STATE RECLAMATION AND MOSQUITO CONTROL BOARD
MASSACHUSETTS MOSQUITO CONTROL DISTRICT
ANNUAL OPERATIONS REPORT

2013 Year of Report Date of Report: 1/22/2014

Project/District Name: **Northeast MA Wetlands Mgmt. Mosquito Control**

Address: 261 Northern Boulevard

City/Town: Newburyport Zip: 01950

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Report prepared by: *William C. Mehaffey, Jr, Emily DW Sullivan, Robyn Januszewski & Esteban Cuebas-Incle*

NPDES permit no. **MA G87A028**

If you have a mission statement, please include it here: The Northeast Massachusetts Mosquito Control and Wetlands Management District represents the mosquito control and wetland management interests of those communities that choose to subscribe to its services. The prime directive of the District is to protect its citizens from mosquito-borne diseases by targeting precise, measured, and preemptive responses to specific risk as prescribed by the District's annually-revised "Vector Management Plan" (VMP). To ensure that our citizens quality of life and regional economy is not severely impacted by abundant pestiferous mosquito outbreaks; strategies targeted to reduce dominant mosquito populations are implemented as prescribed by the District's annually-revised "Best Management Practice" (BMP) plans. BMP's are designed to incorporate the District's environmentally sensitive and cost effective mosquito control strategies with the specific needs and concerns of each member community.

ORGANIZATION SETUP:

Please list your Commissioner's names:

John W. Morris, CHO	Chairman
Vincent J. Russo, MD, MPH	Vice Chairman
Joseph Giarrusso, Conservation Officer	
Paul Sevigny, RS, CHO	
Rosemary Decie, Environmental Consultant	

Please list the Supt./Director's name: Jack A. Card, Jr.
Please list the Supt./Director's contact phone number: (978) 463-6630
Please list your Asst. Supt./Asst. Director's name: William C. Mehaffey, Jr.

Do you have a website? Yes If yes, please list the web address here: http:// www.northeastmassmosquito.com

Please list your staffing levels for the year of this report:

Full time: 9
Part time: 1
Seasonal: 5
Other: 1 (please describe) unpaid intern from Endicott College for fall semester

Please break these down into the following areas:

Administrative staff: 1.5
Field staff: 14
Please check off all that apply, and list employee name(s) next to each category:
☒ Public relations: Esteban Cuebas-Incle, Jack Card, William Mehaffey, Emily Sullivan and Robyn Januszewski
☒ Information technology: Jack Card, Robyn Januszewski, Anthony Corricelli & Emily Sullivan
☒ Entomologist: Esteban Cuebas-Incle;
☒ Wetland Project Coordinator: Emily Sullivan
☒ Biologist: Robyn Januszewski
☒ Education: Esteban Cuebas-Incle, Emily Sullivan and Robyn Januszewski
☒ Laboratory: Esteban Cuebas-Incle and Anthony Corricelli
☒ Operations: Jack Card, William Mehaffey, Esteban Cuebas-Incle, Emily Sullivan, Robyn Januszewski, Anthony Corricelli, Timothy Hay, Dennis Gallant, Ross Mehaffey, Maureen Douglas, Horace Baxter (seasonal), Richard Caron (seasonal), Thaddeus Tatarzzuk (seasonal), William Montgomery (seasonal), Barry Noone (seasonal) and Anthony Souza (intern)
☒ Facilities: Jack Card and William Mehaffey
☐ Other (please list)

For the year of this report, we maintained:
22 vehicles
14 modified wetland equipment (list type) Kassbohrer DR270 Flail mower/Grader; Kassbohrer DR270 Flail mower/Rotary ditcher/Grader; Kassbohrer PB260 Dump Body/Grader; 1987 Bombardier Muskeg Backhoe/Dump Body; 1999 Link Belt 1600 Excavator; 1995 Eager Beaver Heavy Equipment Trailer (rebuilt in 2007); 1996 Hudson Spray Trailer; 1998 Carmate Utility Trailer; 2012 EZ Loader Boat Trailer; 2012 Starcraft 14' aluminum Boat; 2012 Mercury 20 hp Outboard Motor; Wayne Wood Chipper; 1996 Rokon all-terrain Motorcycle; 1987 ARGO 8 wheel Amphibious ATV
6 ULV sprayers (list type)

Type	Mod#	Purchased	Usage
BecoMist	A0003S	(4) in 2006 & (2) in 2008	Adulticiding
ProMist	Dura	6/18/2013	Adulticiding

Larval control equipment (list type)

Other (please be specific):

