currently used by the District include natural Pyrethrins (derived from chrysanthemum flowers) and the synthetic pyrethroid Resmethrin (Scourge). Both contain the synergist PBO (piperonyl butoxide) which improves their effectiveness against adult mosquitoes while reducing the amount of active ingredient needed. Both materials are applied as ultra-low-volume (ULV) fogs by truck or potentially by aircraft. In addition to having low toxicity to humans, these materials are applied in very small amounts (approximately 1 oz. to 2 oz. of active ingredient per acre) and are non-persistent (break down rapidly in sunlight). Applications are generally conducted at night or before dawn, when the target mosquitoes are most active, but bees and other nontarget organisms would not be exposed.

Malathion is an organophosphate material which the District may use for direct control of adult mosquitoes. This is not a routine operational material for the District, and its use is only contemplated in emergency circumstances or in the event that mosquito populations in our area develop significant resistance to other adulticides.

OTHER INSECTICIDES

In addition to direct chemical control of mosquito populations, the District also applies insecticides to control bees and ground-nesting wasps that pose an imminent threat to humans or pets. This activity is triggered by a public request for assistance, rather than in response to direct population monitoring. The District does not control any bees that are located inside a structure or wasps that are on or inside a structure, so if a technician finds that a bee or wasp nest is located inside a structure or a wasp nest is above ground, the resident will be given a referral list which contains the names of companies in Contra Costa County that are certified for structural control of bees and wasps. If a district technician elects to treat stinging insects, he or she will apply an insecticide directly to the insect or insect nest in accordance with District policies to avoid any drift and harm to other organisms.

Pesticides that contain the active ingredient potassium salts of fatty acids (insecticidal soaps), such as M-Pede®, are used to control feral bees. Potassium salts of fatty acids are extremely low in toxicity. Drione® is used by the District against ground-nesting yellowjackets. This is an insecticidal dust containing pyrethrins, PBO and silica. The potential environmental impact of this material is very small because the active ingredients include Pyrethrins, and Piperonyl Butoxide (discussed above), and the mode of application, deep into underground nests, further limits the potential for environmental exposure.

RODENTICIDES

The District uses the rodenticides (rodent poisons) bromadiolone, diphacinone and cholecalciferol. Most of the material is used in sewer systems, or is deployed in locked, tamper-resistant bait stations along creeks and in other natural habitats with no potential for direct human or pet exposure. Used bait is disposed of in accordance with the labels.

OTHER VERTEBRATE PEST MANAGEMENT

In addition to the use of rodenticides for the control of rats and potentially other rodents of public health significance, the District also traps and humanely euthanizes skunks that have established dens on residential or commercial properties. Property owners are educated by inspectors or technicians on how to limit contact with skunks. Skunks can be a reservoir of rabies. The District has approximately 175 live traps which can be distributed to residents and local business owners in the service area. Prior to delivering a trap, our technicians will conduct an inspection of the property to determine what existing conditions might be attracting skunks and provide recommendations for habitat modification. If the problem persists in spite of these efforts, a trap may be provided. Members of the public with District traps on their property are instructed to check the trap daily and to call the District promptly if an animal is captured. If a skunk is trapped, it is humanely euthanized with carbon dioxide gas and transported to the District for storage before being transported to a landfill. Animals other than skunks in the traps are promptly released on site; however, our trap design makes capture of other animals unlikely. Public requests for routine assistance with trapping or removal of other vertebrate animals such as raccoons or opossums are referred to Contra Costa County Animal Control or to local private pest control companies.

Under some circumstances, the District might trap rodents of public health significance, or, in an emergency, other vertebrate vectors for disease surveillance and control.

PUBLIC INFORMATION & EDUCATION

The District's outreach program educates and informs the public about mosquitoes and other vectors along with their associated diseases. Emphasis is placed on prevention methods and reducing the risk of illness. The District utilizes the media, various advertising outlets and the District's website. Staff provide presentations to a plethora of groups and community organizations and disseminate health messages through events, health fairs, community newsletters, social media, city and county partnerships, and local groups.

Mosquito & Vector Surveillance

Our entomology laboratory collects and analyzes the following types of information to help guide and plan effective and environmentally-sound control of vectors and vector-borne diseases in Contra Costa County:

- Mosquito population surveillance
- Encephalitis virus surveillance
- Surveillance for other mosquito-borne diseases
- Tick and Lyme disease surveillance
- Identification of ticks and other biting arthropods
- Quality control for pesticide applications
- Research and special projects

Mosquito Population Surveillance

Mosquito surveillance is a key component of our integrated vector management program. Twenty-three different species of mosquitoes are found in our county, and each one is different in terms of its habitat, biting habits, ability to transmit disease, flight range and appropriate control methods. Our surveillance program monitors larval and adult mosquito populations countywide to track changes over time and identify potential risk areas for nuisance or disease issues. This information is used by our operations team to plan and carry out efficient, effective and environmentally sound mosquito control strategies.

Larval Mosquito Surveillance

Field technicians and inspectors collect samples of mosquito larvae in the field daily and return them to our laboratory for counting and identification. Treatment decisions can then be made based on species and density information, in addition to other factors like habitat type, proximity to populated areas, and presence or absence of natural predators. The data are stored in a database which enables us to make comparisons with historical averages and to map larval populations by species. In 2015, our laboratory counted and identified 45,541 mosquito larvae and pupae.

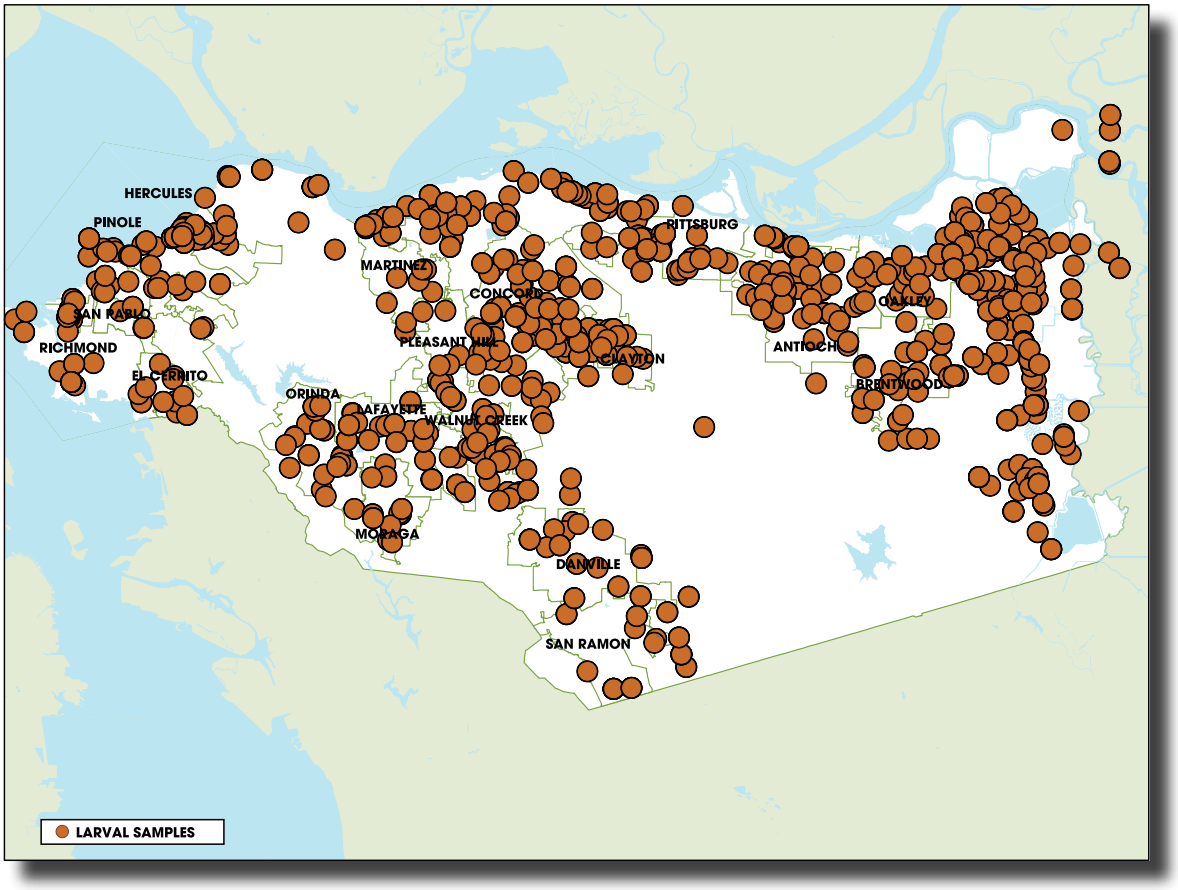
Adult Mosquito Surveillance

The District utilizes two types of traps to monitor adult mosquito populations throughout the county—New Jersey light traps and carbon dioxide traps (CO_2 traps)—at representative locations throughout the county.

Species	Count
Pupae*	2,805
Cx tarsalis	16,815
Cx pipiens	9,908
Cx incidens	7,638
Cs inornata	1,968
Ae dorsalis	1,499
Ae nigromaculis	1,339
Ae washinoi	862
Ae sierrensis	675
Ae vexans	513
Ae melanimon	498
Cx stigmatosoma	466
Ae squamiger	309
Cx erythrothorax	81
An franciscanus	69
Cs particeps	50
Cx apicalis	26
An punctipennis	19
An occidentalis	1
TOTAL	45,541
*pupae not identified to species	

Mosquito larvae identified in 2015 by species

Mosquito larvae breathe air through siphon tubes by penetrating the surface of the water



Locations of mosquito larval samples collected by the District in 2015

New Jersey light traps use light from a 5-watt fluorescent bulb to attract night-flying mosquito species. The traps have light sensors which automatically turn them on at dusk and off at dawn and are operated year-round at 23 locations, some of which have been in use for 20 years or more. Samples are collected once a week by field technicians and returned to our lab for counting and species identification. Each week, current trap counts are compared with historical averages for different regions of the county to identify population trends that might require additional scrutiny.

