



Commonwealth of Massachusetts
STATE RECLAMATION AND MOSQUITO CONTROL BOARD



**NORTHEAST MASSACHUSETTS MOSQUITO CONTROL
AND WETLANDS MANAGEMENT DISTRICT**

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Best Management Practice Plan
Ipswich

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Mosquito/Arbovirus Surveillance Summary

Introduction

Although forty-nine species of mosquitoes are found in Massachusetts, only about a dozen are of concern to the public. The concern is not of their biting activity, but their ability to transmit viruses that cause painful, debilitating, and fatal diseases that has become paramount to our residents. Not often apparent but mosquitoes can also cause economic losses to a community by debilitating livestock and even drive away tourists. Therefore, it is crucial that local mosquito activity and abundance are monitored to help protect the health of community residents and help maintain its economy. Vigilance on mosquito activity and abundance is the core of the mission of the Northeast Massachusetts Mosquito Control and Wetlands Management District. We possess the expertise and means to track mosquito populations, the protocols and connections to test mosquitoes for the viruses they may carry, and the experience and equipment to manage populations. Our District's mosquito control operations have evolved from being exclusively "nuisance control" to more-and-more "vector management". With "vector management", our surveillance and control strategies are designed to identify, monitor, and control vectors of the principal "arboviruses" (coming from "**arthropod-borne viruses**") of northeast Massachusetts, these being West Nile virus (WNV) and Eastern Equine Encephalitis virus (EEEV). See the accompanying 2012 Vector Management Plan (VMP) that describes our District-wide tactics and strategies for monitoring and responding to the vectors of the aforementioned viruses.

The **Best Management Plan** presented here summarizes 2011 mosquito and arbovirus activity in the District overall, then in your community (including our operational responses). This will be followed by preliminary plans (and costs) for surveillance and control in your municipality, as to be agreed upon with your Board of Health, for 2012.

Northeast Massachusetts

The Northeast Massachusetts Mosquito Control and Wetlands Management District has thirty-two subscribing municipalities, thirty are located in Essex County and the remaining two, Revere and Winthrop, are in Suffolk County. Our surveillance program is based primarily on collecting mosquito population and diversity data from at least one “historical trapping stations” (HTS) at each member municipality. The same fixed location is used each year for each station and each station has two different surveillance traps. Additional surveillance traps of a different kind, “resting boxes” have also been set at fixed locations in specialized habitats where EEEV is present; these resting box stations are found along the border with southeast New Hampshire and in suspected EEEV “hot spots” in Essex County. Descriptions and photographs of our traps employed can be found in the accompanying VMP.

The surveillance program runs from the middle of the spring until the beginning of the fall, the time of the year most people are engaged in extensive outdoor activities. There are two collections per week from all the traps. When necessary, additional traps are set when vector species are assumed to be in greater abundance and dispersal and/or when presence of viruses may be suspected. Not only are all collected mosquitoes identified and tallied, key species are selected to be tested to determine if they are carrying WNV and EEEV. The 2011 mosquito surveillance season began on 2 May and ended on 28 September, lasting 22 weeks. Our EEEV-Resting box surveillance began on 27 June and also ended on 28 September.

To summarize the surveillance season, this was one of the most intense years in both mosquito trappings and arbovirus detections. Beginning first with mosquitoes, this year marks **the most mosquitoes** collected at our HTS’s since our current surveillance protocols were instituted in 2002. Nearly 62,000 mosquitoes were collected in our carbon dioxide-baited New Jersey traps, over 15,000 more were trapped in gravid traps, and another 6,400 collected via our resting box traps giving us a grand total of nearly 83,500 mosquitoes trapped, identified, and tallied. Some skeptical resident may claim that 84,000 mosquitoes can be found on their property alone that abuts a wetland. That may be true, but our focus is to collect a representative sample of what may be occurring throughout a city or town; our job is not to collect the most mosquitoes possible from an area we already know that breeds too many mosquitoes! In addition to our HTS trappings, we set more temporary traps this year than ever before, primarily in residential, schools, public-use areas. The specific reasons for the additional trappings are discussed further below.

Based on analysis of our data, we conclude that the predominant mosquito species in 2011 were the floodwater- and “organic water”-breeding mosquitoes. And as you can guess, the unusual abundance of both groups was determined by the unusual pattern of weather and rainfall that was experienced in Northeast Massachusetts last spring and summer. The season began with a wet spring leading up to a dry June, followed by a wet and hot July, then a wet Aug. and finishing with a warm September and October.

The dry spell in June resulted in a drought that created conditions for the rapid development of “organic water-breeding” mosquitoes such as *Culex pipiens* and *Cx. restuans* (see the accompanying VMP for a discussion on how droughts contribute to expand the populations of these mosquitoes, as well as photographs). When the rains came in July and August, dried depressions along floodplains and in woodlands became filled which allowed for hatching of dormant eggs; with the hot spells in between deluges, development and emergence was accelerated for these mosquitoes. Most prominent was *Aedes vexans* (Figure 1. And no, mosquitoes don’t all look alike!), a notorious aggressive daytime human-biting species, followed by a lesser extent by *Aë. canadensis* (Figure 2) and in some municipalities, *Aë. cinereus*. The greatest concern about *Aë. vexans* was that it was abundant during peak WNV and EEEV transmission periods (August through September) when it can easily become infected with either of these viruses and readily infect humans with these viruses.

