Commonwealth of Massachusetts

STATE RECLAMATION AND MOSQUITO CONTROL BOARD

NORTHEAST MASSACHUSETTS MOSQUITO CONTROL AND WETLANDS MANAGEMENT DISTRICT

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District Updates

Zika Virus

Zika virus is not currently found in the United States. However, cases of Zika have been reported in returning travelers. Information, as the status of Zika virus in Massachusetts and the United States changes, can be found at the following state and federal web sites.

http://www.mass.gov/eohhs/gov/departments/dph/programs/id/epidemiology/providers/mosquito/zika-virus.html
http://www.cdc.gov/zika/

Tick-borne Diseases

Ticks can also carry diseases which can make you very sick. There are simple steps that you can take to protect yourself and your family from tick bites, and the illnesses they can cause. For more information, visit the following state and federal web sites.
http://www.mass.gov/eohhs/gov/departments/dph/programs/id/epidemiology/providers/mosquitoes-and-ticks.html
http://www.mass.gov/eohhs/gov/departments/dph/programs/id/epidemiology/ticks/
http://www.cdc.gov/ticks/index.html

The Connecticut Agricultural Experiment Station has developed an integrated guide for homeowners, pest control operators and public health officials for the prevention of tick-borne diseases.

http://www.ct.gov/caes/lib/caes/documents/special_features/tickhandbook.pdf

2016 VECTOR MANAGEMENT PLAN

Introduction

Mosquito-borne viruses such as Eastern Equine Encephalitis virus (EEE) and West Nile Virus (WNV) have been and continue to be the cause of disease outbreaks in humans and animals in Massachusetts. Community-level mosquito control can be a practical and meaningful method of protecting people especially when risk levels of virus become high or critical. Efforts to reduce risk of arbovirus transmission include but are not limited to public awareness and prevention, adult and larval surveillance, and standard mosquito control methods utilized by established Mosquito Control Projects or Districts (MCPs).

Massachusetts Department of Public Health (MDPH)

Main objectives:

- Monitor trends in EEE and WNV in Massachusetts
- Provide timely information on the distribution and intensity of WNV and EEE activity in the environment
- Perform laboratory diagnosis of WNV and EEE cases in humans, horses and other animals
- Testing mosquito batches for disease through the Public Health Laboratory
- Communicate effectively with officials and the public
- Provide guidelines, advice, and support on activities that effectively reduce risk for disease
- Provide information on the safety, anticipated benefits, and potential adverse effects of proposed prevention interventions

Refer to the 2015 Massachusetts State Arbovirus Surveillance and Response Plan viewed online at http://www.mass.gov/eohhs/docs/dph/cdc/arbovirus/arbovirus-surveillance-plan.pdf

Northeast Massachusetts Mosquito Control District-Essex County (NMMCD)

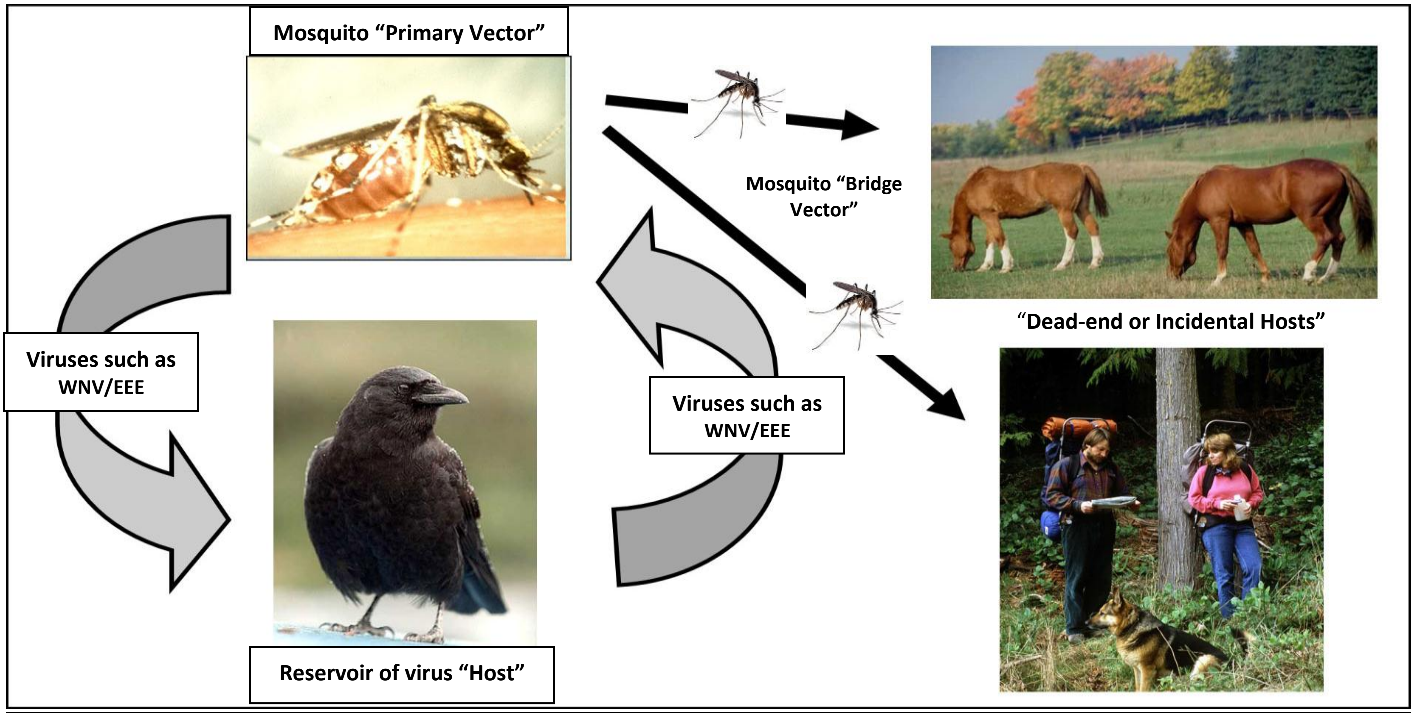
Mosquito control districts serve as critical elements in the surveillance network, and in performing and facilitating intervention efforts to reduce the burden of mosquitoes and mosquito-borne diseases. Districts coordinate the placement of traps, collecting, identifying and submitting mosquitoes and associated data with the Massachusetts Department of Public Health (MDPH).

District personnel have greater knowledge of local habitats and proper equipment that may be rapidly deployed to reduce populations of mosquitoes. Personnel also increase public outreach/educational efforts for mosquito control, disease prevention, personal protection and IPM strategies. Districts also provide weekly summaries on mosquito abundance and diversity as well as on local conditions that may be conducive to mosquito development and survival.

The purpose of the 2016 Vector Management Plan (VMP) is to summarize the NEMMCD mosquito and arbovirus surveillance/management strategies specific to northeastern Massachusetts communities. This plan also outlines specific responses to arboviruses and how our resources will be directed toward implementing these responses effectively and efficiently.

The Arbovirus Life Cycle

Arbovirus: A class of viruses transmitted to humans by arthropods such as mosquitoes and ticks.



Some mosquito species rarely bite humans; they feed on infected birds called "hosts". Newly infected mosquitoes then feed on non-infected birds causing an amplification of that virus in the local bird population. These mosquitoes are referred to as "primary vectors".

The infected birds then become a blood-meal source for other mosquito species who themselves become infected. These other infected mosquito species can then bite humans. The species capable of infecting humans are known as "bridge vectors".

Humans and other mammals affected in this cycle are known as "dead end or incidental hosts". This means they do not develop high levels of the virus in their bloodstream needed to pass the virus to other biting mosquitoes.

Regional Adult Mosquito Surveillance

The Districts surveillance program forms the basis for mosquito control operations. Surveillance of mosquito populations is based on protocols established by the Centers for Disease Control (CDC) and Massachusetts Department of Public Health (MDPH). To monitor adult populations, the District maintains thirty-five historical trapping stations set every year at the same locations for an entire season. There is at least one trapping station in each subscribing municipality. Each trapping station uses two types of traps to collect mosquitoes (Figures 1 and 2).