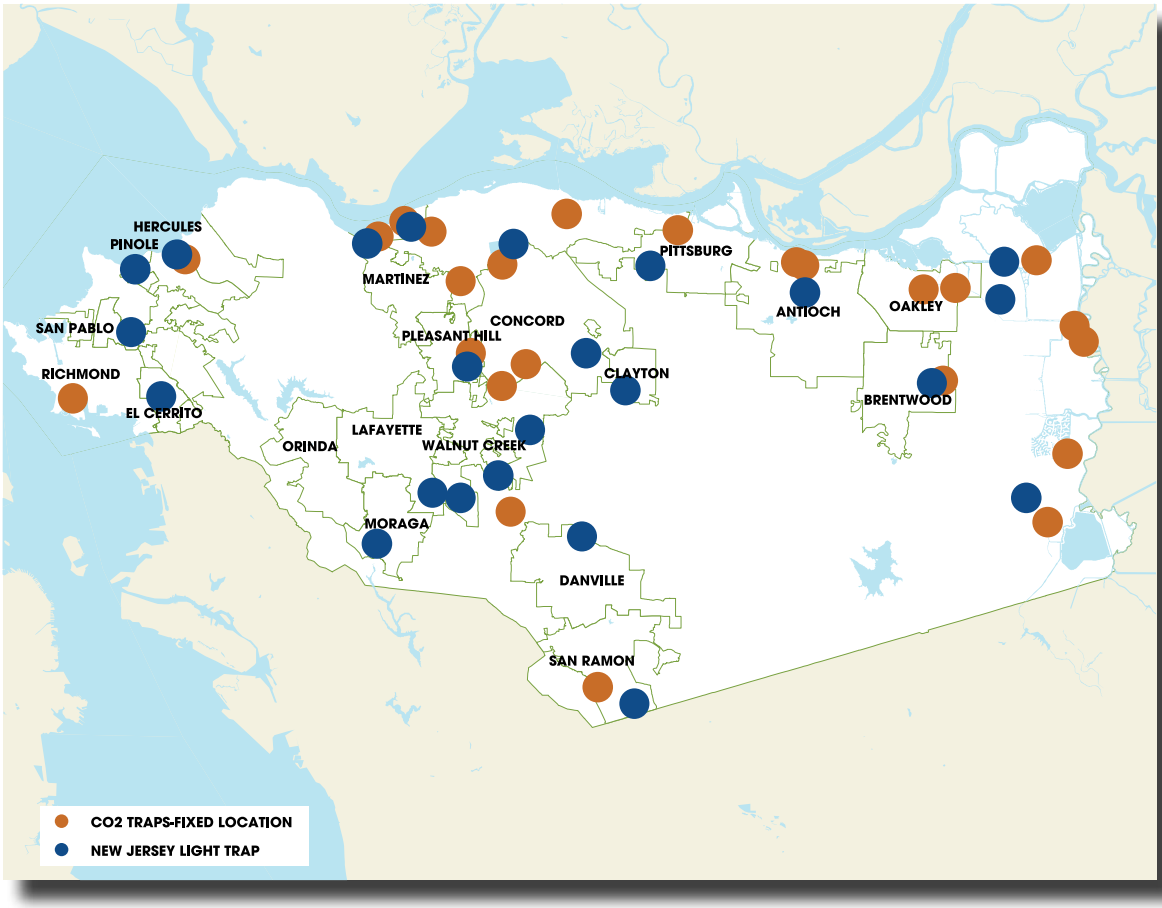
CO_2 traps are portable, battery powered, and use dry ice to produce carbon dioxide, which is a powerful attractant for mosquitoes, as well as a small LED light. Traps are set overnight once per week at 24 'fixed' locations throughout the county and as many as 12-30 variable locations that are chosen based on other surveillance information (dead bird reports, mosquito complaints, field observations by technicians, etc.). In addition to collecting both day and night-flying mosquitoes, these traps also allow us to return the mosquitoes to our lab while still alive so they can also be tested for West Nile virus and other viruses. Counts can also be compared with regional averages to track population changes and target control activities.

A CO_2 trap hangs ready to trap adult mosquitoes. Dry ice produces carbon dioxide, which simulates the breath of a person and attracts adult mosquitoes.

Adult Mosquito Abundance Trends

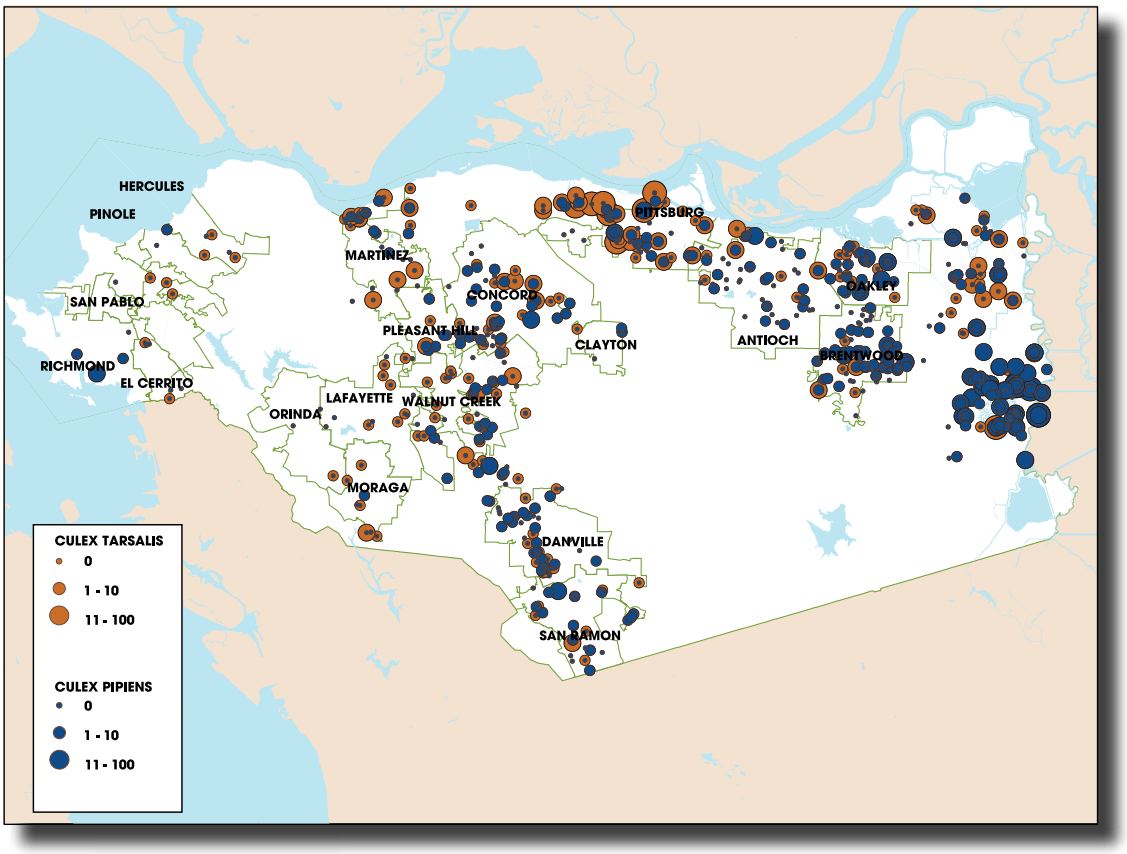
Although we are able to monitor abundance of most of the mosquito species present in Contra Costa County, two species—the Western Encephalitis Mosquito, *Culex tarsalis*, and the Northern house Mosquito, *Culex pipiens*, are considered the most significant since they are the primary vectors of West Nile virus and other encephalitis viruses. Both species are widespread and abundant throughout the county. *Culex tarsalis* prefers clear water and used to be more common in rural agricultural areas; however, in recent years it has become the most abundant species in abandoned or unmaintained swimming pools in residential neighborhoods. This mosquito may fly as far as five miles or more from its larval habitat so a single 'bad' pool can affect a large area. *Culex pipiens* prefer water high in organic material and are most common in sewer plants, dairy farm ponds and underground storm drains. This mosquito usually doesn't travel more than a few blocks from its larval 'source', but may be extremely widespread in residential neighborhoods during the summer due to overwatering of lawns and other urban water runoff that keeps the storm drains constantly wet.

Entomologist Steve Schutz, Ph.D. counts and sorts adult mosquitoes according to species in the District laboratory



FIXED ADULT MOSQUITO TRAP LOCATIONS IN 2015

Both carbon dioxide, which simulates the breath of a person or animal, and light attract mosquitoes to the trap. Mosquitoes are then counted and identified per species to determine the risk of disease or nuisance to people.



RANDOM ADULT MOSQUITO TRAP LOCATIONS IN 2015

Random traps set throughout Contra Costa County capture mosquitoes for surveillance and control applications. Culex tarsalis and Culex pipiens are primary vectors of West Nile virus and other diseases.

In this figure, the size of the circles illustrate how many mosquitoes were collected.

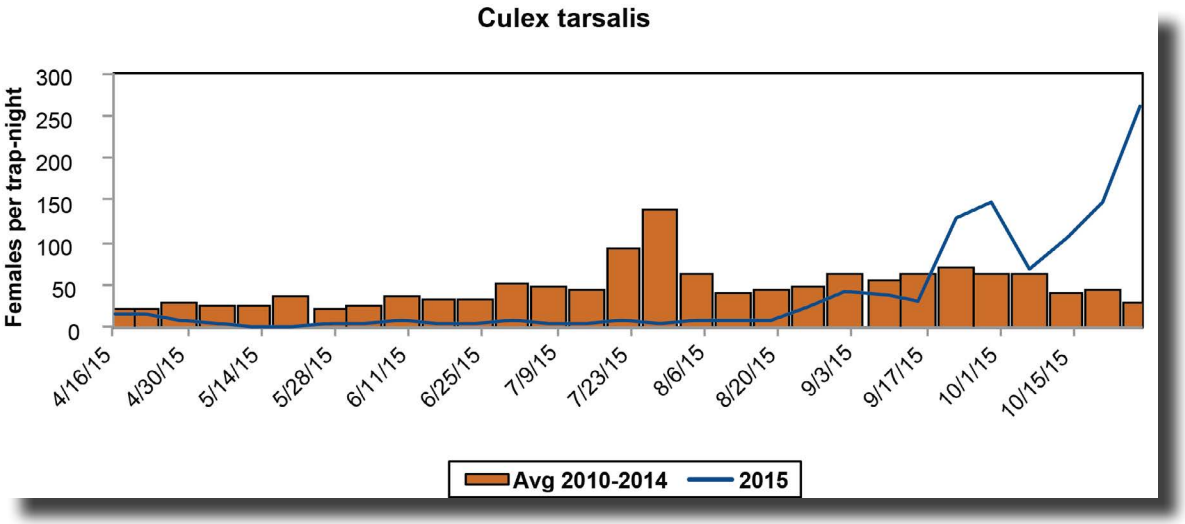
California's drought continued in 2015, with rainfall below average and summer and fall temperatures above average. County-wide populations of *Culex tarsalis* were well below average throughout most of our typical peak season (June through September), but increased to well above average in the fall due to unusually high counts in Pittsburg and other waterfront areas. The cause of this increase is still undetermined, since we did not find high numbers of larvae present at our usual source locations. *Culex pipiens* counts fluctuated, but were above average early in the season and mostly below average during the typical peak. The high *Culex tarsalis* counts and the presence of West Nile virus prompted several fogging operations in the affected areas.