The rains added more water to pools and containers already filled with “organic” polluted water but apparently not enough to wash out these sites. (Replacing completely the “organic” water with fresh rainwater would have changed drastically the habitat and *Culex* species would not develop in these waters until the water again becomes rank and putrid over time.) The *Culex* mosquitoes that exploited these breeding sites continued developing and emerging more quickly thanks to the subsequent warm-to-hot temperatures. The results were record numbers of *Cx. pipiens* and *Cx. restuans* in July and August. And since these species are responsible for WNV transmission, the increase in their abundance resulted in more infected mosquitoes being collected, and with more infected mosquitoes, the risk for human infection by WNV also increased.



www.cirrusimage.com
(www.cirrusimage.com)

Figure 1. *Aedes vexans*



(<http://ka.bestpicturesof.com/culicidae>)

Figure 2. *Aedes canadensis*



(<http://bugguide.net>; Photo#49277)

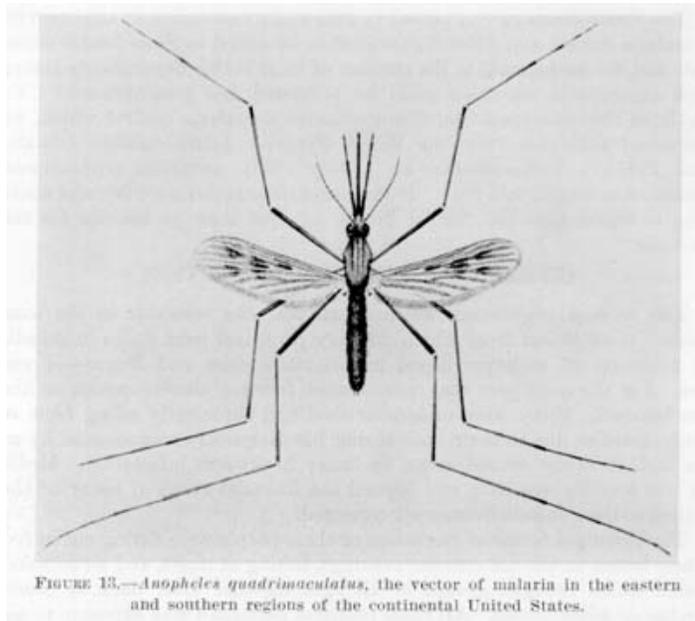
Figure 3. *Aedes sollicitans*



(<http://bugguide.net>)

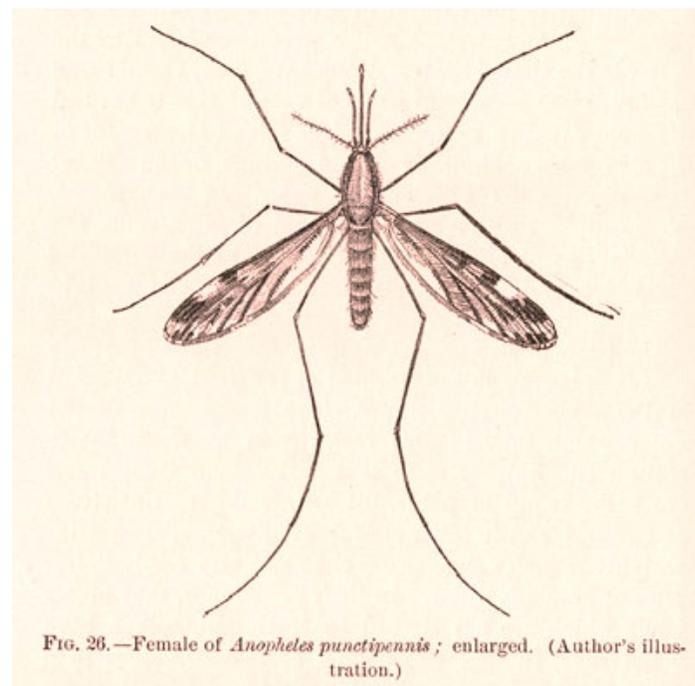
Figure 4. *Coquillettidia perturbans*

Other mosquito species were present but in general, their populations did not warrant the same degree of concern as did the aforementioned species. Salt marsh mosquitoes, *Aë. sollicitans* (Figure 3) and *Aë. cantator*, were kept at manageable levels in part due to the District's aerial salt marsh larvicidal program. *Cx. salinarius* develop in salt marshes, but can also breed successfully in purely freshwater habitats, such as cattail swamps, and depending on location, this species was seen in higher than usual numbers. (This species is reported to be an excellent vector of WNV.) Wetland species such as *Coquillettidia perturbans* (Figure 4), *Anopheles quadrimaculatus* (Figure 5), and *An. punctipennis* (Figure 6) were not deemed more problematic than usual District-wide (although torturous to residents living in the vicinity of large wetlands). And while these can transmit WNV and EEEV, they were not in great abundance during the peak WNV-transmission period. Tree-hole breeding species, *Aë. japonicus* and *Aë. triseriatus*, were also recorded in relatively low numbers that did not generate concern. However, as reported below, a sample ("pool") of adult *Aë. japonicus* was found infected with WNV and this species can transmit WNV successfully.