The stations are generally located at municipal-owned facilities which are secure, have access to electrical power and are within the general vicinity of major population centers. The traps operate from mid-May through mid-October, with one collection cycle per week, each cycle lasting twenty-four hours. Trap contents are collected at the end of each cycle and all adult female mosquitoes are identified, recorded with certain species sent for disease testing. About fifty-two species of mosquitoes are known to live in Massachusetts.

Figure 1. CDC CO2/Light Trap

Figure 2. Reiter-Cummings Gravid Trap

The first of the two traps is the Light/CO_2-baited CDC trap (Figure 1). At the end of 2015, we replaced all "NJ traps" with more current and widely adopted design known as CDC traps (details and design specifications can be obtained by contacting the NEMMC). To attract mosquitoes, light and carbon-dioxide gas (the same chemical as the previous "NJ traps" used, also in our exhaled breath) is released from a pressurized cylinder into a hose located at the top of the trap. As mosquitoes approach the gas released at the hose's opening, they are drawn inside by an internal fan, then blown into a container that hangs below. With this trap, nearly all mosquito species in a community are collected during that night. Because the traps are placed at the same locations every year, population trends can be predicted, studied and compared between years, as well as during the year.

To determine whether infected bridge vectors are present, portable CDC-CO_2 traps (Figure1) are often placed at locations when infected *Cs. melanura* and *Cx. pipiens/restuans* mosquitoes have been collected. These traps collect other species which upon identification, are tested. Knowing the "infection status" of bridge vectors in EEE-known habitats can result in more effective targeted adulticiding responses.
The second trap is the Reiter-Cummings Gravid Trap (Figure 2), our principal WNV detection tool. This trap is designed to attract container-breeding mosquitoes including ***Culex pipiens*** and ***Cx. restuans***, the key carriers of West Nile Virus (WNV). The trap is baited with aged organic material-filled water, held below in a pan, to attract female mosquitoes for egg laying. These blood-fed females come to lay their eggs on the water's surface and when they approach the trap's underside opening, they are drawn into the collection container. The contents are later removed. After their identification, all WNV-vector species are separated and sent to the state lab to be tested for the presence of viruses.

When necessary, additional gravid traps are deployed in communities displaying either increased *Culex* populations and/or recent histories of positive WNV cases. *Cx. pipiens* and *Cx. restuans* breed proficiently in heavily urbanized areas so additional gravid traps may be set as needed. In the short term, these additional trappings provide us with more data on *Culex* population distributions and densities; over the long term, better historical information is obtained to study trends on vector populations and viral activity. See Figure 3 for a photograph of *Cx. pipiens*, also known as the "Northern House Mosquito".

Our third surveillance trap is the Resting Box. Due to the behavior and habitats preferred by yet another species of disease-carrier, resting boxes are not placed at the historical trapping stations. Instead, these are situated in the vicinity of cedar and maple swamps where ***Culiseta melanura*** (Figure 4) resides. *Cs. melanura* or the "Red Maple/Cedar Swamp

Mosquito" is a primary vector of Eastern Equine Encephalitis (EEE). Resting boxes are designed to simulate the tree holes and cavities where these mosquitoes normally rest during the day after they feed on blood. Resting boxes (Figure 5) are visited twice weekly from mid-June through the end of September; *Cs. melanura*, and the closely related ***Cs. morsitans***, are gathered, identified, tallied, then separated to be later tested for the presence of viruses.

Figure 3. Adult ***Culex pipiens***

Figure 4. Adult ***Culiseta melanura***(CDC: PHIL: 4464)

An "epicenter" of EEE activity has developed in southeastern New Hampshire since 2005 so now, monitoring for EEE vectors has become another component of the NEMMC surveillance program. Initially, we had resting box stations at fixed historic locations along the southeastern New Hampshire border from Methuen through Salisbury; nine stations in total (two in each town except for Salisbury) with eight boxes in each station. In addition, resting box stations have also been set gradually since 2006 in Boxford, Topsfield, Hamilton, Wenham, Newbury, Georgetown, Lynnfield, and Middleton. These additional stations were set in response to EEE infections in mosquitoes, horses, alpacas, or humans in these communities. Additional boxes are ready for deployment and stations have been selected in more communities if resting box surveillance must be expanded. Because *Cs. melanura* can also transmit WNV, resting box surveillance has enhanced our WNV monitoring.

Figure 5. Resting Boxes (left back view; right front view)

The <u>BG-Sentinel Trap</u> (Figure 6) mimics the motions and chemicals produced by a human host. The attractants are given off by various lures through a dispenser which releases a combination of lactic acid, octenol, ammonia, and caproic acid, CO2; substances found on human skin or released through breath. These traps were specifically developed for attracting ***Aedes albopictus*** (see exotic species below). The trap consists of an easy-to-transport, collapsible white cylinder with white mesh covering the top. In the middle of the mesh cover is a black funnel through which a down draft is created by a 12V DC fan that causes mosquitoes in the vicinity of the opening to be drawn into a catch bag. The catch bag is located above the suction fan to avoid damage to specimens passing through the fan. The air then exits the trap through the mesh top. We plan on using a few of these traps near large tire collection facilities in 2016 to monitor potential movement of *Ae. albopictus* into this area.

Figure 6. BG-Sentinel Trap

Risk Communications and Public Relations

Dissemination of mosquito and arbovirus information is paramount to the success of any mosquito control operation. With the speed which information, as well as rumors and even disinformation, can be conveyed in all public informational media, it is crucial that Boards of Health and subscribing municipality residents are kept correctly informed. The District continues to improve its communication regarding mosquito species, potential arboviral threats, and details of larviciding and adulticiding operations.

At the end of the season, the District sends detailed Best Management Practice Plans (BMPs) to each participating municipality. Each BMP includes summaries of the previous year's mosquito and arbovirus activities, descriptions of suggested and agreed-upon control operations, as well as their costs. When necessary, the District conducts a Mosquito/Arbovirus Surveillance Workshop to inform/educate health agents and Boards of Health members of District communities. Potential mosquito and arboviral threats along with response options are discussed. When requested, lectures are presented to Boards of Health and other interested municipal organizations. These are often recorded for broadcast on public-access television as well as posted on the internet. District personnel are available to residents for site requests and answering questions about integrated pest management and homeowner risk reduction.

Please visit our website for more information: http://www.northeastmassmosquito.com

Emergent Exotic and Invasive Mosquito Species

Newly imported and exotic mosquito species becoming established in our area is a growing problem. Within the past ten years, we have seen the appearance and rapid spread of ***Ochlerotatus japonicus***, the "Japanese Rock Pool Mosquito", throughout our District (Figure 7). While this species is a competent disease vector in other areas, there is little to suggest it is currently a major disease vector in the Northeast. Therefore, as we monitor our local mosquitoes, we are also conscious of the appearance of any new species.

Another exotic and geographically-expanding species is ***Aedes albopictus***, the "Asian Tiger Mosquito" (Figure 8). It is a notorious daytime human-biting species and competent disease vector; it could be the next exotic species to become established in northeast Massachusetts. Originally from northeast Asia, it has spread rapidly throughout the temperate regions of the world assisted by the importation of used automobile tires. Water-filled discarded tires left outdoors simulate tree-holes where this species tends to lay its eggs. When tires are then imported to the U.S., they are stored outdoors, fill with rainwater, and eggs within hatch and adults eventually emerge and spread.

Ae. albopictus was first found in the U.S. in Houston in 1985 and has spread nationwide as far northeast as Connecticut; it has become the dominant mosquito species in New Jersey. *Ae. albopictus* is a great concern in public health because of its ability to transmit many arboviruses that cause serious disease in humans, including Chikungunya and Dengue (discussed below). *Ae. albopictus* has been collected in Bristol County on repeated occasions since 2011 in used tire-collection facilities (see BG-Sentinel trap for trapping method, pg. 5). It may soon become established there and spread throughout eastern Massachusetts.