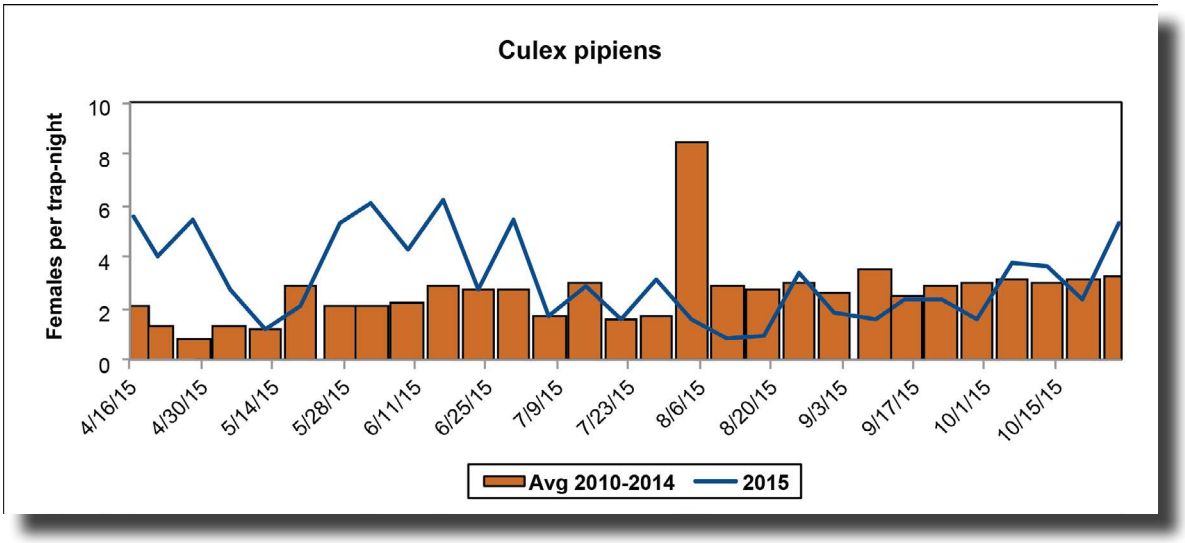
A total of more than 46,000 adult mosquitoes were collected and identified in our random and fixed-location traps in 2015.

Species	Count
Cx tarsalis	34,161
Cx pipiens	2,899
Ae dorsalis	2,898
Cs inornata	2,517
Ae melanimon	1,224
Cx erythrothorax	1,140
Ae vexans	502
Ae washinoi	379
Cs incidens	295
Ae nigromaculis	271
Cs particeps	182
An franciscanus	148
Ae sierrensis	69
Ae squamiger	42
An freeborni	10
An punctipennis	6
TOTAL	46,743

Adult mosquitoes identified in 2015 by species

Abundance of Vector Mosquito Species in Contra Costa County in 2015

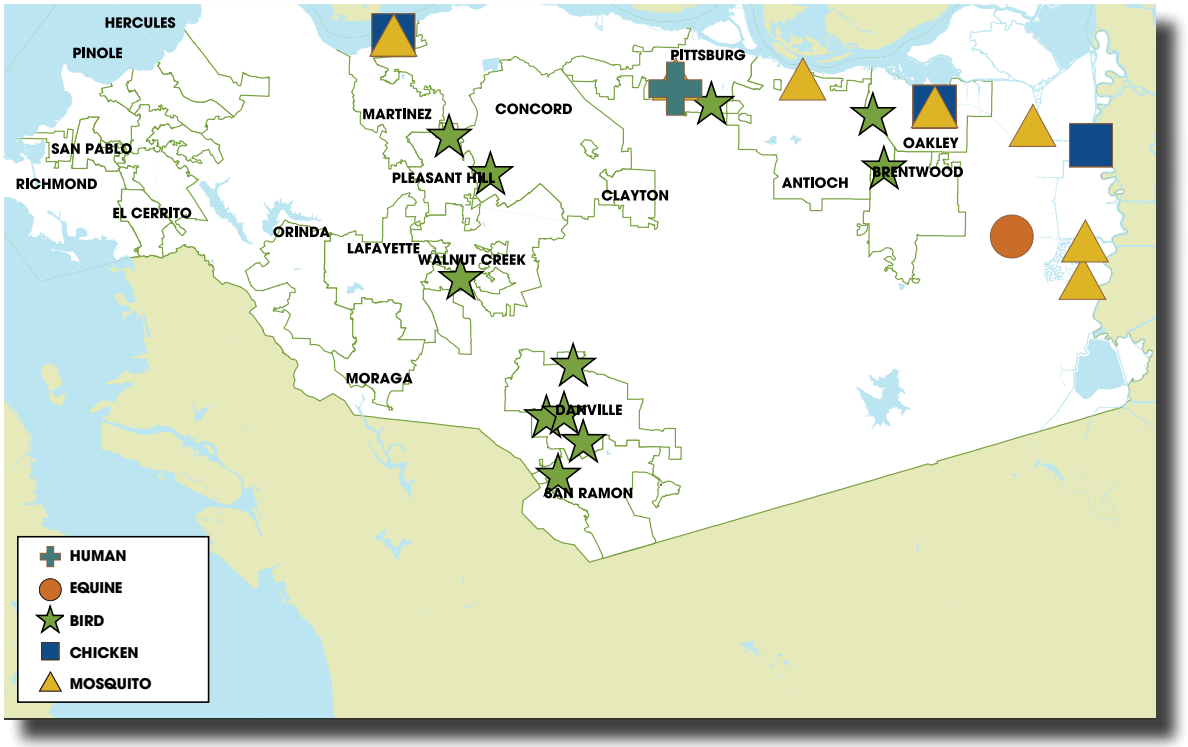




Mosquito-Borne Disease Surveillance

Our laboratory conducts a comprehensive surveillance program for diseases transmitted by mosquitoes, including West Nile virus (WNV), Western equine encephalomyelitis (WEE) and St. Louis encephalitis (SLE) as part of California's statewide surveillance effort. We also collaborate with the California Department of Public Health, the University of California and other state and federal agencies on studies intended to detect or predict new mosquito-borne diseases which might be introduced to our area in the future. WNV, a virus native to Africa which first appeared in the U.S. in 1999, has been the most prominent mosquito-borne disease here in California since its arrival in 2003, with over 5,500 reported cases and 221 deaths (the actual number of cases is probably much higher since only patients with the most severe form of the illness tend to be tested and diagnosed). Serious outbreaks of WEE and SLE occurred in California as recently as the 1950s and 1960s, and could re-occur at any time. The District last detected WEE activity in 1997, when two chickens at our flock in the Martinez waterfront area tested positive for antibodies.

The Bay Area also had a history of severe malaria outbreaks in the early part of the 20th century. Pioneering mosquito control efforts by Stanley Freeborn and others led to the eradication of malaria in California. However, international travel still occasionally brings people infected with malaria to our area, and *Anopheles* mosquitoes capable of transmitting the disease to others still occur here. We work with the Contra Costa Department of Public Health to investigate and treat (if necessary) *Anopheles* mosquito breeding sites in the vicinity of reported human cases in order to prevent local disease transmission.



Positive West Nile Virus Activity in Contra Costa County in 2015

Mosquito Samples

Between 30 and 50 dry-ice baited mosquito traps are set every week, some at fixed locations and others at variable or 'random' locations, based on dead bird reports, mosquito complaints, or other indicators of possible virus or nuisance risk. Mosquitoes from these traps are tested for mosquito-borne viruses in batches, or 'pools' of between 10 and 50 individuals of a particular species. Some testing (for WNV only) can be done in our own laboratory, but the majority of samples are sent to the University of California Center for Vectorborne Disease Research where they are tested for WNV, WEE, and SLE. Results of this testing enable us to determine areas of the County at risk for disease transmission and target our control resources efficiently.

In 2015, 622 samples, comprising 21,533 mosquitoes were tested; 8 samples were positive for WNV (all *Culex tarsalis)*. The majority of these samples came from East County, with two from Oakley, two from Discovery Bay, one from Pittsburg and one from Antioch. The remainder (two samples) came from the Martinez waterfront area. Fogging operations were conducted several times in the Pittsburg area, as well as in Bay Point, Oakley, Antioch, agricultural areas near Discovery Bay, Brentwood and the Martinez waterfront to reduce the risk of West Nile virus cases and alleviate severe nuisance (biting) issues.

District Ecologist Eric Ghilarducci prepares a trap to capture adult mosquitoes. The trap uses dry ice as bait to trap the mosquitoes, simulating the breath of a person.

