



**ADA COUNTY MOSQUITO ABATEMENT DISTRICT  
COMPREHENSIVE PLAN  
For  
MANAGING MOSQUITOES  
IN ADA COUNTY, IDAHO**

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## Prelude

Mosquito transmitted diseases have existed in the Americas since long before European settlement. Eastern Equine Encephalitis, Western Equine Encephalitis, and St. Louis Equine Encephalitis viruses are examples of such long-term threats. With the coming of the Europeans to the New World, additional diseases, such as malaria, dengue and yellow fever were added to the mix of vector-borne diseases. Most people today are unaware that malaria extended throughout the United States and into southern Canada in the 1800's. Before the widespread use of motor vehicles, Equine Encephalitis viruses caused major epidemics in the horse population that resulted in substantial economic losses.

In recent years, a variety of new and exotic disease problems have been encountered. Vectors, such as mosquitoes, transmit many zoonoses, such as West Nile Virus (WNV). WNV spread rapidly after its introduction to the United States, being first confirmed on the east coast in 1999 and distributing across the country to the west coast in only 5 years. Given increasing trends in globalization, travel and commerce, it is likely that other exotic diseases will be transported to and become established in the United States in the future.

The cost of vector-borne disease prevention is normally less than the cost of control after an epidemic begins. Not only is emergency vector control expensive, but there is also the added cost to treat disease cases that might otherwise have been prevented. The average cost per patient hospitalized with WNV infection in Louisiana in 2002 was \$51,826. Ada County had three cases of WNV paid for through indigent services in 2006, which cost tax payers over \$150,000.00. The cost of WNV to the U.S. equine industry may be in the billions of dollars. These numbers fail to address the additional emotional cost to the families of victims of mosquito-transmitted disease, the changed quality of life of the victims and other similar issues. In addition to the impact on human and equine health, these viruses frequently have a major impact on wildlife, including threatened and endangered species. In 2002 alone, it is estimated that more than 2 million birds died from WNV infection in The United States.

The abrupt arrival of WNV in Idaho demonstrates that mosquito control is an important public health function. The challenge that mosquito abatement districts face is to develop and maintain an effective vector control plan.

In Ada County, the original Mosquito Abatement District (MAD) was the Three-Mile Creek District. It was established in 1974 with the mission to control mosquitoes that are both a nuisance and a potential health threat. This first-generation district included 12 square miles between Cloverdale and Cole Roads on the west and east, and Franklin and Columbia Roads on the north and south. Over the next several decades there were numerous district annexations that expanded the boundaries and changed the name. In early 2004, the Ada County Board of County Commissioners agreed to incorporate and operate what was then called the Southwest Ada County Mosquito Abatement District. Today, the Ada County Mosquito Abatement District (ACMAD) includes 406 square miles of Ada County and encapsulates most major residential and urban centers.

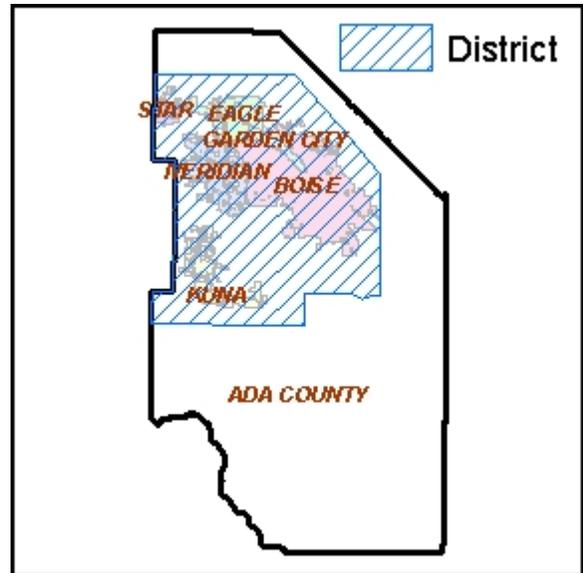


Figure 1 – The current Mosquito Abatement District boundary.

## Statement of Purpose

The ACMAD Comprehensive Plan provides a framework for the structured implementation of a program to effectively control mosquitoes in Ada County. It also offers the public and other interested agencies and organizations a detailed look at our mosquito abatement strategies. Additionally, elements within this plan will help the department determine goals and objectives, prioritize activities, and isolate program areas that need restructuring. Finally, evaluation of this plan will help assure the appropriate and responsible usage of tax funds to provide an efficient and balanced program.