Figure 7. Japanese Rock Pool Mosquito (***Oc. japonicus***) Figure 8. Asian Tiger Mosquito (***Ae. albopictus***)
Both Photographs copyright: Steve A. Marshall Published on *The Diptera Site* (http://diptera.myspecies.info)

Virus Testing

After trapping, specimens of the principal WNV and EEE vectors are collected, counted and sorted into groups by species by hand. At the William A. Hinton State Laboratory Institute (HSLI), MDPH tests these samples (grouped or pooled sets of 10 - 50 mosquitoes) for WNV and EEE. These are frequently referred to as "mosquito pools" which indicates the grouping of mosquitoes for testing purposes and is not a reference to any body of water. Test results from routine mosquito collections are usually available within 24 hours after delivery of mosquitoes to HSLI. Routine collections from fixed and long-term trap sites provide the best available baseline information for detecting trends in mosquito abundance and virus prevalence, and for estimating the relative risk of human infection from EEE virus and WNV. On average, 75 samples (i.e., pools or batches) of mosquitoes are sent each week to the State Labs from this district.

Testing of adult female mosquito specimens starts on June 15th for primary vector species, July 1st to 15th for bridge vector species and ceases for all species on October 1st; unless there is an expressed need to extend the testing season due to increased arboviral risk.

There are approximately 52 mosquito species present in Massachusetts, however less than half of these are considered to be likely vectors or bridge vectors for EEE and WNV. In general, species are identified as vectors based on their local abundance, demonstrated vector competence in the laboratory, and frequent infection with the virus as documented by arboviral surveillance programs. Based on these criteria, the following species are considered to be of present concern for EEE and/or WNV in Massachusetts or the surrounding areas and are sent for testing. This list may expand over time.

Aedes vexans – Is a common nuisance mosquito. Temporary flooded areas such as woodland pools and natural depressions are the preferred larval habitat of this mosquito. It feeds on mammals and is an aggressive human biter. This species is typically collected from May to October. *Ae. vexans* is a (bridge) vector of eastern equine encephalitis (EEE) virus.

Coquillettidia perturbans - Cattail marshes are the primary larval habitat of this mosquito. It feeds on both birds and mammals. It is a persistent human biter and one of the most common mosquitoes in Massachusetts. This species is typically collected from June to September. *Cq. perturbans* is a (bridge) vector of EEE virus.

Culex pipiens – Artificial containers are the preferred larval habitat of this mosquito. It feeds mainly on birds and occasionally on mammals. It will bite humans, typically from dusk into the evening. This species is regularly collected from May to October but can be found year round as it readily overwinters in manmade structures. *Cx. pipiens* is the primary vector of West Nile Virus (WNV).

Culex restuans – Natural and artificial containers are the preferred larval habitat of this mosquito. It feeds almost primarily on birds but has been known to bite humans on occasion. This species is typically collected from May to October but can be found year round as it readily overwinters in man-made structures. *Cx. restuans* has been implicated as a vector of WNV.

Culex salinarius – Brackish and freshwater wetlands are the preferred habitat of this mosquito. It feeds on birds, mammals, and amphibians and is well known for biting humans. This species is typically collected from May to October but can be found year round as it readily overwinters in natural and manmade structures. *Cx. salinarius* may be involved in the transmission of both WNV and EEE.

Culiseta melanura –White cedar and red maple swamps are the preferred larval habitat of this mosquito. It feeds almost exclusively on birds. This species is typically collected from May to October. *Cs. melanura* is the primary vector of EEE.

Culiseta morsitans-Permanent and semi-permanent bogs, swamps, tree root cavities, and boggy margins or lakes are preferred larval habitat. This species is typically collected from May to October. *Cs. morsitans* may be another vector of EEE.

Ochlerotatus canadensis – Shaded woodland pools are the preferred larval habitat of this mosquito. It feeds mainly on birds and mammals but is also known to take blood meals from amphibians and reptiles. This mosquito can be a fierce human biter near its larval habitat. This species is typically collected from May to October. *Oc. canadensis* is a (bridge) vector of eastern equine encephalitis EEE virus.

Ochlerotatus japonicus – Natural and artificial containers such as tires, catch basins, and rock pools are the preferred larval habitat of this mosquito. It feeds mainly on mammals and is an aggressive human biter. This species is typically collected from May to October. *Oc. japonicus* may be involved in the transmission of both WNV and EEE.

Emergent Virus

The threat of mosquito-borne disease is on the rise world-wide. The potential for invasion, transmission, and establishment of new arboviruses in the United States is on the increase. The invasion of exotic vector-borne disease into our District can no longer be disregarded nor deemed as heresy. After the introduction/ establishment of West Nile

Virus in 2000 and emergence of EEEV in 2005, potential viral threats in the District must now be seriously considered and even anticipated.

Zika Virus (Zika)

Zika virus is spread to people through mosquito bites. Mosquitoes become infected when they feed on a person already infected with the virus. Infected mosquitoes can then spread the virus to other people. The most common symptoms of Zika are fever, rash, joint pain, and red eye. The illness is usually mild with symptoms lasting from several days to a week. Severe disease requiring hospitalization is uncommon. There is no vaccine to prevent or medicine to treat Zika.

Outbreaks of Zika virus disease (or Zika) previously have been reported in tropical Africa, Southeast Asia, and the Pacific Islands. Zika virus likely will continue to spread to new areas. In May 2015, the Pan American Health Organization (PAHO) issued an alert regarding the first confirmed Zika virus infections in Brazil.

Zika virus is not currently found in the United States. However, cases of Zika have been reported in returning travelers. With the recent outbreaks in the Pacific Islands and South America, the number of Zika cases among travelers visiting or returning to the United States will likely increase. These imported cases may result in local spread of the virus in some areas of the United States potentially from local populations of *Ae. albopictus* and *Ae. aegypti.*

Chikungunya Virus (CHIKV)

The newest arboviral threat to the continental United States is Chikungunya virus (CHIKV). This virus, originally restricted to east Africa and southern Asia, has been causing a pandemic in South Asia and along the Indian Ocean basin. For reasons totally unknown and catching the public health authorities by surprise, locally-acquired infections by this virus began this past December in several of the islands of the eastern Caribbean. Chikungunya is rarely fatal; it is another debilitating illness, causing excessive and prolonged fatigue and extreme pain in joints lasting up to several weeks. In 2005 and 2006, Chikungunya sickened almost one third of the 800,000 inhabitants of the French island of La Reunion, off the east African coast.

The Caribbean outbreak was not the first recent appearance of CHIKV outside of South Asia recently. The first outbreak outside of the tropics was in northern Italy in September of 2007. The Italian CHIKV was vectored by a new strain of *Ae. albopictus* adapted to transmit the virus. Since 2006, there have been over 100 imported cases of Chikungunya in the U.S. demonstrating the potential for imported cases to serve as sources of CHIKV for domestic *Ae. albopictus* to acquire and transmit.

The first locally acquired US cases of chikungunya were reported in Florida on July 17, 2014

According to Dr. Jean-Paul Mutebi of the CDC, there are currently three circulating international arboviruses with the greatest potential of establishing themselves in the U.S. These are the viruses causing Chikungunya, Rift Valley Fever, and Japanese Encephalitis. Mosquito species that can easily spread these viruses are all found in abundance in the U.S.; most of these species are found in New England as well.

Dengue Virus (DENV)

A continuing arboviral concern in the continental United States is Dengue virus (DENV), also known as “Break bone fever”. It was thought that, except for occasional imported cases, Dengue had vanished from the U.S. There were localized outbreaks near the Texas-Mexican border in the late 1990’s and in Hawaii in 2000. However, the threat level was raised considerably beginning in 2009 when a New York resident visiting Key West, Florida contracted Dengue. In December 2010, there were 55 confirmed cases of locally-acquired Dengue in Key West. Six cases of locally-acquired Dengue were confirmed in Florida for 2011, four more in 2012 and 20 in 2013. And last November, it was announced that a Long Island (NY) man, who had not traveled in the previous months, contracted Dengue. The suspected vector was *Ae. albopictus*, recently becoming established on Long Island.