(<http://history.amedd.army.htm>)

Figure 5. *Anopheles quadrimaculatus*



(<http://www.hsl.virginia.edu>)

Figure 6. *Anopheles punctipennis*

As mentioned earlier, additional temporary traps were set throughout the District. Due the persistent presence of WNV in the North Andover and Winthrop areas in 2010, it was felt that enhanced monitoring of WNV vectors would be prudent in 2011 in the attempt to identify and limit the risk of human infection. Gravid traps were employed since they select for the principal vectors of WNV. Traps are battery-operated, easily set in urban habitats as well as forested wetlands, and can collect for up to 48 hours. The design of the traps allow captured mosquito to stay alive in a humid setting without desiccating and dying, as well as for easy removal. The longer mosquitoes are kept alive in the traps, the greater the likelihood that, if infected, the virus will remain viable and more readily detected in the lab.

A total of 123 separate temporary gravid sites were selected and 264 separate collections were made from these sites; the temporary collections began in the middle of June and continued several times a week through the end of September. These additional trappings were set where one or some of the following conditions prevailed:

- when vector species at an HTS were above or below historical averages;

- in towns that had intense West Nile “activity” in 2010 (e.g., North Andover and Winthrop);
- extent within a municipality (-ies) after WNV detection at the HTS;
- if towns adjacent “WNV-infected towns” possessed infected mosquitoes; and
- collect vector species in a municipality not a District member, but suspected to harbor vector/WNV activity. The municipality in question was Lawrence; we had “WNV-hits” in all its surrounding communities (see below). Because WNV vector-breeding conditions are in great abundance in Lawrence, we hypothesized that this city may not only have WNV circulating, but may be the focus of the spread throughout the northwest sector of the District. Lawrence is not a subscribing member of the District and no mosquito surveillance and control is done at the governmental level.

Furthermore, as requested by the MA Department of Public Health, temporary CO₂-CDC traps were set in Ipswich during the Columbus Day weekend (8 through 10 October). There was a suspected human case of encephalitis, and while it was not yet known if the source of this infection was arthropod-borne, attempts were made to determine whether infected mosquitoes were present. While normally few mosquitoes remain active into early October, recall that this past October the temperature rose into the mid 80’s for much/most of that weekend; higher than normal collections of mosquitoes were made. Fortunately, no mosquito collected was found to be infected with either EEEV or WNV.

1001 mosquito samples or “pools” were sent to MA DPH for arbovirus testing, the most we’ve ever sent for testing. Recall that submitted mosquitoes are tested to determine if they are infected with WNV and/or EEEV. No EEEV was detected anywhere within the District in 2011. Nor was EEEV detected in New Hampshire as well and southeastern NH has been the focal point for the current outbreak of EEEV that has periodically “spilled over” to our District.

On the other hand, 2011 was a “banner year” for WNV for the District. More WNV-infected mosquito pools were detected in the District in more municipalities in more mosquito species than ever in the District:

- 56 infected mosquito pools were collected in 2011, by far surpassing the 21 infected pools collected in 2010:
 - 25 pools came from permanent season-long HTS’s; 26 infected pools came from temporary gravid traps; and even more surprising, 5 infected pools came from resting box traps (designed to collect mosquitoes that transmit EEEV!).
 - Infected mosquito pools were collected from 22 municipalities (over two-thirds of our subscribing municipalities), seven of these never had any infected mosquitoes collected previously. See the table on the next page for the municipalities (and the dates for the first detections).
 - Also found to harbor WNV-infected mosquitoes was the non-District city of Lawrence; four traps were set in early September and collections from two of the four came back positive for WNV. This posed a dilemma for public health in Essex County in that Lawrence may indeed be “ground zero” for WNV amplification and dissemination in the northwest portion of the District, but it does not subscribe to the Northeast MA Mosquito Control District. (Boston, with 70 infected pools, was the “WNV-hub” for the entire Boston-metro area in 2011.) Therefore, we cannot do any form of mosquito control and due to the severe financial hardships being faced by that city, they cannot afford to do anything about mosquito control. And if WNV is indeed emanating from Lawrence to surrounding communities, what can be done to protect residents in surrounding communities?

- Infected mosquitoes were collected from throughout the District although two major “hotspots” can be readily identified. These are the Boston-Metro north region (eight cities with 27 infected pools) and the northwest sector around Lawrence (seven municipalities with 18 infected pools); another smaller cluster can be seen with seven infected pools in the Ipswich-Topsfield area.