Activities described in this plan cover routine operating procedures. Idaho Code (Title 39 Chapter 28 Section 39-2808) provides for additional and cumulative remedies above routine procedures to prevent, abate and control the spread of mosquitoes and/or other vectors affecting the health, safety and welfare of Idahoans. Pursuant to Idaho Code (Title 46 Chapter 10), if all efforts by the district have not stopped an event posing a threat to the public, a government agency may initiate cooperative operations with other state or federal agencies by means of an “Emergency Declaration”. This declaration gives the district access to additional resources and allows for more extensive efforts to maintain the health, safety, and welfare of our residents.

## Introduction

Worldwide there are approximately 3,000 species and subspecies of mosquitoes. Of these, about 170 are found in North America and 51 in Idaho. These pests affect people’s work, recreational activities, impact our agricultural economy, and threaten citizens with diseases they may carry. Most of the 51 species of mosquitoes found in Idaho can be classified as *unimportant* in that they may be pests in certain ecological conditions, but are generally uncommon or rare. A few species are classified as *less important* as they may be disease vectors, but are only abundant under certain ecological conditions. Ada County Mosquito Abatement is most interested in species classified as *important*; namely, those that are abundant, widely distributed, serious pests or competent disease vectors.

The mission of ACMAD is to control mosquitoes that are both a nuisance and a potential health threat for the citizens of the Mosquito Abatement District. Strategic priorities provide for public safety, security and excellent health and public services. To reach this mission and achieve these goals, our agency utilizes an Integrated Mosquito Management (IMM) approach. IMM is a decision-making process that uses all available mosquito management strategies (education, cultural, mechanical, biological, and chemical controls). Utilizing an IMM approach helps determine what combination of control strategies will reduce the mosquito populations to an acceptable level with the least impact to the environment.

- Education is the first and most successful management strategy in IMM. Mosquito control programs need the support of an informed public. Many successful strategies involve training residents to recognize, treat, or remove potential mosquito development sites in their neighborhoods. By learning about the different types of mosquitoes, landowners are better prepared to understand the various control strategies and work together more effectively. As we complement each other’s activities, we maximize the mosquito abatement effort within the district.
- Cultural controls deal with changing a person’s habits to reduce or avoid contact with mosquitoes. Examples are wearing long sleeves to avoid being bitten, or taking a walk at a different time when mosquitoes are less active.
- Mechanical controls involve the physical changing of land or structures, or otherwise known as remediation, to reduce mosquito development sites. Examples are changing the water in a birdbath, or removing a shallow pond of standing water are mechanical processes that eliminate mosquito development sites.

- Biological controls consist of introductions of natural enemies of mosquitoes that kill the larvae or adults. *Bacillus thuringiensis israelensis*, or *Bti*, is a biological chemical control used to kill mosquito larvae by disrupting their digestive system.
- Chemical controls are generally the last choice for mosquito abatement. Sometimes aerial control is necessary to effectively and efficiently reduce flying mosquitoes from large geographical areas.

## Mosquito Population Management

Of the 51 mosquito species found in Idaho, 17 have been identified in Ada County through surveillance activities. These 17 species are divided into two major types; pond and floodwater mosquitoes. The distinction between these two types of mosquito species is very important because the methods to monitor and control them are different. Likewise, control methods are also different for the larval and adult stage of mosquitoes.

Mosquito development sites are dynamic and in a constant state of change. For example, in wet years more pond sites show up than in dry years. Land use changes can also alter the sites and types of mosquitoes present in an area. An example of this is the development of a subdivision from an agricultural field which may either remove the mosquito development site or create urban ponds or the fluctuation of irrigation practices in rural areas. As such, sites are constantly being re-assessed, and field crews are always on the watch for newly created sites.

### *Life Stage Management Strategies*

Larviciding, or abatement of mosquitoes as larvae in bodies of water, is the first line of defense and is a major emphasis in our program. Larvicides, or the products used to control mosquitoes in the larval stage, may be either biological or chemical in nature, and are intended to either stunt the growth or kill mosquito larvae, thereby preventing their hatching or development into adults. Management of mosquito larvae is handled differently depending on the type of mosquito (pond or floodwater). Action thresholds for larvicide treatments are when any immature stage of larvae is present in a site, or when preferred development habitat of species is present which is variable based on species, historical data, surveillance data, environmental factors and impacts, time of year, climatic conditions, and cost effectiveness and feasibility. This is discussed in more detail in the following sections.