Containment of DENV transmission is not easily accomplished when at the same time there are concurrent imported cases of Dengue (infections of patients when traveling outside the US and returning ill); there were 133 imported Dengue cases in the US in 2011, 100 more in 2012, and 519 in 36 states in 2013.

DENV is the greatest mosquito-borne virus circulating in the world today, affecting anywhere from 50 to 100 million people annually in about 100 countries. If *Ae*. *albopictus* becomes established in Massachusetts, it can acquire DENV from an infected returning traveler, and transmit the virus locally, causing a public health havoc. Symptoms of Dengue include high fever, severe headache, severe pain behind the eyes, joint pain, muscle and bone pain, rash, and mild bleeding. A more dangerous manifestation, frequently when there have been multiple dengue episodes in an individual, is Dengue hemorrhagic fever. After the fever declines, there is persistent vomiting, severe abdominal pain, and difficulty in breathing. This can be followed by excessive bleeding into the body cavities leading to circulatory failure and shock, followed by death. There is no medication for the prevention or treatment of Dengue.

<u>Jamestown Canyon Virus (JCV)</u>

Jamestown Canyon virus (JCV) was first isolated in 1961 from a mosquito in Colorado and was first recognized to cause human disease in 1980. Jamestown Canyon virus disease is relatively rare; in the United States, the CDC found only 31 disease cases from 2000-2013, but it is likely under-recognized and probably endemic throughout most of the United States. JCV persists among white-tailed deer and 22 different species of mosquitoes including *Aedes* and *Anopheles*. The infection occurs in June through September with a peak in mid-June to mid-July. Clinical features include mild febrile illness with acute central nervous system infection including meningitis and encephalitis and frequently respiratory system involvement in patients more than 18 years old.

In 2013, of 10 states reporting cases, eight states (Georgia, Idaho, Massachusetts, Minnesota, New Hampshire, Oregon, Pennsylvania, and Rhode Island) reported their first JCV cases. In Connecticut, human cases have been rare, but mosquitoes in eight towns, including Stamford and Norwalk, have tested positive for the virus in 2014. In August 2015 the Iowa Department of Public Health announced that one case of JCV has been confirmed.

<u>Saint Louis Encephalitis Virus (SLEV)</u>

Saint Louis encephalitis virus (SLEV) is transmitted to humans by the bite of an infected mosquito. Most cases of SLEV disease have occurred in eastern and central states. *Culex pipiens* are one of the primary mosquito vectors for this bird disease. Most persons infected with SLEV have no apparent illness. Initial symptoms of those who become ill include fever, headache, nausea, vomiting, and tiredness. Severe neuroinvasive disease (often involving encephalitis, an inflammation of the brain) occurs more commonly in older adults. In rare cases, long-term disability or death can result. There is no specific treatment for SLEV infection; care is based on symptoms. The majority of cases have occurred in eastern and central states, where episodic urban-centered outbreaks have recurred since the 1930s. New Hampshire reported one human case in 2006.

<u>Rift Valley Fever Virus (RVFV)</u>

Rift Valley fever virus (RVFV) causes a fast-developing ("acute") fever that affects livestock animals and humans. Whereas RVF is devastating to livestock, the degree of virulence will vary among humans. Many infected persons will not exhibit symptoms, but others may experience fever, generalized weakness, back pain, dizziness, and extreme weight loss. Some will manifest liver abnormalities while a small percentage may suffer hemorrhagic fever. Approximately 1% to 10% of affected patients may have some permanent vision loss. Approximately 1% of RVF-infected humans die. There is no established treatment for infected patients and there is neither a cure nor a vaccine currently available.

RVF was first identified in 1931 and historically has been confined to eastern and southern Africa; there was a recent outbreak in South Africa with 172 human cases and 15 deaths. However, in 2000, there was an outbreak far north in the Arabian Peninsula and there has been concerns of RVF spreading into North America ever since. The virus is transmitted primarily by floodwater mosquitoes (*Aedes* species). No mosquitoes have been found infected in the U.S. with RVFV, however common species such as *Ae. vexans* and *Cx. pipiens*, have demonstrated the capacity to transmit RVFV.

Japanese Encephalitis Virus (JEV)

Infection with Japanese encephalitis virus (JEV) causes signs and symptoms similar to those caused by West Nile Virus (discussed below). The case fatality rate averages about 30%. It is the leading cause of encephalitis in Asia averaging 30,000 to 50,000 cases annually; children are most at risk to infection. Although its principal vectors are not found in the U.S., *Oc. japonicus* has been shown to transmit JEV and as discussed earlier, this species has become prevalent in Massachusetts.

We will continue to monitor for these potential threats, particularly Dengue and Chikungunya. Our partnership with the state Arbovirus Surveillance Labs and our affiliations with mosquito control associations can assist us with the additional expertise to implement intervention strategies if and when necessary.

Established virus in our region: West Nile Virus

Introduction: West Nile Virus (WNV) was introduced to New York City in 1999 and within five years had spread to all 48 continental US states. It was first isolated in Essex County in 2000, and is now endemic throughout eastern MA, particularly in the Boston metropolitan area. Since its first appearance in North America, WNV has caused significant illness to over 39,000 persons in the United States; Table 1 shows WNV cases/fatalities in Massachusetts since 2000. While about 80% of all West Nile virus infections in humans are not symptomatic, approximately 20% of infections are manifested as some form of fever and varying degrees of serious neurological ailments are displayed by less than 1%. These neurological diseases include acute febrile paralysis, encephalitis, and meningitis resulting in death to about 10% of all neurological cases. Of the over 17,000 neuroinvasive cases since 1999, there have been almost 1,600 deaths. Descriptions of all neurological manifestation of West Nile infections can be found at the Iowa State University Center of Food Security and Public Health website: http://www.cfsph.iastate.edu/Factsheets/pdfs/west_nile_fever.pdf. WNV has also taken its toll on native bird populations with dramatic declines in seven species and many avian populations have yet to recover.

It was thought that WNV associated neurological ailments were short-lived, affecting only a small percentage of those infected. However, recent studies suggest that neurological disorders may be more prolonged and serious, affecting more people than originally thought.

Table 1. Total Number of Human WNV Cases/Fatalities in Massachusetts 1999-2015.

Year	Neuroinvasive (1)	Non-Neuroinvasive (2)	Total	**Fatalities**
2001	**3**	**0**	**3**	1
2002	**19**	**4**	**23**	3
2003	**12**	**5**	**17**	1
2004	**0**	**0**	**0**	0
2005	**4**	**2**	**6**	1
2006	**2**	**1**	**3**	0
2007	**3**	**3**	**6**	0

Year	Neuroinvasive (1)	Non-Neuroinvasive (2)	Total	**Fatalities**
2008	**1**	**0**	**1**	0
2009	**0**	**0**	**0**	0
2010	**6**	**1**	**7**	1
2011	**4**	**1**	**5**	1
2012	**27**	**6**	**33**	1
2013	**7**	**1**	**8**	0
2014	**5**	**1**	**6**	0
2015	**6**	**3**	**9**	2
Totals	**99**	**28**	**127**	**11**

1: CDC now classified all encephalitis, meningitis, & acute febrile paralysis cases as "Neuroinvasive Disease"
2: CDC now classified all related fevers as "Non-neuroinvasive Disease Cases"

It was also assumed that after its initial spread, WNV would decrease in prevalence in both bird and human populations, since there would be too few susceptible hosts to maintain and amplify the virus. It was theorized that the virus would become dormant and not appear again in the U.S. for several years or decades, in the manner exhibited historically by Eastern Equine and St. Louis encephalitis viruses. However, the numbers of WNV-infected mosquito detections in Massachusetts began to increase in 2010 (Table 2) for reasons still unknown. There were human infections in the District again starting in 2010, manifested as meningoencephalitis and meningitis.