Table 1. Collection of WNV-infected mosquitoes from District municipalities; unless otherwise indicated, infected mosquitoes were collected at each municipality’s Historical Trap Station.

<u>District Municipality</u>	<u>Date of 1st WNV(+) Collection</u>	<u>Dates of Additional Collections of WNV(+)'s</u>	<u>#’s Temp. Traps Set</u>	<u>Infected WNV(+) Vector Species</u>
Revere	28 July	31 July; 31 July ⁽²⁾ ; 29 Aug.	10	<i>Cx. pipiens</i>
Saugus	25 July ⁽¹⁾	8 Aug.; 15 Aug.; 21 Aug. ⁽¹⁾	17	<i>Cx. pipiens/restuans</i>
Boxford	3 Aug. ⁽²⁾	31 Aug. ⁽⁴⁾ ; 14 Sept. ⁽⁴⁾	15	<i>Cx. pipiens/restuans & Cs. melanura</i>
Lynn	1 Aug.	21 Aug. ⁽³⁾ ; 5 Sept.	10	<i>Cx. pipiens/restuans</i>
No. Andover	1 Aug. ⁽³⁾	15 Aug. ⁽³⁾	29	<i>Cx. pipiens/restuans</i>
Andover	10 Aug. ⁽¹⁾		11	<i>Cx. pipiens/restuans</i>
Haverhill	15 Aug. ⁽³⁾	6 Sept.	12	<i>Cx. pipiens/restuans</i>
Methuen	15 Aug.	17 Aug. ⁽²⁾ ; 31 Aug.; 6 Sept.	13	<i>Cx. pipiens/restuans, Aë. japonicus & Cx. salinarius</i>
Nahant	21 Aug. ⁽¹⁾	22 Aug.	8	<i>Cx. pipiens/restuans</i>
Newburyport	22 Aug.		15	<i>Cx. pipiens/restuans</i>
Swampscott	21 Aug. ⁽²⁾	22 Aug.; 31 Aug. ⁽²⁾	5	<i>Cx. pipiens/restuans</i>
Ipswich	31 Aug.	5 Sept. ⁽²⁾ ; 13 Sept. ⁽¹⁾	13	<i>Cx. pipiens/restuans</i>
Danvers	7 Sept.		10	<i>Cx. pipiens/restuans</i>
Georgetown	6 Sept.	12 Sept. ⁽²⁾	2	<i>Cx. pipiens/restuans</i>
Salem	5 Sept ⁽²⁾	12 Sept. ⁽¹⁾	12	<i>Cx. pipiens/restuans</i>
Topsfield	7 Sept.	7 Sept. ⁽⁴⁾ ; 14 Sept. ⁽⁴⁾	3	<i>Cx. pipiens/restuans & Cs. melanura</i>
Wenham	6 Sept.		6	<i>Cx. pipiens/restuans</i>
Merrimac	14 Sept. ⁽⁴⁾		0	<i>Cs. melanura</i>
Marblehead	21 Sept.		5	<i>Cx. pipiens/restuans</i>
W. Newbury	21 Sept. ⁽²⁾		17	<i>Cx. pipiens/restuans</i>
Peabody	28 Sept. ⁽²⁾		9	<i>Cx. pipiens/restuans</i>
Rowley	28 Sept.		6	<i>Cs. melanura</i>

(1) - Collections from two temp locations with WNV+ mosquitoes

(2) - Collection from temporary trap location with WNV+ mosquitoes

(3) - Collection from permanent gravid trap station

(4) - Collection from permanent Resting box station

The distribution of WNV can be summarized as follows: The heavily urbanized areas are providing abundant infected vectors. The birds infected by these mosquitoes are spreading the virus to the rest of the

District to then be acquired by local mosquitoes biting these birds. That there were not more infected pools in the heavily urbanized areas of Winthrop (no infected pools) and Haverhill (only two pools), even after the extensive temporary trappings done in these cities reflects, in our opinion, the intense larviciding control efforts performed by District personnel.