2005 – 2015 SUMMARY OF ENCEPHALITIS VIRUS SURVEILLANCE

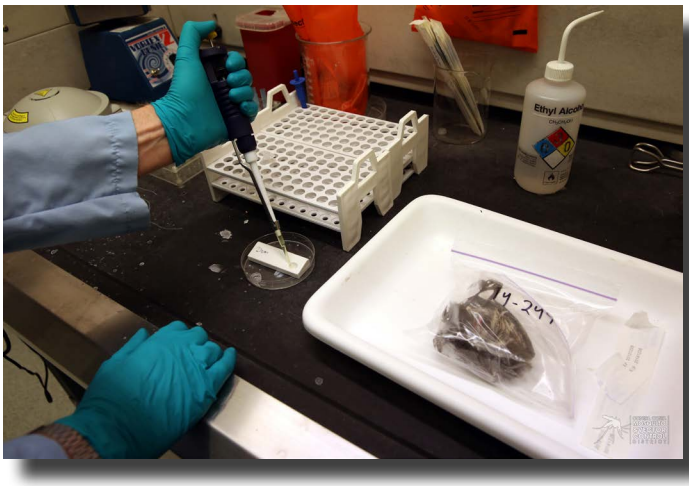
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mosquito Samples	Samples Tested	425	523	721	729	814	536	484	468	454	652	622
	Total No. Mosquitoes	20,309	24,358	28,290	23,502	27,436	16,820	14,321	11,571	12,730	17,999	21,533
	West Nile Virus Positive	4	20	28	31	17	4	7	19	13	25	8
Chickens	Blood Samples Tested	800	904	669	851	717	773	600	590	631	598	609
	Total No. Chickens	50	50	50	50	50	50	50	50	50	50	50
	Seropositive	18	24	5	15	13	4	0	7	8^	15	18
Dead Birds	Total Reported	5,589	3,472	2,042	2,227	1,221	923	1,057	1,816	1,377	1,355	912
	Total Tested	518	388	158	115	80	32*	74*	106*	123*	115*	49*
	West Nile Virus Positive	94	92	29	88	45	8	43+	66	68	44	11
Dead Squirrels	Total Tested	45	41	29	39	19	0**	0**	0**	1	0**	0**
	West Nile Virus Positive	25	19	5	9	2	--	--	--	1	--	--

*testing restricted to crows/jays only **squirrels not tested + includes five 'chronic positive' birds ^Includes 1 RAMP positive

Dead Birds

The dead bird surveillance program represents a very successful collaboration between the California Department of Public Health, the District and the residents of Contra Costa County. Dead birds are reported by the public to the statewide WNV Hotline (1-877-WNV-BIRD) or online. Hotline operators screen the calls to determine whether the birds are suitable candidates for testing; if so, they are referred to the District to be collected. Although not all birds are candidates for testing, all reports are important since they are mapped and used to identify potential risk areas and to target additional surveillance (mosquito trapping and larval source inspections, for example).

Testing in 2015 was restricted to corvid (crow family) birds only (crows, ravens, jays, magpies). Although we have occasionally found WNV positive individuals of other species, corvids are the most highly susceptible and therefore represent the most sensitive indicators. Also, corvids tend to develop higher virus levels in their bodies than other birds, which means that the virus can often be detected in our own laboratory the same day the bird was collected, using a rapid screening test. Birds testing negative on our initial screening may be sent to the University of California for confirmatory testing. During 2015, the WNV Hotline received 912 dead bird reports from Contra Costa County residents. Of those, 49 birds were collected for testing and 11 (22 percent) tested positive. Positive birds were scattered throughout Central County with a few in East County.



District Entomologist Steve Schutz, Ph.D. tests a dead bird's saliva for West Nile virus.

Sentinel Chickens

Chickens are naturally resistant to mosquito-borne viruses and do not become ill, nor can they pass the virus back to mosquitoes, but they do develop antibodies that can be detected in lab tests. This makes them ideal 'sentinels' for detection of virus transmission. The District maintains a total of 50 chickens (10 at each of five flock sites) within the County. New young chickens are obtained from a commercial chicken farm each spring to insure that they have not been previously infected. Blood samples are collected twice a month from April through October and submitted to the California Department of Public Health's Viral and Rickettsial Disease Lab in Richmond to be tested for antibodies to WNV, WEE and SLE viruses. In 2015, 18 of our chickens (eight on Holland Tract, seven in Oakley and two in Martinez) tested positive for WNV antibodies. Positive chickens occurred between mid-July and mid-October. Since chickens cannot pass the virus on to others, they are donated to charitable organizations for egg production or adopted by owners of the host properties at the end of each season.

District Ecologists Damien Clauson and Eric Ghilarducci obtain blood samples from chickens' combs. Chickens do not get sick from West Nile virus, but they develop antibodies to the virus. If antibodies are detected, then it's evidence of West Nile virus transmission in the area.

Human and Equine Disease Cases

One non-locally acquired human WNV case was reported by the Contra Costa County Department of Public Health. The patient reported being bitten while traveling in another county in California and was listed as 'recovering' as of the February 2016. The vast majority of milder cases go un-tested and unreported since they may be asymptomatic (no symptoms) or mistaken for 'the flu'. Equine (horse) cases are no longer being actively tracked due to cutbacks in the statewide veterinary diseases surveillance program, but one non-fatal horse case was reported in East County (the horse was unvaccinated). An effective vaccine for horses has been available for several years; human vaccines are still not available.

Statewide in 2015 for West Nile virus, 798 human cases and 14 fatalities were reported. Although this is not a record number of cases (there were 880 reported in 2008), 544 of them were neuroinvasive cases, more than in any previous year. The Centers for Disease Control and Prevention reports that there are typically 30 to 70 non-neuroinvasive (West Nile fever) cases for every case of neurological disease, so as many as 38,000 Californians may have had West-Nile related illness in 2015, the vast majority of which were never reported or diagnosed.

Research, Special Projects and Presentations

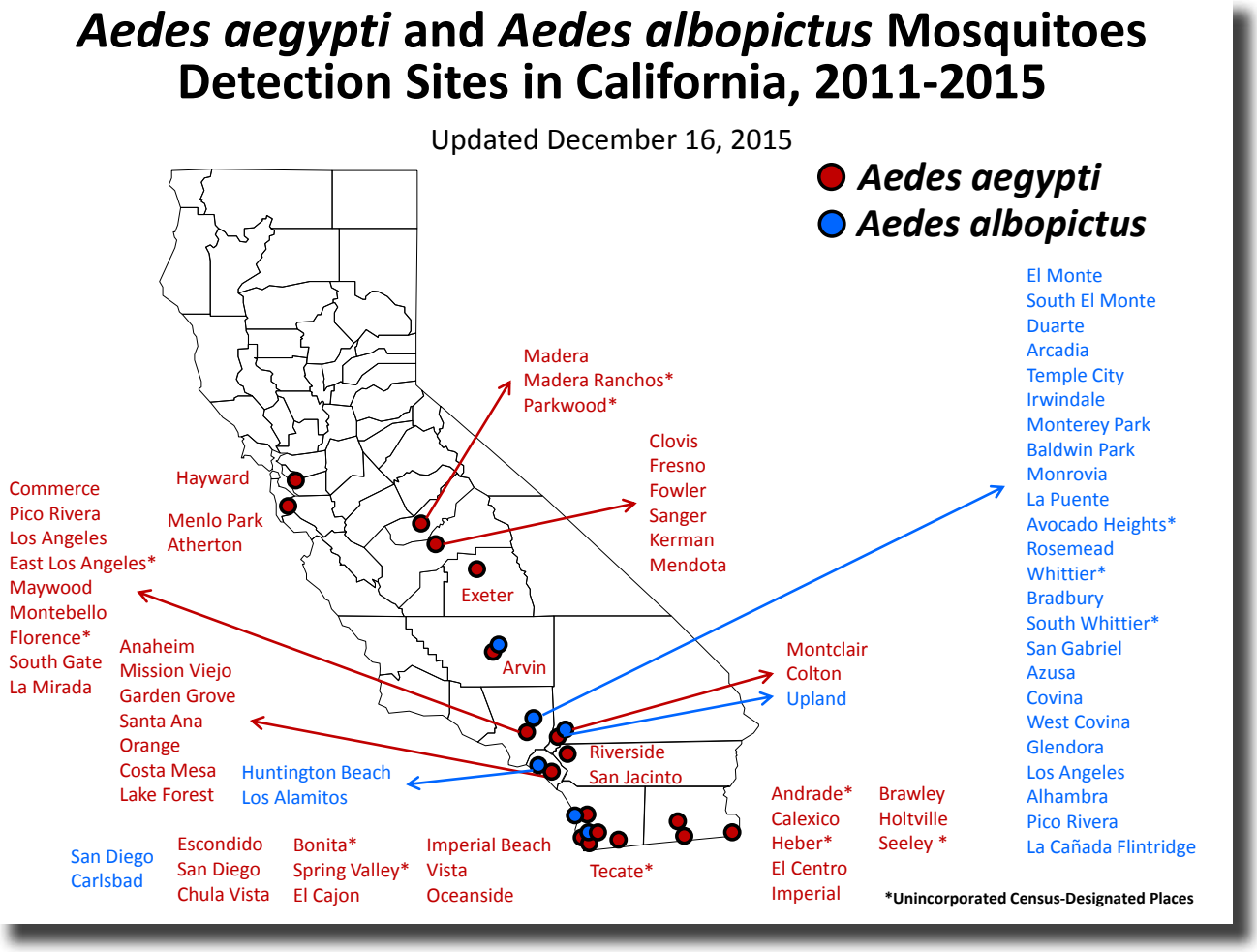
Our Scientific Programs staff continued to work with the U.S. Department of Agriculture, Agricultural Research Service on a project to determine the impact of invasive aquatic weeds on mosquito populations in the San Joaquin Delta, and to rear and evaluate potential biological control agents for the introduced water hyacinth, which has been choking Delta waterways.

Water hyacinth is an attractive floating aquatic plant that was introduced into the Delta from South America more than 100 years ago. The invasive plant can double in size every ten days in hot weather and can quickly become a dense floating mat of vegetation up to six feet thick. Mats can travel with river currents and with tidal movement and can also attach to structures.

Invasive Mosquito Species

In addition to the non-native Asian tiger mosquito (*Aedes albopictus*), which has been established in parts of the Los Angeles basin since at least 2011, vector control districts in Fresno, Madera, Tulare, Kern, San Mateo, Alameda, Los Angeles, Orange, Riverside, San Bernardino and San Diego Counties reported finding populations of the yellow fever mosquito, *Aedes aegypti* in 2015 (map). Both of these species are similar in behavior, in that they are adapted to living around humans and lay their eggs in a wide variety of natural and artificial water containers. They are potential vectors of human disease, including dengue virus, which has been on the increase worldwide with a recent outbreak in Hawaii, chikungunya virus, which spread explosively throughout the Caribbean, Central and South America in 2014, and Zika virus, which spread rapidly in South and Central America in 2015. The vector species are known for being difficult to control and causing significant nuisance issues. So far, attempts to eradicate these new mosquito populations have met with limited success.

Recent cases of chikungunya, dengue and Zika diagnosed in travelers returning from the affected areas raise the concern that these mosquitoes may spread these viruses locally in California. In 2015 our comprehensive surveillance program did not detect the presence of any non-native mosquito species in Contra Costa County. Our technicians will continue to proactively search for them. However, since these are very much 'backyard' mosquitoes, it is essential for the public to be vigilant in eliminating any potential mosquito breeding sites on their property, reporting mosquito problems (especially mosquitoes biting during the day) to us, and saving mosquito samples for identification.