Mosquitoes of the species *Culex pipiens* are primarily responsible for the transmission of WNV to birds and humans in endemic areas in the northeast U.S.; *Cx. restuans* is also responsible for the virus's spread, but this species bites birds almost exclusively. The larvae of both these species develop in "high-organic content" water that accumulate in containers and large water-holding structures that are in greater abundance in urbanized areas. Since many water-holding structures are permanent and the water contained cannot often be drained, the water itself must then be treated with larvicides to reduce/eliminate larvae from using the water to develop into adults.

Therefore, the principal strategy used by the District to combat WNV transmission and risk is by reducing and/or eliminating larval development to ultimately reduce adult vector presence. This can be one of the best cost and environmentally effective means for vector control. If efforts to reduce/eliminate larvae are not successful, then truck-based spraying operations are recommended and activated to reduce adult populations during periods of high WNV transmission. These strategies are outlined below.

Table 2. Summary of Arbovirus-infected mosquito pools in Massachusetts 2000-2015.

	Total number of WNV pools			Total number of EEEV pools	
Year	Statewide	NEMA District		Statewide	NEMA District
2000	4	0		16	0
2001	25	4		12	0
2002	68	14		1	0
2003	48	2		9	0
2004	15	4		39	0
2005	99	11		45	2
2006	43	5		157	11

Year	Total number of + WNV pools			Total number of EEEV pools	
	Statewide	NEMA District		Statewide	NEMA District
2007	65	14 (1)		31	0
2008	135	10		13	0
2009	26	2		54	13
2010	121	21		65	0
2011	275	56 (2)		80	0
2012	307	48 (3)		267	14 (3)
2013	335	77		61	4
2014	56	7		33	2
2015	164	8		1	0
Totals.....	**1786**	**165**		**884**	**32**

(1) = Not including two infected pools from Manchester
(2) = Not including two infected pools from Lawrence
(3) = Includes two pools that tested positive for both arboviruses

Catch Basin Treatments: The preferred long-term and more cost-effective vector control strategy is to eliminate larvae before they become adults. While *Culex* mosquitoes can develop in a variety of freshwater habitats, the greatest concentration of *Culex* breeding is in the estimated 80,000 catch basins found in the District (Figure 16). The two principal urban *Culex* mosquitoes, *Cx. pipiens* and *Cx. restuans* breed in highly organic or polluted water that collect in catch basins, storm water structures (including retention ponds; Figure 17), and discarded tires, clogged gutters, bird baths, and the like (Figures 18-20).

Figure 16. Catch Basin
(http://www.neponset.org)

Figure 17. Retention pond.
(http://dunwoodyusa.blogspot.com)

Figure 18. Discarded tire yard (Middleton)

Figure 19. Clogged rain gutter filled with water (http://www.moonworkshome.com)

Treating catch basins consist of the application of packets/"briquettes"/"ingots" of either bacteria or "growth regulators". The bacteria are effective towards killing exclusively mosquito larvae; the "growth regulator" retards or completely ceases development of larvae into adults. Short term surveillance data showed an 80% reduction in *Culex* species in communities where basins are treated as compared to communities with untreated basins.

In a study conducted in Portsmouth, NH in 2007 by Municipal Pest Management Services Inc., there was a 75% reduction in mosquitoes breeding in treated catch basins compared to untreated basin. It is preferred that basins be treated in the late spring or early summer to maximize the effects of the larvicidal agents. However applications of larvicides are often delayed in some communities until basins are cleaned of debris by the local DPW's. Basins filled with organic debris will reduce the effect of the larvicides to the extent they may be rendered useless.

Figure 20. Bird bath filled with debris & water (Amesbury)

Long term surveillance data has shown that the continued annual treatment of basins has gradually and significantly decreased *Culex* populations throughout the District in normal rainfall years. Early-season basin-treatment strategy will continue as best as possible in 2016. Droughts present special problems. How WNV-vector breeding is enhanced as well as how our operations are affected by droughts will be discussed below.

The order of catch basin larvicidal treatments for 2016 will be prioritized as follows. First to be treated will be basins in District municipalities directly north of Boston. These cities are suspected of being the prime WNV foci in northeast Massachusetts. Treatments of basins in these communities will begin in early April through July as conditions allow. Ultimately, time, weather, DPW basin-cleaning schedules, and extent of other District operations will determine when all basins will be treated.

Waste Water Treatment Facilities Inspection: An additional "preemptive strategy" is to inspect and treat, where necessary, all wastewater treatment facilities, when requested. This way, actual or potential *Culex* breeding can be reduced or eliminated. District personnel are authorized, under the provisions of Chapter 252 Section 4 of the General Laws of the Commonwealth, to enter upon lands for the purpose of inspections for mosquito breeding.

However, we are not a regulatory agency. We cannot penalize any persons or agencies for providing breeding habitats. It is not our intention to cause any imposition to the management of wastewater facilities. Instead, we wish to be a resource of information and technology to assist facility managers to prevent and/or abate mosquito breeding to the mutual benefit of the facility, the community, and mosquito control.

Property Inspection: Socioeconomics often plays an important role in mosquito control and associated public health risk. In a study conducted in California in 2007, there was a 276% increase in the number of human WNV cases in association with a 300% increase in home foreclosures. Within most foreclosed properties in Bakersfield (Kern County, CA) were neglected swimming pools which led to increased breeding and population increases of *Cx. pipiens/restuans*; see Figure 21.

Figure 21. Abandoned swimming pool with collapsed cover collecting water & debris (Topsfield).

Figure 22. Abandoned home property with containers of all types scattered about and collecting water (West Newbury).

In recent years we have received requests from Boards of Health to inspect abandoned properties (Figure 22) and we will continue this practice in 2016. In the course of our routine activities, we will also inspect and report such properties to your Board. In the long term, we will offer any support that may be appropriate to resolve mosquito problems related to such properties. In the short term, with the support of the Boards of Health, we will implement the necessary control measures to mitigate any immediate mosquito problem associated with such properties.

Selective Ground Adulticiding: As a final measure to reduce the risk of WNV infections, the District may recommend selective and targeted adulticiding applications when WNV-infected mosquitoes are discovered. The District uses "Ultra Low Volume" (ULV) for ground-based adulticiding operations. One advantage of ULV applications is that only very minute amounts of pesticides are dispersed over a large area (Figure 23); between 0.41 and 1.23 fluid ounces per acre are applied, depending on truck speed, which ranges between 5 and 20 miles per hour, with each pesticide particle measuring 15 to 30 microns in diameter (there are 1,000 microns in a millimeter). Due to the pesticides employed, ground-based adulticiding is done **only at night**.

The District may recommend a “targeted” application within a municipality (several streets or a neighborhood) based on the following criteria:

1) Two or more WNV-mosquito isolations in close proximity
2) One or more human cases of WNV

On occasions when WNV has yet been recovered but *Culex* populations are seen increasing at higher-than-usual rates, we will recommend that targeted adulticiding operations be commenced. These operations would only be recommended during high WNV-transmission periods (late July through September) in communities with historical WNV activity. **Only the local Board of Health can authorize ground-based adulticide operations.**

Ground Adulticiding Exemption*:* Residents who request their property be excluded from **all pesticide applications** (including larvicide as well as adulticide) must comply with the legal process to exempt their property (333 CMR Section 13.03; see http://www.mass.gov/agr/legal/regs/333_CMR_13.00.pdf). The process consists of the property owner sending a **certified letter** with the request to the town or city clerk prior to **March 1st** of each year; the property owner is **not** allowed to make such a request by telephone**. No exclusions will be allowed after March 1st.** The deadline of March 1st is to insure that residents requesting exemptions are also not subjected to springtime larviciding operations; there is no option of selecting what control operations are exempted.

Figure 23. Truck spray at night

Figure 24. Truck applying barrier treatment.