- It should be noted that additional trappings for WNV vectors in several towns did not yield infected vectors. Additional trappings were done in Amesbury (twelve additional trappings), Winthrop (eleven), Newbury and Salisbury (nine each), Beverly (six), Hamilton (two), and Lynnfield (one). In all the aforementioned communities, the additional trappings were mostly done in late August through late September, during the time of peak WNV transmission. The temporary trap results from these towns were definitely not lacking in *Culex* mosquitoes, so there was the possibility that WNV was not circulating in these towns or at least in levels that could be detected. In the case of Winthrop, temporary collections were made as early as the 4th of July weekend and no WNV was detected.
- More infected pools were collected in August (28) than in September (21) (seven pools collected in July). There were more temporary trapping done in September than in August, thus the lower infected pool collections in September may indicate that the District's response to infected pool announcements in August *may* have helped in reducing the populations of infected mosquitoes and lowering risk of residents to infection.
- More species were detected with virus than ever before in the District. Although the number of other infected species pools is low, this may be more a reflection of the low number of pools that are submitted for testing of these species, rather than an accurate representation of their vector potential. We were often "pressured" by MA DPH to submit fewer pools for testing than what we wished to submit! These other species have been shown experimentally to transmit WNV to humans. The species found infected with WNV in the District (number of infected pools of each species in parentheses) were:
 - *Culex pipiens/Cx. restuans* complex (49); a species complex is one which two or more species are morphologically identical but biologically distinct (i.e., they may act differently but they appear identical);
 - *Culiseta melanura* (5); this species is the usual vector for EEEV but since its preferred hosts are birds, it is not that surprising that this species can pick up WNV as well from infected birds;
 - *Culex salinarius* (1); its infection was of concern because this species is suspected to be the "best" vector for WNV and may be the principal vector of this virus in the eastern US;
 - *Aedes japonicus* (1); this species is also deemed to be a good vector in that the virus can easily amplify within its tissues and is readily a human biter but since its principal hosts are mammals and not birds (from where WNV originates), it is not often high on the "vector species watch list".

That more WNV was detected in the District the past two seasons (77 infected pools) than all the previous years put together (66 infected pools from 2000 through 2009) is a great concern. What is causing the increase in the transmission and amplification of WNV in the District is not known, especially since pre-emptive and responsive control operations have not declined? Changes in weather patterns is obviously part of the answer with repeated cycles of heavy rain followed by stretches of warm-to-hot temperatures manifested last summer. Another mystery about the current WNV outbreak is that the virus has yet to "disappear in to the landscape"; i.e., become dormant, as it was predicted to do by now.

The pattern of increased WNV activity was exhibited statewide as well. There were 275 WNV-infected mosquito pools across Massachusetts with five human cases (four, all between 40 and 64 years of age,

manifesting the more serious neurological disease with the lone remainder, over 64 years old, exhibiting high fever). Although we have been told that they have recovered, I am sure there is no detailed follow-up of the progress of their recovery (no longer dying or hospitalized doesn't necessarily mean that an infected person has fully recovered!). There was one human case in the District, a woman (aged 40 to 64) from Peabody who developed meningitis after infection with WNV.

As stated earlier, no EEEV was recovered in the District. However, statewide there were 80 positive pools of mosquitoes infected with EEEV, all west and south of Boston; there was one human fatality. Although the number of infected mosquito pools increased in July similar to a pattern displayed in July 2010, along with an increase in human-biting species, the state elected not to do an aerial adulticiding operation for reasons that were never fully explained to the satisfaction of many experts and concerned citizens.

Ipswich

While mosquito populations increased District-wide in 2011, there was an overall decrease of under 25% in mosquitoes collected Ipswich compared to 2010 collections, as registered at our historical trapping station (Wastewater Treatment Plant on Fowlers Lane). Species with lower than usual populations included floodwater species *Aedes vexans* and to a lesser extent, *Aë. canadensis*; salt marsh mosquitoes (*Aë. sollicitans* and *Aë. cantator* and to a lesser extent *Culex salinarius*); freshwater species (*Anopheles punctipennis*, *An. quadrimaculatus*, and *Coquillettidia perturbans*); and tree-hole breeding species (*Aë. japonicus* and *Aë. triseriatus*). For reasons unknown *Aë. vexans* did not experience any population “explosions” unless the areas that successfully re-flooded after the summer rains were at a considerable distance from the HTS. Yet, with a flight range of as much as twenty miles, there should have been more than a handful that successfully located our traps! Wooded floodplains within salt marshes have been known to “breed” *Aë. vexans*, as seen in parts of Newbury; why didn't *Aë. vexans* breed in Ipswich salt marsh floodplains is not known.

Whereas salt marsh mosquitoes were present, they were nowhere near to being the most abundant mosquitoes collected in Ipswich as they once were in the not-so-distant past, either in individual species or collectively as a group. And *Aë. sollicitans* (“White Banded Salt Marsh Mosquito”), historically the greatest mosquito scourge of Ipswich, was now the smallest component of the salt marsh catch. This is because its breeding sites are easily accessible to the larva-killing bacteria that are released from our aerial spraying program. *Aë. cantator* (“Brown Salt Marsh Mosquito”) on the other hand, breeds along the most upper reaches of the salt marsh in areas that under more tree canopies. The greater arboreal habitats make it more difficult for the spraying helicopter to reach and apply larviciding agents to the breeding pools situated below and thus more *Aë. cantator* survive. Still, over two-thirds fewer *Aë. cantator* were collected in 2011 than in 2010.

The most dominant freshwater species in Ipswich used to be the cattail swamp mosquito, *Coquillettidia perturbans*. But this species also declined significantly in 2011. Unlike *Aë. vexans*, it is not a re-flood species and is instead a “once-a-year” species (i.e., “univoltine”); *Cq. perturbans* does not appear again after its initial emergence from mid-June through late July.