Mosquito Control Operations

Fourth Year of California Drought Reduces Some Mosquito Issues While Creating Others

All mosquitoes must start their lives in water. Contra Costa County's 23 species of mosquitoes can lay eggs in naturally occurring, commercial and residential water sources. Once in water, the eggs can develop into adult mosquitoes, and some species have the ability to transmit mosquito-borne diseases. Due to California's persistent drought, the number of natural water sources continued to diminish in 2015. In April, Governor Jerry Brown issued an historic executive order requiring the State Water Resources Control Board to implement a 25 percent reduction in residential water usage across the state. The decrease in residential watering coupled with the lack of rain likely contributed to a decrease of some mosquitoes resulting in fewer requests the District received from the public for mosquito service in 2015. The District received 2179 requests from the public for mosquito service in 2015 compared to 2670 requests in 2014.

The California drought may have helped to reduce the number of mosquitoes in the county, but increased mosquito habitat in some places not usually associated with mosquitoes. For example, this occurred at the Contra Loma Reservoir in Antioch. The ongoing drought conditions caused water levels to drop significantly. High temperatures heated the water and helped vegetation and algae bloom. Warm water allows mosquitoes to develop from egg to biting adult rapidly and vegetation to flourish providing young larval mosquitoes protection from natural predators. Algae serves as food for larva. These conditions in combination resulted in mosquitoes emerging from the Contra Loma Reservoir for the first time according to District records. Fortunately, the mosquito species that emerged is not a vector of West Nile virus. Treating the reservoir was not an option since it serves as a drinking water source.

Drought Impacts Number of Neglected Swimming Pools Increasing Mosquito Populations

Due to the timing of the state-mandated residential water restrictions, some California swimming pool owners had to choose between paying new water fines to refill their pools or risk creating mosquitoes by leaving the pools alone. District employees conducted 525 swimming pool inspections in 2015 compared to 608 in 2014. The fewer number of inspections in 2015 may be because homeowners used swimming pool water to hydrate landscaping in lieu of tap water due to imposed state and local water use restrictions. This practice often left the pools partially filled with water and actively producing mosquitoes — even partially filled swimming pools can produce more than 1 million mosquitoes and affect people up to five miles away. Neglected swimming pools are a significant source of the species of mosquitoes than can transmit West Nile virus.

Artificial Containers Provide Mosquitoes with Water During Drought

In addition to swimming pools that were used by residents as a source of water during the drought, District inspectors estimate that one in four homes they visited had artificial containers such as pots, buckets and garbage cans holding water, collected during 2015's brief rainy season or saved from dish drains or indoor showers.

Many of these containers held hundreds of mosquito larvae. Mosquitoes only need a few tablespoons of water to produce hundreds of mosquitoes. Inspectors advised the residents to safely save water during the drought without raising mosquitoes by using one large container like a garbage can and covering it with window screen that is held in place by bungee cords. Rain water or other water can easily be collected in this way, but mosquitoes cannot access the water.

Collaboration With Agencies Help Reduce Mosquito Habitat in East County

In addition to advising residents about mosquito mitigation, District employees met with state and county officials, as well as local land owners and managers to achieve large scale mosquito prevention.

At Lindquist Landing Marina in Brentwood, the District worked with several agencies, the California Department of Public Health, Contra Costa County Environmental Health, Ironhouse Sanitation District and land managers for a cattle ranch, and a nearby aquatic fowl club to alleviate mosquito production coming from flooded land, leaking sewage, and damaged ditches. The efforts led to successful changes that reduced mosquito habitat.

On Bethel Island, ongoing talks with land owners, county officials and members of the Bethel Island Municipal Improvement District board yielded action on the removal of some of the Himalayan blackberries that overtook a series of ditches along Taylor Road. The invasive plant blocks the water from receiving mosquito control larvicide and allows mosquitoes to grow unabated.

Other collaborations led to a repurposing of pasture land that produced high numbers of mosquitoes due to standing water in cow hoof prints. The change to the agricultural land limited irrigation and no longer holds standing water or produces mosquitoes.

Variety of Mosquitoes Emerge Late in the Season

Most of the 23 species of mosquitoes in Contra Costa County end their season by late October or early November; however, this year in the coastal areas of eastern Contra Costa County, the number of mosquitoes collected in traps peaked in November and waned into December.

The District fogged for adult mosquitoes 12 times in 2015.

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Looking to the Future

Each year presents new challenges in vector control and weather plays a crucial part in vector production and control. District staff will pay close attention to 2016's predicted El Niño and the consequences. Experts predict an extended rainy season which means more water in places where mosquitoes could lay eggs and the possibility of changing species of mosquitoes should previously brackish water become dramatically diluted with an influx of fresh water.

Mosquito Zones

The District divides the county into 10 mosquito control zones and assigns one vector control inspector or technician to each zone to oversee control efforts and garner a familiarity with the geography and potential mosquito sources.

In 2015, the zone one inspector provided mosquito control by using larvicide in coastal areas where mosquito problems can intensify, particularly during the rainy season. The inspector paid particular attention to the seven sanitation districts which lie within the zone because *Culex pipiens*, a species able to transmit West Nile virus, typically lay eggs in polluted water and these areas can produce mosquitoes during much of the year. The same mosquitoes are known to come from storm drains and catch basins, and so the inspector treated 170 catch basins in 2015 to reduce the risk of mosquito-borne disease.

The zone two inspector conducted ultra low volume truck-mounted application of mosquito adulticide along the Martinez waterfront to mitigate adult mosquitoes. The mosquitoes, which prefer saltwater, emerged in large numbers due to the drought and lack of natural snowpack runoff that traditionally dilutes coastal saltwater and prevents coastal mosquitoes. Interestingly, creeks that had naturally dried from lack of rainfall received an influx of water from swimming pools that residents drained. Their choice to disable their pools was often due to water restrictions imposed by Governor Brown. This prompted the zone inspector to conduct mosquito control to the new man-made sources. The zone two inspector also worked with officials at the Shell Oil refinery to reduce mosquito production in pieces of equipment and areas within the facility that held water. The ongoing collaboration resulted in positive results as refinery representatives worked to remove vegetation that prevented mosquito control from occurring in several ponds.

The zone three inspector found himself busiest in 2015 in the coastal marsh areas of Bay Point and Pittsburg that became increasingly brackish due to the drought's lack of water. As in the case along the Martinez shoreline, this area also became breeding grounds for *Aedes dorsalis*, the salt water marsh mosquito. These mosquitoes can bite day or night, but are not a vector of West Nile virus. Because they can fly up to 10 miles, these mosquitoes also showed up in neighborhoods where the zone inspector received an increase in requests for mosquito service in 2015 compared to previous years. By September, the inspector found very few young developing mosquitoes in water sources throughout the area, which should have signaled a waning mosquito season, however, from late September through early October, the number of mosquitoes being caught in traps set up in the coastal communities not only increased, the species changed to *Culex tarsalis*. *Culex tarsalis* is one of the two vectors of West Nile virus in Contra Costa County.

The cities of Lafayette, Moraga, Orinda and part of Walnut Creek make up zone four. Due to numerous old-growth trees, this inspector spends time each year controlling Western tree hole mosquitoes. These mosquitoes can transmit dog heartworm. In 2015, several District employees assisted the inspector with a tree hole assault in Lafayette and Moraga designed to treat a number of tree holes with an absorbent to prevent an accumulation of water that would allow young mosquitoes to develop. In Orinda, the inspector prevented mosquitoes from developing in mitigation ponds by using granules of naturally occurring bacteria to kill young mosquitoes, while leaving other aquatic life unharmed. He also stocked potential water sources throughout the zone with mosquito-eating fish to prevent young mosquitoes from developing into adults capable of transmitting disease.

The rest of Walnut Creek, along with Alamo, Danville, Diablo, Blackhawk and San Ramon fall within zone six. The leader for this zone found the drought had a major impact on past mosquito sources. With little rain, many of the ponds, channels and creeks were dry and did not produce mosquitoes in 2015. The inspector did, however, receive requests for service to investigate the origin of mosquitoes that showed up on residential properties. The inspector suspected these mosquitoes were coming from uncovered water that had been collected by residents in order to irrigate vegetation without violating California's mandated water restrictions.

Zone seven is made up of Jersey Island and Oakley. Jersey Island has many facets that could produce mosquitoes—from annual flooding to levee repairs and a temporary dam. Despite the potential for increased mosquito production, the inspector worked to prevent mosquitoes in these areas and did not see an increase in mosquitoes on Jersey Island in 2015.

In nearby Oakley, however, two properties required mosquito abatement to reduce the risk of mosquito-borne illness. In one case, a project to convert land into protected marshland stalled and became an active site for mosquito production. Following the abatement of that property, the inspector continued to communicate with the tenant to ensure a reduction in the number of mosquitoes being produced on the property. Cool weather finally slowed mosquito production there. The inspector also worked closely with the manager of Ironhouse Sanitation District to ensure minimal mosquito production.

Zone eight includes Discovery Bay, Byron, Knightsen and Brentwood—one of Contra Costa County's traditional hot spots for West Nile virus activity due to its usual hot weather. Mosquitoes not only complete their lifecycle in just five days in hot weather, mosquitoes can replicate West Nile virus in their salivary glands quicker as well, making them more viremic—more potent.

Due to the drought's lack of rainwater and mitigation efforts by business owners and officials, the inspector found fewer mosquito issues in 2015. When mosquitoes caught in traps tested positive for the virus in Discovery Bay, the inspector conducted ultra low volume truck-mounted fogging in an effort to eliminate infected mosquitoes. He also used mosquito-eating fish in catch basins that contained enough water to support the fish.

In Byron, the Irrigation District allowed a small area of wetlands to dry to prevent mosquitoes. In Knightsen, a repaired irrigation pipe successfully reduced the likelihood mosquitoes would come from that area. In Brentwood, a French drain was installed in a retention pond that had been a major source of mosquitoes in the past. The drain reduced mosquito production and the pond's maintenance was handed over to Contra Costa Flood Control. The City of Brentwood stepped in to prevent neighborhood runoff from collecting in another retention pond that had produced large numbers of mosquitoes in the past. And agricultural areas that installed drip systems succeeded at reducing risk of mosquito-borne illness. The inspector did, however, find new sources of mosquitoes when the drought caused water levels to fall at the Brentwood Golf Course. That lack of water caused mosquito-eating fish that had been successfully preventing mosquitoes to die. The remaining water subsequently produced mosquitoes. The inspector conducted hand-held fogging to reduce the number of mosquitoes after the number of mosquitoes caught in traps increased dramatically.