Barrier Treatment: While ULV is a cost-effective procedure on a large scale, it only affects those mosquitoes active **at the time** of the application; repeated applications are sometimes necessary to sustain population control. To reduce the need for repeated applications and provide more sustained relief from mosquitoes in high public use areas, the District may recommend a smaller scale “barrier spray treatment”. This application would be made to public use areas such as schools (applications to schools must be in compliance with MGL Ch. 85), playgrounds, athletic fields, etc. (Figure 24) A barrier spray may reduce mosquito presence for up to two or more weeks. The District strongly recommends member municipalities take advantage of this service when necessary.

Special Circumstance: Droughts: During intense drought seasons, normal development and distributions of *Cx. pipiens/restuans* can be increasingly unpredictable. Prolonged droughts together with periods of intense heat result in “explosions” of these species, as was seen in our District in 2010, 2013 and 2015. Patterns of heavy rainfall followed by stretches of intense heat lasting weeks will also result in greater than normal populations of these species, as exhibited in 2011. The availability of standing water diminishes during droughts and most mosquito species suffer significant population losses, the breeding habits of *Cx. pipiens/restuans* allow them to take advantage of conditions provided by droughts. Recall that these species breed in waters with high organic content. One type of artificial container filled with such water is the catch basin, as discussed earlier. Basins in urbanized areas can dry during a drought. However, people continue to water lawns and wash their cars during droughts. All the excess runoff from these activities keeps catch basins filled. If basins have been treated with most larvicides, breeding should be kept in check. If the basins are property of a municipality, and we have records of their locations, they will be treated. However, we may not know of their existence on private properties and thus, they remain untreated and become a continual source of *Culex* mosquitoes throughout the season.

Normally, *Cx. pipiens/restuans* mosquitoes do not breed in great abundance in wetlands and definitely do not breed in moving water. However during a drought, large expanses of water become smaller, shallower, and more concentrated with more organic debris, presenting *Culex* mosquitoes with more breeding habitats to exploit. With more development going on in more habitats, their populations surge. There are also fewer predators present (especially fish) as wetlands dry and the survivorship of the developing larvae is dramatically increased. Also during droughts, flowing waters such as rivers, streams, and brooks gradually slow and decrease in volume. Either in the very slow moving water or more likely, along the puddles and pools formed at the edges (usually filled with organic debris; see Figure 25), more breeding sites are available for *Culex* to utilize.

As any large body of water dries, containers and tires that were dumped into these bodies (when full of water) now become exposed (Figure 26). Being filled with polluted water, these also become ideal breeding sites for *Culex*. Debris-filled ground holes and depressions (either naturally-occurring or artificial) can become filled with water in a sudden downpour and also become instant breeding habitats for these species. Therefore, breeding areas for “urbanized” *Culex* mosquitoes are always in abundance, even in the middle of the worst drought. These unexpected breeding areas cannot, unfortunately all be treated, even by mosquito control projects with unlimited budgets! This is why the control of *Cx. pipiens/restuans* populations is extremely difficult during a drought. This is also why human WNV-infections are at their highest during a drought.

Special Circumstance: Beaver Dams: In recent years, beavers have made a comeback in population and have made an environmental impact in northeastern Massachusetts. Because the impoundments beavers construct often result in large stretches of standing water, there has been great debate as to whether these impoundments create more areas to be used by mosquitoes for their reproduction.

Steady increases in permanent and flood water mosquito species populations have been noted after a beaver dam is created. Perimeters of beaver ponds are subjected to periodic receding and re-flooding. Newly inundated forests could become development sites for cryptic-breeding EEE vectors and the abundance of dead decaying trees in flooded forest swamp pools contribute to breeding of WNV vectors. We will continue to monitor beaver pond habitats to identify whether arbovirus vectors may be taking advantage of these habitats.

Figure 25**.** Powow River (Amesbury) during June 2010 drought.

Figure 26. Drying pond in Newburyport in August 2010 exposing debris and containers originally found under water.

Endemic virus: Eastern Equine Encephalitis Virus

Introduction: EEEV-human infections manifest symptoms similar to West Nile encephalitis and while the human infection rate is lower, the fatality rates are much higher with EEEV infections, about 33%. Also, the recovery rates from EEE disease are longer and most often are incomplete. EEEV seems to attack the young as readily as the elderly unlike WNV which the elderly are far more susceptible.

EEEV was first discovered in horses hence, the basis for the name “Equine Encephalitis”. The name “equine” stuck even after it was later discovered that this was the same virus that caused the same encephalitis in humans. Humans and horses are “dead-end hosts”, meaning that the virus cannot be transmitted from infected horses or humans. Like WNV, EEEV is an avian virus, transmitted bird-to-bird principally by ***Cs. melanura***. While *Cs. melanura* mosquitoes are primarily responsible for the amplification of virus in bird populations, they typically might not bite humans. It is other mosquito species with wider host preferences (“bridge vectors”), when infected (after biting infected birds) can transmit EEEV to humans. Bridge vectors such as ***Ae. vexans*** and ***Oc. canadensis*** are notorious human-biting mosquitoes and may effectively transmit EEEV. Nonetheless, it is our judgment that while risks to humans directly from infected *Cs. melanura* are extremely low, we will continue to take preemptive protective operations directly against *Cs. melanura* when infected mosquitoes are detected. Lack of early intervention activity can result in accelerated EEEV amplification into other species which can increase human risk to infection later in the season.

Prior to 2004 there were never serious concerns about Eastern Equine Encephalitis in Essex County. EEEV seemed to be restricted to southeast Massachusetts (Table 2) and its vector, ***Cs. melanura***, seemed to thrive in the expansive habitat of the great cedar swamps found there. No such huge cedar swamps are found in northeast Massachusetts nor has *Cs. melanura* been collected here with any abundance. Historically, clusters of human cases have occurred over a period of two to three years, with a variable number of years between clusters. In the years between these case clusters or outbreaks, isolated cases can and do occur. Outbreaks of human EEE disease in Massachusetts occurred in 1938-39, 1955-56, 1972-74, 1982-84, 1990-92, 2004-06 and 2012.

2010- 65 of 3558 mosquito samples collected in Massachusetts were positive for EEE. They were collected from 19 towns in 3 counties. One human case of EEE infection was identified in a Plymouth County resident. A case from Rhode Island was also suspected to have been caused by an exposure in Southeastern Massachusetts.

2011- 80 of 4604 mosquito samples collected in Massachusetts were positive for EEE virus. They were collected from 17 towns in 5 counties. One fatal case of EEE infection was identified in a Bristol County resident. A case was also identified in a Missouri resident. An epidemiologic investigation determined that this individual was most likely exposed in Southeastern Massachusetts.

2012- 267 of 6828 mosquito samples collected in Massachusetts were positive for EEE virus. They were collected from 43 towns in 8 counties. There were seven human cases of EEE reported in Massachusetts in 2012, one from Middlesex County, which was believed to have been acquired out of state, one from Worcester County, one from Franklin County, two from Plymouth County, and two from Essex County.

2013- 61 of 6092 mosquito samples collected in Massachusetts were positive for EEE. These positive samples were from 27 towns and 6 counties in the Commonwealth; one positive sample was found in Quincy. There was one human case and fatality in 2013, from Norfolk County.

2014- 33 0f 5039 mosquito samples collected in Massachusetts were positive for EEE. These positive samples were from 13 towns in four counties in the Commonwealth. No positive samples were found in Quincy. There were no human cases or fatalities in Massachusetts for 2014.

In the Northeast District during 2004 and 2005 came reports of EEEV-infected mosquitoes, birds, horses, and humans from just over the border from Essex County in southeast New Hampshire. The more EEEV that was reported in New Hampshire, the more the virus began to present itself in our District beginning in 2005. Infected mosquitoes were collected from one or more of our border towns annually from 2005 through 2009 and again in 2012-2013 (Table 3). 2015 has been a relatively quiet year in this district as well as the rest of the state due to drought conditions for most of the season. There was only 1 EEE mosquito pool (Worcester County), no veterinary or human cases for the year.

Table 3. EEEV detections and infections in SE New Hampshire and NE Massachusetts from 2001 through 2015.