Field crews monitor all larvicide sites via visual inspection or dipper sampling in different treatment areas of the county to determine the need for larvicide applications. If dipper samples find larvae present, and all other Pest Management Options are considered first and the site requires treatment then the site is treated with chemical or biological controls. The applicator that performs the inspection determines what the best treatment practice should be and makes the appropriate applications. All inspection and treatment information is recorded digitally and stored in centralized databases. Each development site in the county is issued a 'Next Survey Date' (NSD), which is determined by the length of time the applied treatment will be effective on the mosquito larvae found in the site and is a way to monitor the application of the pesticide post treatment when feasible. Typical application methods consist of hand spreader, broadcast spreader, maruyama machines, and boom applicators for liquid larvicides; additionally there may also be a need for an aerial larvicide application.

Adulticiding, or the abatement of mosquitoes as flying adults, is an important control method in protecting public health, but is used only when conditions are warranted and all other Pest Management Options have been considered. Adulticiding can be conducted by air but most commonly is a ground based application of insecticide using an Ultra Low Volume (ULV) fogging machine mounted on a small truck. Floodwater mosquito adults are the major thrust of the adulticiding program. These mosquitoes commonly hatch and mature simultaneously thus producing large numbers of nuisance mosquitoes. Most complaint calls for mosquitoes can be traced to this type of mosquito. Action thresholds for adulticide treatment depend on species type and are described in detail below.

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Adulticide chemical application occurs near dawn or dusk and late into the evenings, when adult mosquitoes are most active and beneficial insects are inactive. Application areas are determined by complaint calls, requests from the larvicide crews during the day, and from surveillance information. In the event of an outbreak of a disease, such as happened in 2006 with WNV, a contingency plan for aerial application of adulticides could be initiated to supplement ground applications. Additionally when a disease outbreak may be of concern based on mosquito species, historical data, surveillance data, presence of disease in the MAD or in neighboring counties, environmental factors and impacts, time of year, climatic conditions, and cost effectiveness and feasibility, an adulticide aerial application may be necessary to potentially avoid the outbreak and hope to reduce the risk to the residents of ACMAD.

*Management of Larval Stage Pond Mosquitoes*

Urban development and construction in Ada County is continuously changing land use, removing some of our identified mosquito development sites and creating new sites. Our staff is regularly watching for new site locations and mapping them when found. Permanent pond sites are areas that fill and hold water after a rain or irrigation event. Generally they permit multiple successive generations of mosquitoes. Populations of this type of mosquito increase at a slower rate than the floodwater mosquitoes, resulting in fewer complaints about their presence and biting habits. Since these sites are permanent to semi-permanent we can routinely monitor, trap, and control species at these sites and determine if WNV or other disease is present.

Pond mosquitoes in Ada County are *Anopheles freeborni*, *Coquillettidia perturbans*, *Culiseta inornata*, *Culiseta incidens*, *Culex restuans*, *Culex erythrothorax*, *Culex pipiens*, and *Culex tarsalis*. Most pond mosquitoes lay raft-like egg masses; the exception is the genus *Anopheles*, which lays eggs singly, directly on the water’s surface. Pond mosquitoes typically overwinter as adults in dark sheltered areas such as animal burrows, man-made shelters, basements, etc. When they emerge in the spring, they lay their eggs when conditions are ideal. Mosquito eggs can progress from egg to adult within 7-14 days normally but as summer progresses, they can develop much quicker.

Pond mosquito development sites are variable and a list of common development site types can be found in Table 1. Pond mosquitoes generally lay a single brood, but are more commonly known to be multi-brooded (meaning they can lay several egg raft masses throughout their life cycle). Some species stay very close, within 1 mile, of their development site, while others will travel great distances (*Culex tarsalis* have been found to travel up to 15 miles from a development source). Pond mosquito populations usually start small and then increase over the mosquito season. They are usually most active between dusk and dawn, at the same time that human populations are more active during the summer months. Some pond mosquito species have the potential to carry diseases, such as malaria and WNV. Our department is particularly concerned with the control of pond mosquitoes and a large program focus is placed on larviciding and surveillance in these areas.

Table 1 – List of some of the most common development sites for pond mosquitoes in Ada County.