In zone nine, neglected swimming pools that required inspection and treatment by the inspector continued to be a source of mosquitoes in 2015. The zone is comprised of parts of Antioch, Pittsburg, Bay Point and Clayton. The inspector worked with employees from the golf course; Pittsburg water plant; and Keller Canyon Landfill. Her instruction included how to keep cows out of the area so that their hoof prints didn't create thousands of places where standing water can collect and produce mosquitoes. The inspector conducted ultra low-volume truck-mounted fogging when needed to reduce the number of adult mosquitoes when the counts were high.

Zone ten includes Bethel Island, Holland Tract, and East Oakley. While there are residential areas, the zone is largely agricultural in nature. Due to many ponds, lakes, channels, ditches, pastures, and habitat for aquatic fowl, the zone is a frequent site of West Nile virus activity—and 2015 was no different. While some areas did become dry due to the drought, many other areas maintained water whether from natural or man-made sources. Mosquitoes caught in traps as well as sentinel chickens housed within the zone tested positive for West Nile virus prompting the inspector to initiate an integrated vector management plan to prevent mosquitoes through granular larvicide, sometimes applied to large areas by using an amphibious vehicle. The inspector used mosquito-eating fish in areas where there was adequate water to sustain the fish. He also conducted ultra low volume truck-mounted fogging for adult mosquitoes to reduce virus activity.

Zone 12 is the City of Concord. The inspector responded to requests for mosquito service and conducted inspections and treatment when necessary to both existing and new sources of mosquitoes. One area that needed particular attention from the inspector involved catch basins.

District Inspector Josefa Cabada treats a backyard source for mosquitoes at a vacant house in Antioch.

Rats + Mice

Door-to-Door Campaign Unites Neighborhoods

The 2015 Strategic Education program aimed to bridge the silence about rat issues between neighbors and to fight the stigma that rats exist only in filthy areas. In fact, rat and mice issues flourish anywhere food, water, and shelter are plentiful. And residential neighborhoods boast plenty of these elements. Bird feeders, vegetable gardens, and fruit trees especially yield a steady, healthy diet for rodents. Experienced District inspectors correlate heavier rat and mice infestations and issues where ample food is located.

Door-to-door education highlighted the importance of neighbor connection and promoted unification and activities to eliminate, as much as possible, the three elements. Simple steps such as harvesting ripe vegetables and fruits and picking up and properly discarding fallen ones, as well as sweeping residual seeds from beneath bird feeders on a regular basis proved essential for the biggest impact. Especially since the extended drought dried up natural food and water sources and forced rodents to yards that were sustainable with lush vegetation, damp earth and abundant fruits and veggies, an irresistible good fortune, no matter the creature. Residents had abandoned lawns and other non-producing vegetation, choosing instead to water fruit trees and gardens with their coveted water amounts restricted by law.

Door-to-door efforts in one Concord neighborhood garnered media and subsequent social media coverage which increased requests for rodent services and education countywide. In addition, canvassing neighborhoods helped to identify other important rat-supporting elements, such as abandoned vehicles, lumber piles, and heaps of rubbish—all elements attractive to rodents.

In all, the District received 903 requests in 2015 for rat and mouse inspections compared to 758 in 2014. More than 40 percent of the requests for service in 2015 came from four cities within the county— Walnut Creek with 126 requests, Concord with 113, San Ramon with 74 and Richmond with 73.

Product Recommendations & Availability

District staff surveyed and confirmed that local hardware and home improvement stores had ample availability of products recommended for rat exclusion and control. In some cases, staff discussed District services and recommendations with store staff, providing information for continued support from stores who sell products with the same aim of helping constituents control vectors.

Countywide

The District partners with a variety of entities in Contra Costa County to aid in the reduction of vectors and risk of vector-borne diseases. In 2015, District staff consulted with and provided training to several key personnel in joint endeavors. For example, District staff worked with inspectors from the Contra Costa County Environmental Health Department whose responsibility is to oversee food inspections and other health-related protocols about rat infestations, biology, and control of rats.

In addition, District staff completed surveillance and control along the waterfronts in Antioch, Bethel Island, Oakley and Richmond. Waterfronts boast the additional risk of damage by rats and mice to boats where the rodents chew on everything, including wiring that proves a fire hazard. These rodents can cause significant damage to floating vessels.

In other areas of the county, vast construction work sites forced rodents to relocate to new areas and that required assistance from a team of District staff.

District Inspector Dave Obrochta inspects a residents' car for rodent infestation. Rats and mice often nest in idle vehicles and chew on the vehicles wiring causing thousands of dollars in repairs.

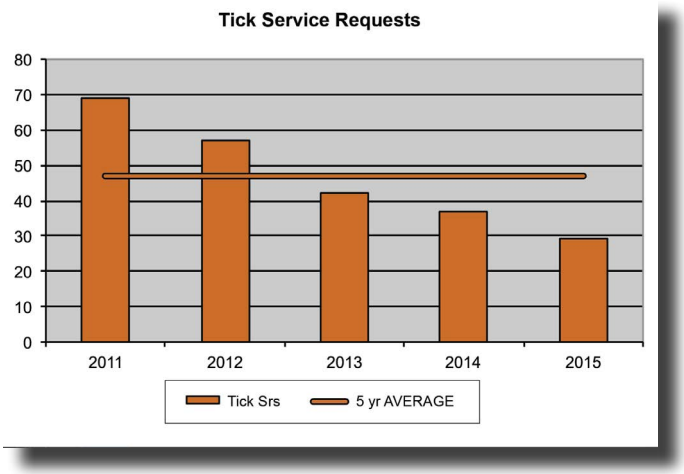
Ticks & Lyme Disease

Lyme disease is a bacterial infection transmitted by the Western black-legged tick (also known as the deer tick). While Lyme disease is rare in Contra Costa County (on average there are two to four human cases reported per year), it can cause serious complications if not treated promptly.

District staff continue to identify ticks brought in by members of the public, as this is important because there are three species of ticks that commonly bite people and only one, the Western black-legged tick, transmits Lyme disease.

After careful consideration, the District entomologist and vector ecologist, along with biologists from the California Department of Public Health concluded that individual tick testing for the bacteria does not significantly reduce the risk of Lyme disease for patients since the data cannot confirm human disease. People who are concerned with possible Lyme disease should contact their physician.

Tick related service requests in 2015 continued to decline as was seen in 2014, 2013 and 2012. Of the 29 ticks identified by our staff, 12 were Western black-legged ticks, the vector of Lyme disease.



What to Do If You Are Bitten by a Tick

Remove an attached tick using fine-tipped tweezers as soon as you notice it. If a tick is attached to your skin for less than 24 hours, your chance of getting Lyme disease is extremely small. To be safe, watch for signs or symptoms of Lyme disease such as rash or fever, and see a health care provider if these develop.

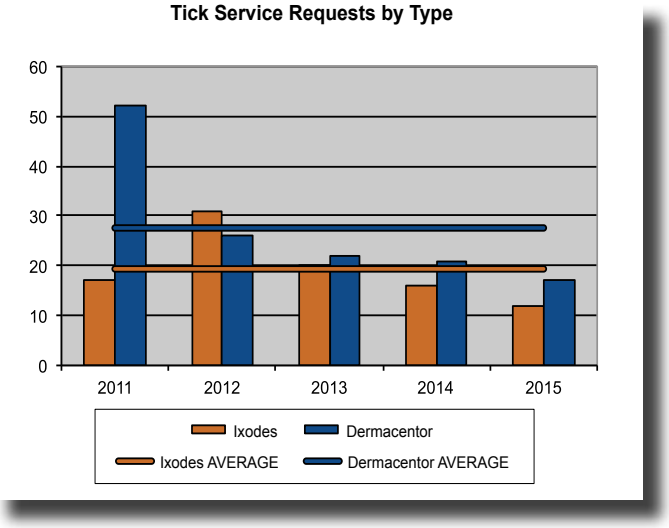
Your risk of acquiring a tick-borne illness depends on many factors, including where you live, what type of tick bit you, and how long the tick was attached. If you become ill after a tick bite, see a health care provider.

Ticks of Contra Costa County

There are three species of common human-biting ticks in Contra Costa County.

- Western black-legged tick (*Ixodes pacificus*)
- Pacific Coast tick (*Dermacentor occidentalis*)
- American dog tick *(Dermacentor variabilis*)

Of these three, only the Western black-legged tick (*Ixodes pacificus)* is known to transmit Lyme disease in California. Adult females of the species are about 1/8” long and reddish-brown in color. Males are slightly smaller and brownish-black.



Skunks and Rabies Risk Reduction

Skunks can transmit rabies by biting an animal or person. The virus infects the central nervous system and can lead to death if left untreated. The District provides inspections and advice to county residents who believe a skunk may be living on their property. This service is part of the Rabies Risk Reduction program which facilitates the skunk services in order to reduce the risk of rabies posed by the skunk population in Contra Costa County

Requests for Service Decrease due to Drought and Education

In 2015, members of the public requested inspections 789 times compared to 876 requests in 2014. The decline in service requests can be attributed to two likely reasons. First, California's historic drought left wildlife in need of water and food in many areas where vegetation died reducing the amount of plant food and animal prey to be found. For skunks, the lack of food and water likely made many of them unhealthy and less likely to propagate. An additional reason for the decrease in the number of requests for inspection can be credited to increased community education by the District employees.

Educating the public about the importance of habitat modification was the program's top priority in 2015. "You can't catch a smell," was a common refrain to explain why a passing skunk poses little risk of disease, but a skunk that passes through a yard and sees desirable food or habitat is another story. By removing items that could provide the skunk with food, water or a location suitable for a skunk den, the resident takes important steps to reduce the risk of rabies.

The cities where citizens requested the largest number of inspections came from Walnut Creek (100), Danville (86), Martinez (85), and Concord (64) in 2015. With the exception of Martinez, which replaced Antioch (55) on the list, these are the same cities that requested the largest number of inspections in 2014.

Skunk Removal

In addition to educating the public on how to prevent skunks and the associated risk of rabies, District employees do on occasion provide traps to residents in order to catch a skunk that is living on their property. The District employee only leaves a live-catch trap if specific criteria have been met, usually when it includes the existence of a skunk living on the property. In 2015, District employees removed 250 skunks from residential properties, down from 320 skunks removed in 2014. In accordance with California code, relocating skunks is not allowed and they are therefore humanely euthanized.