	Southeastern New Hampshire (EEEV)(1)			Northeastern Massachusetts (EEEV)(2)		
Year	# infected mosquito "pools"	Veterinary infections	human infections//deaths	# infected mosquito "pools"	Veterinary infections	human infections//deaths
2001	**0**	**0**	**0**	**0**	**0**	**0**
2002	**0**	**0**	**0**	**0**	**0**	**0**
2003	**0**	**0**	**0**	**0**	**0**	**0**
2004	**19**	**3**	**0**	**0**	**1 (3)**	**0**
2005	**15**	**14**	**7 // 2**	**2**	**2**	**0**
2006	**40**	**1**	**0**	**11**	**0**	**0**
2007	**6**	**2**	**3 // 0**	**0**	**0**	**0**
2008	**8**	**1**	**0**	**0**	**0**	**1 (4) // 1**
2009	**73**	**7**	**1 // 0**	**13**	**(alpaca)**	**0**
2010	**0**	**1**	**0**	**0**	**0**	**0**
2011	**0**	**0**	**0**	**0**	**0**	**0**
2012	**9**	**4**	**0**	**14**	**2**	**2 // 2**
2013	**24**	**3**	**0**	**4**	**0**	**0**
2014	**18**	**3**	**3 // 0**	**33**	**2**	**0**
2015	**0**	**0**	**0**	**0**	**0**	**0**

1: includes Merrimac, Hillsborough, Strafford, & Rockingham counties

2: Essex County only

3: also an emu was infected with EEEV

4: resident of Newburyport but acquired infection in either NH or ME

Habitat Surveillance: Predictive models of EEEV cycles and distributions are apparently no longer reliable as is EEEV activity can no longer be estimated by high populations of ***Cs. melanura***. It was seen in several resting box sites in 2012 that even with lower than usual populations of *Cs. melanura* EEEV was still being transmitted. Monitoring their populations to help in predicting EEEV activity has been troublesome due to the locations where this species breeds and develops. *Cs. melanura* is one of only a few mosquitoes that survive the winter in the larval stage. Instead of open water, they develop inside flooded root meshes, holes and tunnels ("crypts") under trunks of trees and in tree hummocks in Atlantic white cedar and red maple swamps (Figure 29 & 30).

Figure 29. "Inside the Atlantic White Cedar Swamp Trail"
http://www.paulscharffphotography.com/occ-insidetheatlanticwhiteceda.htm

Figure 30. "Breeding" habitat of ***Cs. melanura***.
(http://www.co.oswego.ny.us/info/news/2012/061112-1.html)

These habitats are in relative abundance in northeast MA, although they exist more as isolated pockets and are difficult to access. Since 2004, we have been searching for *Cs. melanura* habitat to monitor in winters. Trying to find *Cs.*

melanura larvae breeding in crypts is very much like trying to find a needle in a hay stack; to date we have been unsuccessful in locating such sites with consistency. During the winters, we continue to narrow our search for *Cs. melanura* breeding to areas within a one mile radius of our surveillance stations in communities bordering NH and in the Hamilton/Topsfield area. The objective is to find these breeding locations from which we can monitor larval populations through the winter; the expectation is to make better projections of what may happen in the following seasons and prepare better for intervention.

Selective Ground Adulticiding: Because of the elusive nature of *Cs. melanura* larval development, larviciding is not a viable option as a manageable preemptive strategy. Therefore, the District may recommend selective and targeted adulticiding applications to reduce *Cs. melanura* populations in an effort to break the mosquito-to-bird transmission phase of the virus cycle. Historically, when horse and human infections are reported, truck-spray operations are initiated. But by this time, these interventions are late and their effectiveness in reducing risk is limited at best. Therefore to reduce risk, adulticiding operations will be recommended to a municipality when the any one of following criteria are met:

1) Above average *Cs. melanura* populations
2) One EEEV detection in *Cs. melanura* mosquito
3) One EEEV isolation in horse
4) One human EEE case

As with WNV intervention, the District uses Ultra Low Volume (ULV) for ground adulticiding applications.

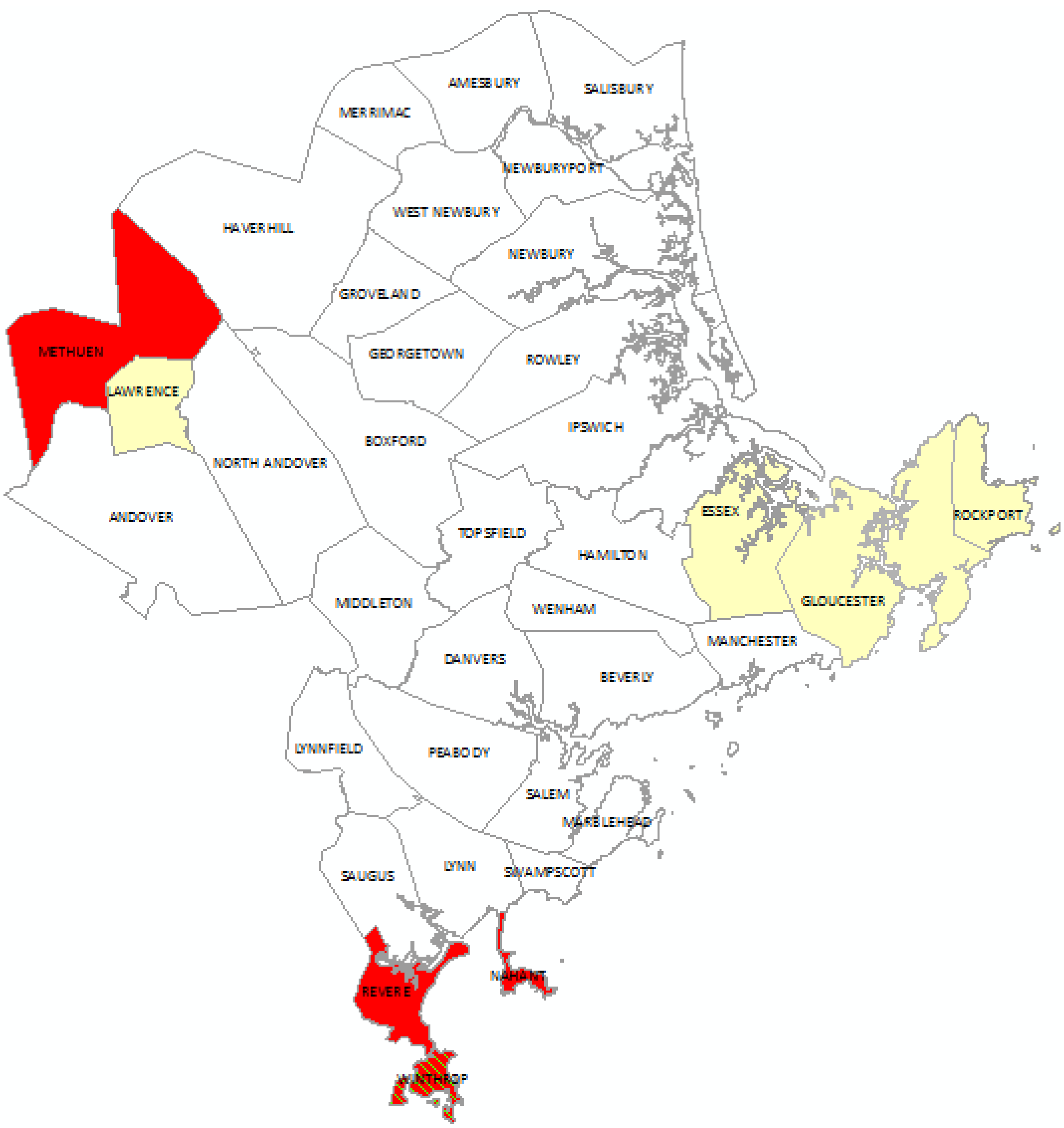
Barrier Treatment: The discussion of barrier application in the attempt to reduce exposure to WNV-infected mosquitoes also applies to reduce exposure to EEEV-infected mosquitoes.