Ditches	Roadside drainages	Irrigation canals
Borrow pits	Retention ponds	Catch basins
Gutters	Storm drains	Margins of slow flowing rivers
Lakes, ponds, and reservoirs	Springs	Swamps and marshes
Artificial containers (cans, buckets)	Bird baths	Horse troughs
Ornamental fountains and pools	Abandoned Swimming Pools	In ground trampolines

### *Management of Larval Stage Floodwater Mosquitoes*

Floodwater mosquitoes typically hatch as a result of flooding. For example, snowmelt, irrigation of pastures, river flooding or residential yards, etc. Fields and pastures usually have thousands of depressions that can develop flood water mosquitoes. These areas may not be mapped or monitored as they are too diffuse and numerous to specifically locate. Unlike the pond mosquitoes, floodwater mosquitoes hatch out only when a flood event occurs, either naturally or artificially through irrigation, due to the nature of the species present.

Mosquito traps can be set in flood mosquito areas, but may not catch any mosquitoes until flooding occurs. Typically, floodwater mosquitoes may be treated with larvicides when development locations are found through ground and trapping surveillance but because of the large number of very small sites over vast areas, not all areas can be treated. Large areas require large amounts of product and would ideally be applied through a larvicide aerial application, but can be cost prohibited.

Flood water species found in Ada County are *Aedes vexans*, *Ochlerotatus dorsalis*, *Ochlerotatus nigromaculis*, *Ochlerotatus sticticus*, *Ochlerotatus flavescens*, *Ochlerotatus increpitus*, and *Ochlerotatus sierrensis*, *Ochlerotatus spencerii idahohensis*, and *Ochlerotatus melanimon*. Flood water mosquitoes typically lay eggs singly on damp soil above the water level. These mosquitoes can overwinter as eggs, and when a flooding occurs and the temperatures are warm, they can hatch within minutes or days. A floodwater mosquito egg can survive for years, (*Aedes vexans* eggs can survive up to 3 years) until a flood event occurs.

It has been found that hatching delays increase the survival of the floodwater species. Due to the nature of their life cycle, when a flood event occurs, most of the eggs will hatch and emerge into adults very quickly, within 4-5 days, and their populations' spike at that time. Flood water mosquitoes may deposit eggs once, or multiple times throughout their life cycle, and have been known to migrate large distances. They are usually active during the day, swarming in the shade, and from dusk into the early evening. These species are known to be vicious biters and swarms of certain species (such as *Ochlerotatus nigromaculis*) can make human activities come to a standstill.

### *Management of Adult Stage of Mosquitoes*

When mosquito adults are present and creating a nuisance or public health threat or have the potential of this, then ACMAD sends out our adulticide crews to areas of concern through the ACMAD. The adulticide activities are based on surveillance data and public complaints and landing count rates. As threshold levels are met or exceeded based on surveillance (see below), then chemical adulticide treatments are requested to the area of concern. The adulticide chemicals used are very specific to the targeted pest and at the rates used have shown through scientifically proven data to have limited to no impact to beneficial insects, like moths, that may be active during the time of applications (evenings). Application variables are evaluated using Best Management Practices such as treatment areas, mosquito population abundance and diversity, climatic conditions, public health threats, potential of spread of WNV, or other vector mosquito borne diseases, time of year, environmental impacts, cost effectiveness and feasibility.

## **Trapping and Surveillance**

### *History of Surveillance*

Abrupt introduction of WNV to Idaho in 2006 necessitated an emergency declaration for public health reasons, and demonstrated the importance of having a mosquito surveillance program in place. An effective program will aid in predicting emergency situations, allowing an opportunity for vector management to intercede before a situation becomes critical. Historically, up to twenty trapping sites had been utilized across

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Ada County. Once per week, a trap was set at each location in the evening (Monday through Thursday) between the hours of 7 and 11 pm. The next morning, all set traps were collected between the hours of 5 and 9 am. The contents of each trap were sorted, and all mosquitoes collected were counted by species. These data are entered into a database and compared with historical records to provide the context of the current mosquito season and to help plan necessary control efforts.

An ecologist was added to the ACMAD staff in 2007 to help facilitate the surveillance process. In 2007, the number of trap sites was increased to 40, setting and picking up 10 traps per night (Monday – Thursday). These changes increased the amount of information available to help determine and address problems before they reach endemic proportions. Expanded trapping also results in the discovery of new mosquito species, *Ochlerotatus sierrensis* and *Ochlerotatus spencerii idahohensis*; which had not previously been identified in Ada County. The greatest advantage of these changes has resulted in a more effective adulticiding program which enables ACMAD to determine when to apply what product and intensify our control efforts when required. Increased data also provides a clearer understanding of when large scale aerial applications are necessary.