Drought Prompts Citizens to take Well-Intentioned, but Potentially Dangerous Action

The extremely dry conditions brought about by California's historic drought prompted some residents to help animals, but, in actuality, those efforts may have done more harm than good. District inspectors found many cases where residents sought to provide relief to wildlife by leaving pet food and water in open spaces. They used a collection of objects as containers to hold the food and water. Some dug holes to create artificial ponds while others used tires filled with water for the wild animals. Some citizens purchased or built cat houses and left them in open spaces with pet food and water.

While citizens' actions are well-meaning, these actions actually increase the risk of vector-borne disease and threaten the natural instincts of wildlife. Containers of food attract many different animals, including skunks. Water containers also attract insects. Mosquitoes need just two tablespoons of water in which to lay up to 400 eggs. The bowls and cans left behind fences, in opens spaces, and along trails are perfect habitat for mosquitoes capable of transmitting West Nile virus.

Vector Control Inspector Jason Descans inspects a deck for evidence of skunk activity.

Yellowjackets

Contra Costa County is home to four species of yellowjackets. Common yellowjackets (*Vespula vulgaris*) build nests above ground, while western yellowjackets (V*espula pensylvanica*) nest underground—usually taking over abandoned rodent holes and subterranean voids. Both yellowjackets have the ability to eat small pest insects and perform incidental pollination; however, they also have the ability to bite and sting any perceived threat including a person or animal. Unlike a honey bee, a yellowjacket's stinger does not detach and so the yellowjacket can continue to sting and bite in defense of its own safety.

The unrelenting and aggressive stinging and biting, particularly from western yellowjackets, is deemed a public health risk and therefore one of the services the District provides to Contra Costa County residents. District employees provide inspections and treatment of only in-ground species to prevent human injury, particularly to those people who suffer from an allergic reaction to stings and bites. In 2015, the District received 261 requests for yellowjacket inspections and treatment, a 49 percent decrease from the 515 inspections requested in 2014. The reason for the decrease is likely due to California's historic drought.

Drought Forces Yellowjackets to Change Behavior

Small insects such as aphids can be found living on and eating plants and other vegetation. The tiny insect is a food source for yellowjackets, but during California's extended drought, the lack of water prevented vegetation from growing and left vast areas of terrain and residential landscaping to die. The consequence was that the county's yellowjacket population likely decreased due to lack of food and water. Evidence of this possible population decrease is the decrease in total number of requests for inspection as well as the fact that during 2014 the District received requests for inspection during all 12 months of the year, but in 2015, the District received requests from members of the public during just 10 months.

Yellowjackets that did survive were forced to adapt to the changing availability of food and water. District employees witnessed evidence of the changing behavior in two particular cases. In Concord, a homeowner complained that yellowjackets appeared to be coming from a tree in the backyard, but the District inspector only found foraging yellowjackets without a nest. A lengthy investigation failed to reveal the location of the nest. District employees worked with the homeowner to lure the yellowjackets to a specific location by using chicken meat. While the yellowjackets were distracted by the meat, the District employees sprinkled a small amount of fine, powdered sugar onto the yellowjackets so that the human eye could follow them as they returned to their nest. The nest was revealed to the District inspectors to be more than 1,000 feet away.

While yellowjackets are capable of flying as far as one mile from a nest in search of food, District employees commonly find them within several yards of a nest. In this case, the lack of water and vegetation due to the drought likely forced the yellowjackets to fly further in search of the food they finally found in the sap from the homeowner's tree.

In another case of yellowjackets behaving in a way of which they are capable, but rarely observed within Contra Costa County, a beekeeper in Moraga contacted the District for service when she witnessed yellowjackets invading beehives that she maintained on her property. Yellowjackets have been known to eat bee larvae, but it is not an occurrence that the District has witnessed in the county.

Upon arrival at the scene, District employees observed yellowjackets forcibly removing honey bees from the beehive, that they would then drop on the ground where other yellowjackets would attack them. The beekeeper said she'd never experienced anything like it. The yellowjackets killed off one of the beekeeper's four hives.

Using the same technique with chicken meat and powdered sugar, District employees were able to track the yellowjackets back to their nest and again it was not nearby. The nest was more than 500 feet away suggesting again that due to a lack of food and water options, the yellowjackets found the beehive to be a viable option during the drought.

Looking to the Future

A long-term message of the District for county residents to alleviate yellowjackets is to start early in the year. For those who put out yellowjacket traps, the ideal location is far from any doors or windows. The ideal time is after the last hard freeze of winter in an effort to capture the queen and prevent her from creating a colony that can have a population from 1,500 to 15,000 yellowjackets.

Carefully maintaining vegetation to make it less attractive to yellowjackets and less likely to be a place where they would build their nests is also an important step to reduce the risk of yellowjackets—and something that can be done year-round. The underground holes that yellowjackets inhabit can often be found under shrubs and other bushes. Keeping the foliage trimmed so that light can penetrate beneath the plants is one way to make any potential holes unattractive to yellowjackets.

Africanized Honey Bees

Contra Costa County's first detection of Africanized honey bees (also known as "killer bees") was in July of 1997. The second was in December of 2008. Both incidents involved imported bees that hitched a ride on cargo ships. The bees were intercepted before they could escape and establish new colonies. The Contra Costa Mosquito & Vector Control District responds to public complaints of honey bee swarms and new hives in potentially hazardous locations.

In 2015, the District received four calls about Africanized honey bees. Most of the calls received are due to the presence of a honey bee swarm passing through the area or resting in a neighborhood. These swarms are generally not a threat as the bees are simply in search of a new hive location.

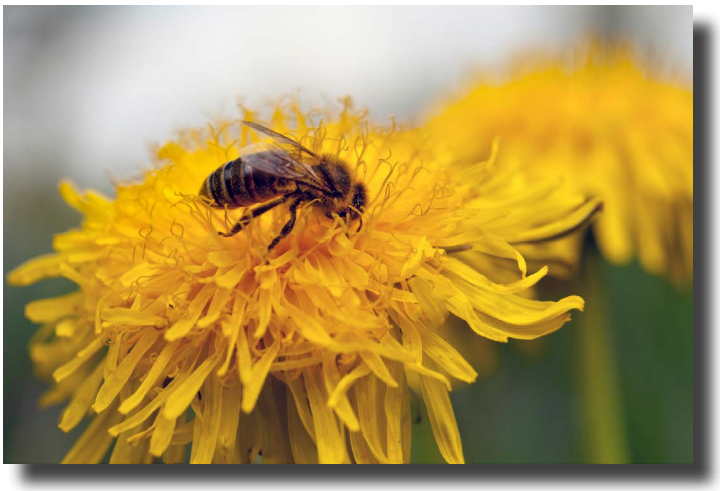
Africanized honey bees do not look noticeably different from the typical European honey bees. Initial screening for AHB is made by District scientists measuring the wing span of the bees and comparing them to those of the European honey bees, but they can only be positively identified through DNA testing.

Africanized honey bees have an interesting history. In1950, researchers in Brazil bred them with European honey bees (EHB) in an effort to make a "super bee" capable of surviving better and making more honey in tropical climates. Thus, the AHB was born. Unfortunately, some of those bees escaped the lab in 1957 where they naturally mated with other bees. Today, researchers say AHB are established as far north as the southwestern United States where they coexist with people and animals pollinating, making honey, and contributing to the environment.

There are differences between the two varieties of bees. Both spread in swarms, but AHB do so more often and further in distance than European bees. They tend to be more protective of their queen, sending more bees to guard a hive, and they are less successful at surviving in areas with very cold winters that create a prolonged lack of food. It's their shorter fuse that differentiates them from their European cousins. Both will act to defend their hives from a threat; however, studies show that AHB are more protective of their hives. When swarming, both varieties tend to be non-aggressive as they do not have a hive filled with food and larvae to defend at that time. Africanized bees are more likely to react defensively to loud noises like those made by lawn mowers and power tools.

Like all honey bees, AHB will only sting once and then die; however, because they have that overprotective instinct toward their queen, larger numbers of AHB may sting at one time. The venom from either bee variety is the same. The reason people or animals die from AHB stings is largely due to the number of stings---hundreds or thousands. Most of the victims of bee attacks have been dogs that were tied up and couldn't run away. And some people can suffer a serious allergic reaction from bee stings.

All bees are more aggressive when they feel that their hive is being threatened. But bees, even Africanized bees, out foraging on flowers are just looking to gather food and are not interested in stinging anyone unless they are threatened or swatted.



An Africanized honey bee gathers nectar from a flower.

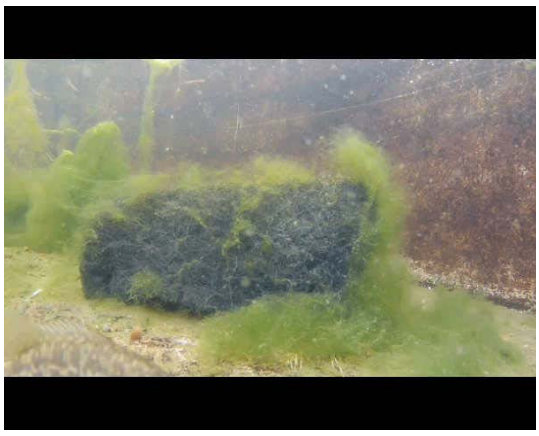
Fisheries

The District produced approximately 1.6 million mosquitofish (*Gambusia affinis*) and distributed 112,383 in Contra Costa County in 2015. In addition to rearing mosquitofish, the District is currently working with two California native fish: the California roach (*Lavinia symmetricus*) and the Sacramento Hitch (*Lavinia exilicauda exilicauda*).

The District has been working with the California roach since 2009 and can consistently produce juveniles. Roach have been used in swimming pools and in one private pond (in Yolo County). This species controls mosquito populations in stocked sites. While we don't expect to do wide spread stocking of this species due to regulations, we will continue to produce roach to have them on hand if specific circumstances develop. Roach eggs were produced from March 2 through April 15 with 5,200 larvae produced. The District fish biologist has provided the Oakland Museum and East Bay Regional Parks with this species for educational displays.