The two species that increased their numbers significantly were *Cx. pipiens* and *Cx. restuans*. This observation generated concern since these species are the principal vectors of WNV in northeast Massachusetts. As reported in the preceding section, *Cx. pipiens* and *Cx. restuans* both breed in organic and/or polluted water-filled pools and/or containers (especially catch basins). And usually their populations can be regulated by treating catch basins with larvicides. Their numbers were higher than what was normally collected in June and July and as stated in the preceding section, droughts and unusual rainfall patterns will affect and increase overall

Culex abundance. Therefore to determine if the pattern of abundance seen at the HTS was repeated town-wide, additional temporary gravid traps were set around Ipswich as early as late June and again in September. (Being a location overflowing with organic putrid-smelling water, you would think all the *Cx. pipiens* and *Cx. restuans* in Ipswich would gravitate to the Wastewater plant to breed!) Six locations were selected (“Ipswich Crossing” supermarket complex; behind the public library; adjacent to the DPW lot; Doyan Memorial school; Hamlin reservations; and the Old Linebrook cemetery) and thirteen 48-hour collections were made; all the collected *Cx. pipiens* and *Cx. restuans* from the temporary traps as well as from the HTS were sent to ASL/DPH for testing.

With all the WNV being detected throughout the District, it was not a major surprise that the first WNV-infected mosquitoes were collected from the HTS on 31 August (announced on 2 September). What was a surprise was that the infected pool contained only seven mosquitoes! When a pool with so relatively few mosquitoes is found infected, this is an indicator that the percentage of infected mosquitoes in an area is relatively high. And the risk to humans now becomes high.

Upon receiving news of the WNV-infected mosquitoes, the District discussed response options with the Ipswich Board of Health. The Board authorized a limited truck-spray adulticiding operation on 8 September conducted in an area bordered by Spring Street to the west and east of High Street and Mitchell Rd. We had set temporary gravid traps again after the first WNV announcement and we detected WNV again in the following two weeks, from “Ipswich Crossing” and the Doyon School. After discussions again with the Board of Health, the District was authorized to conduct a town-wide adulticiding operation on the evening of 12 September and another targeted application in northwest area of Ipswich, bounded by Linebrook, Mile, Paradise, Mitchell, Avery, Locust, High, and Pine Swamp, on the night of 19 September. Very few *Culex* mosquitoes were collected in the last weeks of September and there were no further WNV-infected mosquitoes detected. Adulticiding is almost never done in late September however during this last September, summer conditions prevailed up through the beginning of October. There were still plenty of mosquitoes still alive and active (many still infected); it was agreed that with the risk of human infection still being relatively high, the adulticiding operations were warranted.

Prior to the WNV detection in Ipswich in 2011, the last WNV-infected mosquitoes were collected in 2005 (four pools). There were infected birds collected in Ipswich as recently as 2007 (recall that birds are no longer tested for WNV in Massachusetts). EEEV-infected mosquitoes have yet to be detected in Ipswich, although they have been collected in nearby Hamilton as recently as 2009.

Focus of Operations

The District’s Vector Management Plan VMP will take precedence over all operations prescribed in this BMP. Regional control efforts will focus primarily on adult mosquito surveillance, virus testing and preemptive virus intervention strategies.

Regional Control Measures

Regional Adult Mosquito Surveillance Program: The importance of surveillance data in reducing the risk of vector borne disease can not be overstated. By focusing on areas of heightened viral activity, preemptive control measures can be timely, efficient and effective. In 2002 we expanded and greatly improved our surveillance program by developing and implemented an automated carbon dioxide (CO₂) surveillance system. This system incorporates a CO₂ modified light trap and gravid trap into one automated unit. CO₂ traps are used

to sample the general adult mosquito population, monitor both short and long term trends, and determine dominant species and population density.

Gravid traps are designed to collect adult female *Culex* species the primary vectors of WNV. One of these dual function units is placed in a fixed location in each member municipality for a total of 32 deployed throughout the District. Mosquitoes are collected and identified from each trap twice a week beginning on or about May 1st thorough September 30th and beyond if conditions and circumstance warrant.

To supplement *Culex* collections from fixed gravid trap locations, the District will deploy additional gravid traps at multiple random location in communities with a history of WNV activity as conditions and circumstances warrant .

The District will operate 128 resting boxes at 15 sites. Resting boxes are designed to collecting blood fed female *Culiseta melanura* mosquitoes relevant to EEE transmission. The District began deployment of resting boxes in 2006 in response to the emergence of EEE in the Northeast and they have proven to be a valuable tool in early intervention. Six to eight resting boxes will placed at each fixed location and there will be two fixed locations in communities bordering New Hampshire as well as other communities considered to be at risk. The District will collect and identify samples from each trap twice a week and the specimens will be tested for virus.