Emergency Response Aerial Adulticiding Plan: In the event that the risk of EEEV infection escalates to a point that ground adulticiding is insufficient to reduce that risk, an emergency aerial adulticiding application may be warranted. The effectiveness of aerial adulticiding operations have been documented. Fixed-winged aircraft would be employed to release adulticides over targeted areas. For this aerial application to proceed, a consensus must be reached by the District, the State Reclamation and Mosquito Control Board, the Massachusetts Department of Health, an independent advisory board, and lastly a declaration of a Public Health Emergency from the Governor is required.

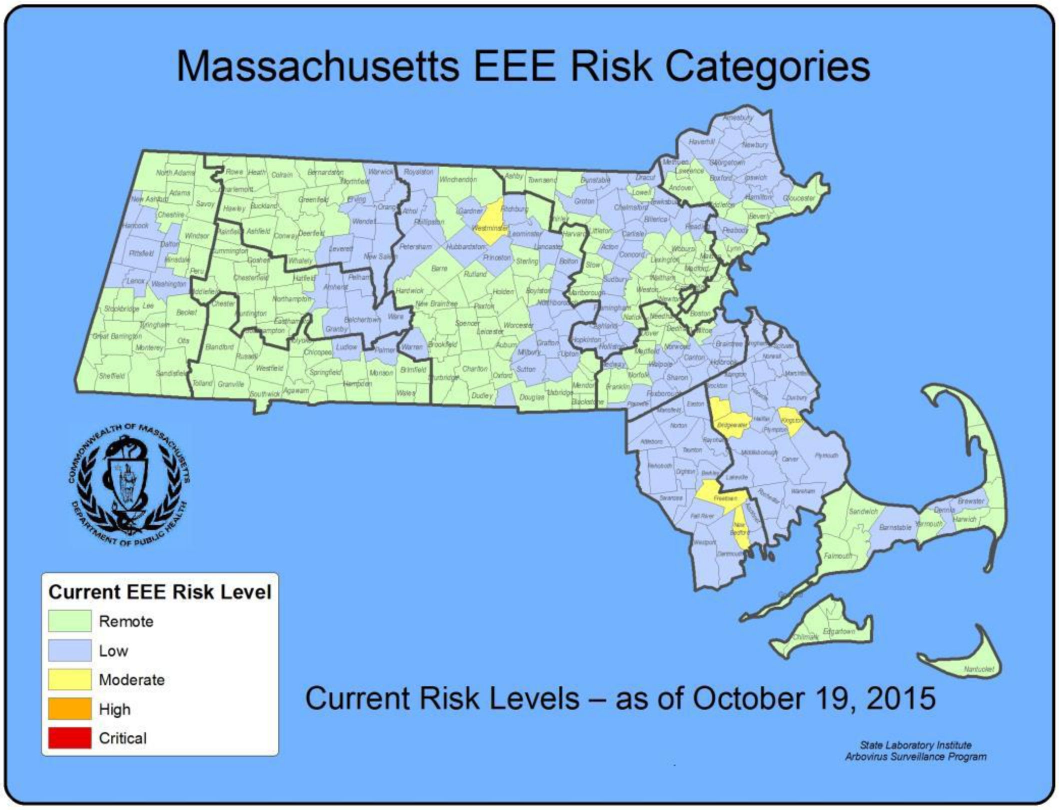
Typically, once the decision is made, the need for action is immediate and the window of opportunity is short. It is imperative that the complex logistics of executing the aerial application are already in place even before a consensus is achieved. The Emergency Response Aerial Adulticiding Plan is outlined as follows:

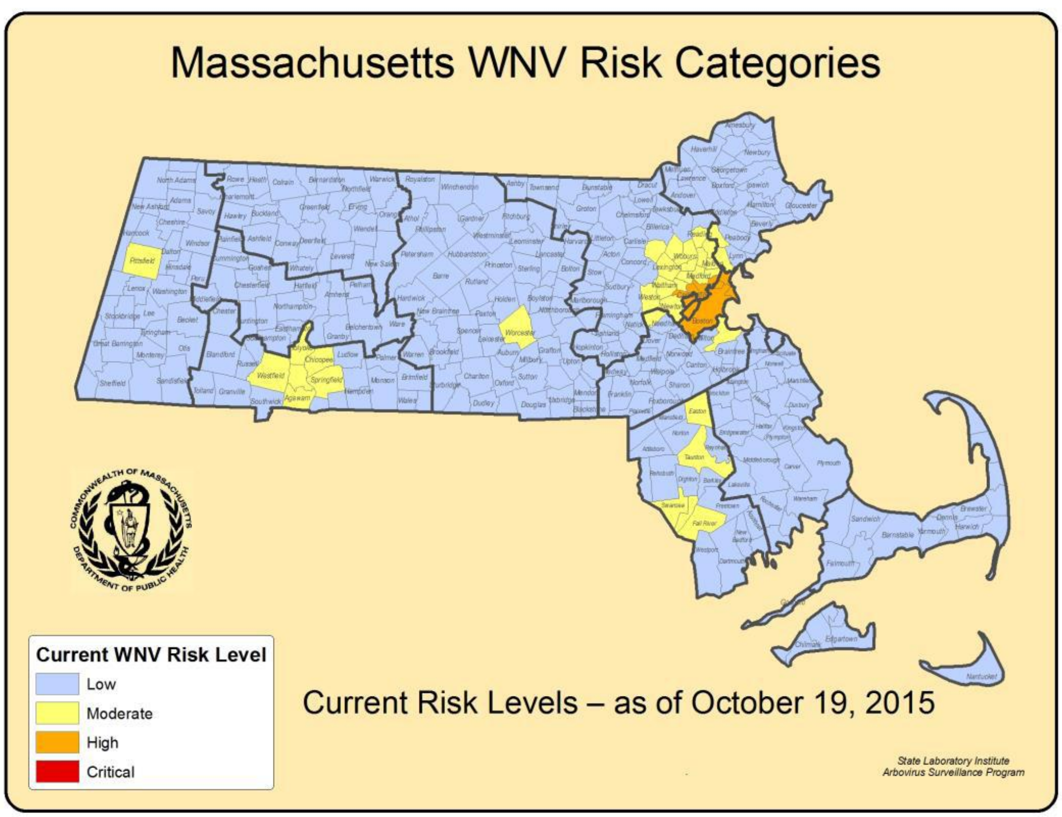
1. The District has already in place, and continually revises, a Global Positioning Satellite (GPS) mapping program that designates areas to be excluded from an aerial adulticide operation. These include reservoirs, endangered species areas, etc. The areas to be sprayed would be determined by the current mosquito and risk data and environmental circumstances. These data can be quickly downloaded into an aircraft's navigation system which would then direct the aircraft to areas to be sprayed as well as areas to be avoided.
2. The District has (and annually revises) Memorandums of Understanding (MOU) with the Lawrence and Beverly airports. In the event that an aerial adulticiding operation is essential, Lawrence airport would be closest to the likely target area to be the staging area for the operations. In the event Lawrence airport is unavailable or the target area has broadened, then the Beverly airport would be used.
3. Through the state's procurement program, contracts are already in place for the acquisition of aircraft and pesticides. If events warrant, it is the District that will communicate directly with aircraft and pesticide contractors, airport staff, and other relevant personnel to secure the necessary equipment and materials for our use.

Figure 28. NE MA Mosquito Control District Municipalities reporting WNV and EEEV infections in 2015



Municipalities with WNV positive mosquitoes
Municipalities with WNV human cases
Municipalities not in the program


Massachusetts EEE Risk Categories
Current EEE Risk Level
Remote
Low
Moderate
High
Critical
Current Risk Levels – as of October 19, 2015
State Laboratory Institute
Arbovirus Surveillance Program


Massachusetts WNV Risk Categories
Current WNV Risk Level
Low
Moderate
High
Critical
Current Risk Levels – as of October 19, 2015
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