The District has worked with Sacramento Hitch (*Lavinia exilicauda exilicauda*) since 2011. This species needs to be at least two years old to spawn. In 2013, we did observe Hitch exhibiting spawning behavior (chasing and balling up around artificial vegetation) although no eggs were obtained. After deployment of a new egg trap in 2014, we produced 271 juveniles. Hitch spawned from April 1 through April 18.

In 2015, 374 hitch juveniles were produced from February 16 through March 2. Some eggs and larvae were provided to Fisheries Biologist Rene C. Reyes of the Bureau of Reclamation. Mr. Reyes is documenting the early life history of this species as well as all species of fishes in California. The small numbers of juveniles produced was disappointing. The District plans to use more egg traps in smaller tanks to improve production and possibly hand strip fish of eggs and sperm. The District will evaluate Hitch for mosquito control in 2016.



Video (click here to view): *Male Sacramento perch guarding eggs 06/23/15*

The District also started a small pilot project in March 2015. California Department of Fish and Wildlife and East Bay Parks Fisheries branch requested that the District aquarium spawn Sacramento perch from Jewel Lake in Tilden Park. The District was asked because of extensive experience with Sacramento perch and success in aquarium spawning. The project was to set up ten 20-gallon aquariums, spawn Sacramento perch and distribute larvae perch to different locations. This strain of perch has unique genetics that need to be preserved. Currently Jewel Lake is in need of repairs (the dam is leaking) and now California Red-Legged frogs have been found in the lake so perch will be removed and will not be replaced. We were successful in spawning perch and produced 62,410 larvae from May 27 through November 11. These larvae were bagged and given to the East Bay Parks Fisheries biologists and transported to an approved stocking site.

The District will continue to maintain populations of California roach (*Lavinia symmetricus*) and Sacramento hitch (*Lavinia exilicauda exilicauda*). In addition, we expect to obtain another fish species for evaluation for mosquito control— the California native Hardhead (*Mylopharodon conocephalus*).

The District is working with California Fish and Wildlife for possible funding for Sacramento perch projects as well and providing technical support on artificial propagation of California native fish species.

A pair of Sacramento perch

Public Affairs & Community Outreach

Community Outreach

Promoting healthy activities and educating the public about good mosquito control practices that reduce risk of vector-borne disease is the mainstay of the public affairs program. But, it's not easy to change people's behavior, even when it's in their own best interest. Our diverse approach ensures we reach as many constituents as possible in a way that meets their information needs.

Social and Traditional Media Outreach

Communicating on a mass scale is essential when delivering important health messages. We work closely with and rely on traditional media to reach to our varied audience of more than 1.2 million residents. Our research shows that the majority of our constituents want to receive our news information from media outlets like television and newspapers.

Of course, media are just a click away on Twitter where we post our breaking news and adult mosquito spray notifications. From there, all media outlets report to the public. They are keen to important messages and often one tweet results in a media interview within one minute of posting. We are careful to post only newsworthy information and the media are swift to inform the public. More than 50 percent of our social media users view our information on their mobile devices versus on the traditional desk-bound personal computer.

Our billboard sign located eastbound Highway 4 in Antioch illustrates the impact of neglected swimming pools

Website

The rise in viewership on mobile media illustrates the necessity for our website to be mobile friendly. Revamping of the site began in early 2015 and continues so that residents can view our information right at their fingertips and on demand.

Looking to further improve our resident's experience, our resident poll of our site revealed that 90 percent found our website "very informative and easy to use".

Local Reach and Beyond

The District's award-winning website remains the No. 1 communication tool for constituents and media alike. The nearly 300-page site serves as an important reference tool for a worldwide audience.

No greater example can be found than the Huffington Post story Alarming Consequences of the California Drought you May Not Have Expected that referenced our featured article Why Drought Years Can Increase the Risk of Mosquito-Borne Illness in February. Huffington Post has a worldwide audience that as of late 2014 boasted 115 million global unique visitors and currently has 6.5 million Facebook followers and 6.7 million Twitter followers.

In addition to the Huffington Post story, Getty Images supplies stock photography of District activities in photos for a worldwide audience and many media outlets have purchased the photos from Getty for their stories about mosquito control. Working with Getty Images allows the District to contribute to the global conversation about mosquito control efforts in California.

Electronic Communication

Our electronic communication consists of Media Releases, Adult Mosquito Spray Notifications, and the Mosquito Bytes Newsletter. Subscribers to these publications continue to increase. The electronic communication offers immediate and timely information about District activities and important messages. The maps are interactive and understanding when and where adult mosquito spraying takes place is easy. Breaking news such as West Nile virus cases or disease confirmation in the county is efficiently delivered and immediately available.

Environmental

In addition to protecting public health, the Contra Costa Mosquito & Vector Control District is also dedicated to protecting the natural environment. Healthy wetlands support populations of natural predators which produces fewer mosquitoes than habitats modified or damaged by human activity. The District plays a leadership role in the conservation and restoration of Bay Area wetlands, protection of endangered and threatened species, and promotion of biorational (environmentally compatible) control methods in order to protect both human and environmental health.

The Central Contra Costa Sanitary District recognized the District as a Water Quality Community Partner for 15 years of full compliance with their Industrial User Permit where “your efforts to reduce pollutants entering the sewer system help us to achieve our mission of protecting public health and the environment.”

Continuing Education

The District employs vector control technicians and inspectors certified by the California Department of Public Health. In order to become certified, they are required to pass an exam in pesticide use and safety, in addition to at least one of the following: Mosquito Biology and Control; Terrestrial Invertebrate (insect) Biology and Control; Vertebrate (animal) Biology and Control. Certificates are renewed every two years provided the following continuing education requirements have been met during that period: 12 hours of Pesticide Use and Safety, 8 hours of Mosquito Control, 8 hours of Terrestrial Invertebrates, and 8 hours of Vertebrate Vectors. In addition to these basic requirements, the District conducts annual in-house training and frequent reviews and updates of policies and procedures at weekly and monthly staff meetings.

Shop & Facility Maintenance

The District employs one mechanic responsible for all automotive and facility repair and maintenance. He maintains 37 field vehicles, three staff vehicles, 18 vehicle sprayers, two boats and their trailers, five 8-wheel ARGOs, five 4-wheel All Terrain Vehicles, 11 trailers, seven Ultra Low Volume sprayers, one catch basin mister, and 1 forklift. The mechanic designs and fabricates specialized equipment, provides most needed repairs and maintenance of grounds and equipment, such as electrical upgrades, plumbing repairs, solar panel maintenance, flooring and miscellaneous projects.

Information Technology

The information technology systems administrator is responsible for all communication technology at the District including maintaining all aspects of the administration phone system, cell phones, computers, and internet services. The systems administrator maintains multiple virtual servers and approximately 40 workstations with associated software. The administrator also programs and maintains the District’s specialized database known as VXS, which is used to record data for vector control surveillance, monitoring pesticide usage, workload management, and more.

Administration

Administrative staff serve the residents of Contra Costa County by responding to telephone inquiries, scheduling service requests, compiling mandated reports and maintaining public records. Staff responsibilities also include processing service requests, contract billing, payroll and accounts payable, as well as providing administrative support. Working closely with city and county personnel, staff also correspond and work extensively with city and county entities regarding compliance and enforcement on vector control issues.

The District is located in Concord, California

Financial Statement

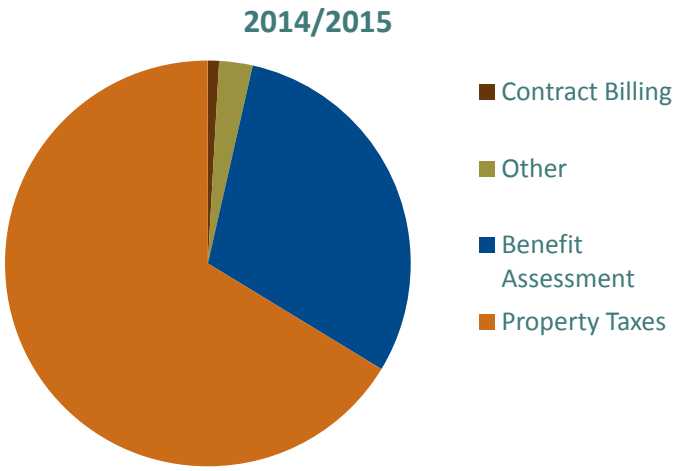
The Contra Costa Mosquito & Vector Control District depends on property tax revenues and benefit assessment charges in Contra Costa County to fund operations.

The District receives approximately two-thirds of its annual revenue from property taxes and this revenue stream rose approximately 5.7 percent in the fiscal year 2014/2015 as compared to fiscal year 2013/2014. This is in strong contrast to the dramatic drop the District saw in property tax revenue during the housing crisis. We continue to see signs that Contra Costa County property tax assessed values will continue to rise due to a recovery in the housing market.

Additionally, local property taxes earmarked for the District are diverted annually to the State of California's Educational Revenue Augmentation Fund (ERAF). In 1996, the District implemented a countywide benefit assessment to replace these lost funds. This nominal annual charge varies among four zones in Contra Costa County according to benefit of our services and generates revenues that are used to provide mosquito and vector surveillance and control projects to the properties in Contra Costa County.

The District's board of trustees created a trust and adopted a policy to begin funding Other Post Employment Benefits , "OPEB". Under Government Accounting Standards Board recommendations, public agencies need to start funding future retiree health benefits. Based on studies completed by an independent outside actuary, the District currently contributes $145,000 from reserves to this trust fund.

As mandated by government code, the District is annually audited by an outside firm. The firm audits the District's financial statements to obtain reasonable assurance that the financial statements are free of material misstatement, they review the accounting principles used, all financial disclosures, and the overall financial statement presentation. The District annually receives an *Unqualified Opinion*, which is the best opinion bestowed.



Revenues	2014/2015*	2015/2016**
Property Taxes	$4,409,312	$4,629,778
Benefit Assessment	2,004,107	2,006,000
Contracts	58,292	60,000
Interest	17,582	13,000
Miscellaneous	160,385	155,000
Total Revenues	$6,649,678	$6,863,778
Expenditures	**2014/2015**	**2015/2016**
Salaries & Wages	$5,057,614	$5,302,682
Operations	1,393,806	1,396,401
Capital	156,729	140,124
Total Expenditures	$6,608,149	$6,839,207
Transfer to reserve	41,529	24,571

*Audited **To be audited

CONTRA COSTA
MOSQUITO & VECTOR CONTROL
DISTRICT

Protecting Public Health Since 1927

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