In the event *Cs. melanura* mosquitoes collected from resting box sites test positive for EEE the District will deploy portable CO₂ traps at those sites. Whereas *Cs. melanura* rarely bites humans they serve as an early indication of the presences of EEE in the environment. CO₂ traps attract human biting mosquitoes and mosquitoes testing positive from CO₂ traps indicated heightened risk.

Virus Testing: Specimens from our trap collections will be sent to The Massachusetts Department of Public Health (DPH) to be tested for the presence of encephalitis viruses.

Regional Vector/Virus Intervention: Control efforts will focus on early intervention strategies in municipalities that have shown a greater risk to mosquito borne virus based on events of the previous season and surveillance data. This approach is in the best interest of all member municipalities as focused early intervention strategies seem to demonstrate containment of WNV, and may reduce the risk of exposure to humans and the spread of this disease to other municipalities.

Control Measures Specific to Ipswich

Aerial Salt Marsh Larviciding: From around the first week in April to the last week in September salt marsh larviciding sites from the District's data base as well as the salt marsh in general, will be monitored for mosquito breeding. Upon determination that a larviciding application is necessary a pre treatment survey will be conducted to determine mosquito population density and area to be treated. All data will be recorded on an aerial larviciding Pre Treatment Survey Sheet. Conditions permitting and as determined by pre treatment surveys, a minimum of three and a maximum of six applications will be made. Upon completion of each application a post treatment survey will be conducted to determine efficacy of the application. All data will be recorded on an aerial larviciding Post-Treatment Survey Sheet.

Catch Basins: Catch basins, retention basins, detention basins etc. will be treated first in those communities prioritized in the District's VMP. Catch basins, retention and detention basins will be checked and treated as necessary from approximately May 1st to August 31st.

Manual Ditch Maintenance: In the course of catch basin treatments, roadside ditches and culverts will be manually cleared of manageable blockages and debris in order to reduce mosquito breeding habitat and or potential habitat.

Wetlands Management: The Town may petition the District to undertake larger scale ditch main-tenance projects, wetlands enhancement and restoration projects requiring specialized mechanized equipment and expertise. Petitioned sites will be evaluated and a site specific proposal will be written for acceptable projects. Wetlands management projects may be beyond the scope of any municipality's assessment and may be funded by separate and additional appropriation.

Ground Larviciding: Larviciding sites will be treated first in those communities prioritized in the District's VMP. Larviciding sites from the Districts data base and areas requested by the Board of Health will be checked and treated from April 1st to August 31st and beyond if circumstances warrant and conditions allow.

Open Marsh Water Management: OMWM has been an important component of the District's IPM strategy to manage salt marsh mosquitoes for 25 years. During this time hundreds of OMWM projects have been successfully completed resulting in an incremental reduction in acres aerial larvicided and a dramatic reduction in truck spraying for adult mosquitoes. While the District continues to strongly support the concept and implementation of OMWM, our permit has expired and despite a two year effort to renew the permit, it has been denied. Therefore we are unable to implement any OMWM projects for the foreseeable future. While the District is actively working to resolve this matter we are also reviewing the fiscal realities of continuing to implement OMWM. Extensive permitting procedures and increased site monitoring and project implementation protocol will significantly increase operational costs. These considerations may ultimately make OMWM cost prohibitive.

Selective Salt Marsh Ditch Maintenance: In lieu of OMWM and to insure that the significant gains achieved through OMWM are not lost, the District will implement a selective salt marsh ditch maintenance program. The District will investigate potential sites for opportunities to implement selective salt marsh ditch maintenance. Sites will be considered based upon surveillance data obtained through the District's aerial larviciding program: known mosquito larval habitat. Areas of greatest distance from aerial larviciding landing zones (to minimize operational costs) and areas which are difficult to treat due to physical site characteristics will be given priority.

Inspectional Services: While the District is authorized under the provisions of Chapter 252: section 4 of the General Laws of the Commonwealth to enter upon lands for the purpose of inspection, it is not a regulatory agency. Nor is it our intention to impose on any resident or business, but rather to be a resource for information and technology to help property owners prevent or abate mosquitoes to the mutual benefit of the property owner and the community. The District will act as a technical advisor as requested by the Board of Health and represent the municipalities public and animal health and human annoyance concerns relative to mosquito breeding, potential breeding and proposed development. The District, at the request of the Board of Health will also review site plans and inspect sites were storm water structures are planned or under construction. Upon inspection of a site the District will make written recommendations, submit these recommendations to the Board of Health and "cc" a copy to the land owner.

Property Inspection: Socioeconomics often plays an important role in mosquito control and associated public health risk. This is evident by a study conducted in 2007 entitled "Delinquent Mortgages, Neglected Swimming Pools, and West Nile Virus, California" which demonstrates a 276% increase in the number of human WNV

cases in the summer of 2007 associated with a 300% increase in foreclosures which led to a large number of neglected swimming pools in Bakersfield, Kern County. Last year we received many requests from Boards of Health to inspect abandoned properties.