In 2009, there was an increase in our trap numbers to 50 traps per week (10-14 traps per night; Monday evening through Thursday), allowing for analysis Tuesday through Friday. The traps were located where there was a higher population of *Culex species*. The purpose of the 10 new trap locations was to not only increase *Culex species* observations, but increase the surveillance of developing floodwater mosquito populations in areas where floodwater mosquitoes are known to be prevalent

In 2011, an increase in traps was seen throughout the county. The 50 permanent, or fixed, trap locations were still being monitored for species abundance and WNV presence, however, an additional 65 flex, or semi-permanent, trap locations were created in addition to 3 more permanent trap sites for the season. This allowed ACMAD to determine distribution and abundance of species, and species diversity in Ada County. It also allowed for monitoring and validity of public complaints from the residents and adulticide effectiveness on mosquito populations.

### *Methods of Surveillance*

Surveillance practices were designed as proactive measures to locate areas of disease concentration as well as mosquito population abundance. The ACMAD routinely uses Center for Disease Control and Prevention (CDC) light traps baited with carbon dioxide (CO<sub>2</sub>) to monitor mosquito numbers and species. Other adult trap devices that may be used for surveillance are gravid traps, New Jersey Light Traps, EVOS light traps, Rotating Collector Traps, etc. Trap site locations are typically set once per week in the evening after 7 pm and picked up the following day by 9 am and this is considered a trap night. If a site location has a vector potential mosquito (examples are *Culex spp.* and WNV or *Aedes albopictus* and dengue viruses) then an adulticide treatment may occur, depending on the time of year, climate, abundance of the species, and the presence of disease, however, typical action thresholds for an adulticide treatment application is 5 *Culex* species in a single trap in a single trap night. For nuisance or floodwater mosquitoes, typically the minimum action threshold is 25 nuisance mosquito species in a single trap in a single trap night; however both of these thresholds are dynamic depending on the location, public complaints, climate, and time of year. An example may be that out south in the desert where there may be a minimal human population, the action threshold would be set much higher based on ACMAD department surveillance and best management practice; i.e. 100 nuisance mosquito species in a single trap night. It is important to note that these nuisance mosquitoes can fly great distances for feeding, so it is still important to monitor and treat these areas appropriately when necessary. The ACMAD field technicians also use landing count rates when in the field as well as to monitor areas of public complaints in areas of concern.

The mosquito species that are competent vectors for disease (in the case of WNV this would include *Culex spp.*) are sorted and separated into pools containing 50 mosquitoes or less. These mosquito pools are tested for WNV using Rapid Analyte Measurement Platform (RAMP) equipment at ACMAD. Sample results

exceeding Idaho Health and Welfare Department defined thresholds are automatically considered WNV Positive. If a sample returns a value less than the states defined threshold, they are considered ‘temporarily positive for WNV’ and are sent to the Idaho Bureau of Laboratories for more in depth disease sampling and final confirmation.

## **Disease Presence**

When surveillance disease testing has a confirmation of WNV presence, or any vector-borne disease, in a location in Ada County, then all efforts are stepped up by larvicide and adulticide crews and increases in trap locations around the positive are utilized when feasible. The ACMAD Mosquito Tracker Website is updated daily when WNV is found for notification to the public. The goal is to find as many of the *Culex* species development locations, whether known or unknown, which may be contributing to the vector mosquito populations and making larvicide treatments or remediation’s to knock the populations back down. At times this effort includes going door to door and inspecting back yards and educating the public of the known threat of WNV in the area when feasible. Additionally adulticide activities increase around the area depending on the vector species found with the disease, anywhere from a quarter mile around a site to a full mile around the positive location may typically be treated. If surveillance testing shows repeating WNV positives in further testing, additional efforts are made including the possibility of aerial applications.

## **Mapping and Monitoring**

ACMAD maintains a Geographic Information System (GIS) that contains a digital inventory of all known pond development sites. When sites are found, they are mapped using Global Positioning Systems (GPS) technology. Office digital processes automatically manage site inspection requirements (determined by NSD) and applicator area assignments. Maps and reports can be printed on the fly for field crews or crew leaders as needed, and field crews have current digital maps on mobile computer devices with them in the field at all times.

## **Acknowledgements**

Information on mosquito species and their biology was compiled from the following text and is used with the permission of Donald R. Brothers, author of “Mosquitoes of Idaho: An Introductory Guide to Understanding Them, Their Importance, and the Control Process.” This publication is available in Ada County WPM libraries.

We also follow the Idaho Department of Health and Welfare Arbovirus Surveillance and Mosquito Control in Idaho, Guidance for Counties publication as guidelines for our IMM program.