While the district has a long standing policy of property inspections at the request of Boards of health, in the past we have taken a passive approach to property inspection. Given the current economic climate and likelihood of increasing property abandonment and the potential for increased health risk associated with property abandonment the district will take a more aggressive approach to property inspections. In the course of our routine activities in your community we will be on the lookout for such properties and report such properties to Boards of Health. We understand that addressing concerns related to such properties is a matter of time and process. In the long term, we will offer any support that may be appropriated to resolve mosquito problems related to such properties and in the short term with the Boards of Health's support we will implement the necessary control measures to mitigate the immediate mosquito problem associated with such properties.

Mosquito Habitat Mitigation: The District will represent the Town's mosquito control concerns in an advisory capacity relative to proposed development and where prudent as requested by local health officials.

Specific to the Parker River National Wildlife Refuge and the Trustees of Reservations: The District will represent the Town's mosquito control interest relative to the management and operation of the Refuge and Reservations. The District has established agreements with the USFWS and Trustees and negotiates these agreements annually. These agreements allow the District to conduct aerial larviciding applications on these properties. This is essential in managing salt marsh mosquito populations. It is important to note that through our efforts the Parker River Wildlife Refuge is one of only a few refuges where mosquito control is allowed.

Adulticiding: (Revised 2/13/12 by Board of Health) Selective adulticiding as directed by the Board of Health in response to the recommendations of the District from June 1st to October and beyond if circumstances warrant and conditions allow, in accordance with the following criteria.

- Nuisance control: By Board of Health request for targeted or town wide Adulticide application due to a spike in salt marsh mosquito populations based on the District's surveillance data and with emphasis on public use areas such as ball parks, schools, cemeteries and residential areas if requested.
- Public Health: Specific to West Nile Virus, the District may recommend a target or town wide adulticide application based on the criteria established in the District's Vector Management Plan; spike in vector species, WNV isolation (s) in mosquitoes, a human case, one positive virus acknowledgment or positive activity along a bordering community. Additional trapping will also be activated.

Specific to Eastern Equine Encephalitis, The District may recommend a targeted or town wide adulticide application based on the criteria established in the District's Vector Management Plan; above average *Culiseta melanura* populations in a year of anticipated EEE activity; one or more EEE virus isolations in mosquitoes, one or more EEE virus isolations in horses; one or more human EEE cases, or positive activity in an adjoining community. Additional trapping will also be activated.

Barrier Treatment: The District uses a system called Ultra Low Volume (ULV) for ground adulticiding applications. ULV is designed to dispense very small amounts of pesticides over a large area. While this is a cost effective means of reducing mosquito populations on a large scale, it only affects those mosquitoes present at the time of the application and repeated applications are some-times necessary to sustain the initial reduction

in the mosquito population in some areas. To reduce the need for repeated applications and provide more sustained relief from mosquitoes in high public use areas, the District may provide barrier treatments to public use areas such as schools (applications to schools must be in compliance with MGL ch85), playgrounds, athletic fields, etc., at the request of the Board of Health and school departments.

Research and Development: Evaluate the efficacy and efficiency of current control methods. Investigate new methods, procedures and technologies in mosquito control and wetlands management and evaluate their implications for use in Ipswich.

Education: Present educational displays and programs on mosquito control and related wetlands management programs at the request of health officials, schools or civic organizations. Monitor and update local schools and daycares etc. regarding IPM plans and current child protection requirements.

FY13 percentage of assessment allocated to specific measures as prescribed by individual municipality's Best Management Practice Plan, (BMP) in the Town of Ipswich

Since 2004 the District has been level funded and actually had reductions over the last few years due to assessments and other factors. This year the District is requesting a 5% increase. The FY13 budget reflects the need to update and increase available services to participating Communities as a way to counter act the steadily increasing level of mosquito control required to combat the endemic virus issues within our region.

Assessment: As estimated by the Massachusetts Department of Revenue, Division of Local Services for, in accordance with Chapter 516 of the General Laws of the Commonwealth. The assessment formula is based on a regional concept, which considers square miles and evaluation. The District offers this breakdown as a general guide to how these funds are allocated specific to your community.

FY13 Estimated Assessment for the Town of Ipswich \$98,317.00 (FY12 \$93,635.00)

District Breakdown of Administrative and General Operational Cost

State Reclamation and Mosquito Control Board	2.45%	\$ 2408.76
Administration and Facilities Cost Share	28.8%	\$ 28,413.61
Balance of assessment allocated to Operational Cost	68.75%	\$ 67,592.93

District Breakdown in Approximate Percentages Specific Control Measures as Prescribed by BMP

General Operational Cost Share	31.6%
Regional Adult Mosquito Surveillance Program	10%
Regional Vector/Virus Intervention	5%

Aerial Salt Marsh Larviciding	39%
Catch Basins/Larviciding/ Manual Ditch Maintenance	8.31%
Open Marsh Water Management	
Adulticiding	3%
Inspectional Services	1%
Habitat Mitigation	1%
Research and Development	0.09%
Education	1%