Type	Mod#	Purchased	Usage
Leco	HD Series D 70001047 (Blower Model 26-3210)	6/20/06	Barrier
Leco	ULV 1100 (Blower Model RAI 89D Roots ID # 865-105-20)	1/22/08	Barrier
Rears Ag Sprayer S-95-1044			Veg. Control

Comments: _____

How many cities & towns in your service area? 32
Please list: Amesbury, Andover, Beverly, Boxford, Danvers, Georgetown, Groveland, Hamilton, Haverhill, Ipswich, Lynn, Lynnfield, Manchester-by-the-Sea, Marblehead, Merrimac, Methuen, Middleton, Nahant, Newbury, Newburyport, North Andover, Peabody, Revere, Rowley, Salem, Salisbury, Saugus, Swampscott, Topsfield, Wenham, West Newbury, Winthrop

Any changes to your service area this year? No
Please list cities/towns added or removed

***Please attach a link to a map of your service area if possible.**
northeastmassmosquito.com (Click on: "About Us" then "Municipalities Served").

INTEGRATED PEST MANAGEMENT (IPM):

DEFINITION: a comprehensive strategy of pest control whose major objective is to achieve desired levels of pest control in an environmentally responsible manner by combining multiple pest control measures to reduce the need for reliance on chemical pesticides; more specifically, a combination of pest controls which addresses conditions that support pests and may include, but is not limited to, the use of monitoring techniques to determine immediate and ongoing need for pest control, increased sanitation, physical barrier methods, the use of natural pest enemies and a judicious use of lowest risk pesticides when necessary.

Please check off all of the services that you currently provide to your member cities and towns as part of your IPM program; details of these services are in the next sections.

☒ **Larval mosquito control**

☒ **Adult mosquito control**
☒ **Source reduction**
☒ **Ditch maintenance**
☐ **Open Marsh Water Management**
☒ **Adult mosquito surveillance**
☒ **Education, Outreach & Public education**
☒ **Research**
☒ **Other (please list): Inspectional Services, Development Plan Reviews, Wastewater and Water Treatment Facility inspections and treatments, Site Reviews, Greenhead Fly Control, Wetland Restoration, Problem Beaver Management, Tire Removal / Recycling, Aquatic Invasive Vegetation Control**

Comments: POLICY, PROCEDURE AND FACTS: INSPECTIONAL SERVICES
Original: 02/09 - Merged: 04/11

Existing and potential mosquito development habitats can often be readily corrected without treatment of an insecticide if early intervention actions are conducted. 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. The District carries no regulatory authority nor is it our intention to impose upon any citizen or business but to rather be a source of information to help people prevent or abate mosquitoes to the mutual benefit of the community. The District may act as technical advisor as requested by local boards of health to represent the municipalities' public and animal health as well as human annoyance concerns relative to factors effecting mosquito populations (potential and realized).

The primary vector species of West Nile Virus, Culex pipiens usually breeds in artificial containers, catch basins, storm water control structures, and other highly organic and polluted water. Therefore the District will routinely inspect areas in and around industrial facilities, office parks, and agricultural based operations because of the potential for Culex species proliferation and its correlation to West Nile Virus by request of the Board of Health. The District may review proposed new development site plans upon request and /or inspect sites where storm water control structures are located or are in the process of being constructed. Upon inspection of a site the District makes written recommendations and submits them to the Board of Health, cc-ing the land owner.

The District has recently found that in many cases, routine maintenance practices on private properties have been abandoned in lieu of recent economic decline. Neglect often leads to increased potential for mosquito larval development habitat i.e., discarded items in and around yards like trash, tarps, debris, abandoned swimming pools etc. The District works with local boards of health to assist in abating mosquito issues related to abandoned/neglected properties.

LARVAL MOSQUITO CONTROL:

Do you have a larval mosquito suppression program? Yes

If yes, please describe the purpose of this program: The District implements aerial and ground applications as a pre-emptive measure to control mosquito populations before they become adults.

Aerial fresh water larviciding is a site specific application of an insecticide to fresh water wetlands to control mosquitoes in their immature aquatic stages and before they emerge as adult mosquitoes. Aerial fresh water larviciding is typically conducted in the spring months (March – May). The application targets early season nuisance species such as Aedes canadensis.

The District's aerial salt water larviciding program was developed to control salt marsh mosquitoes in approximately 23,000 acres of salt marsh stretching from Boston north to the New Hampshire border. Two species of salt marsh mosquitoes lay there eggs in moist muddy areas like salt pannes, depressions and overgrown ditches along the upper edges of the salt marsh. Flooding of the marsh, the result of monthly high run tides, storms or rain events, triggers the hatching of dormant mosquito eggs into mosquito larvae. The larvae then progress through a series of instars, pupating and then eventually emerging as adult mosquitoes. Under optimal conditions the whole process from egg to adult can occur in as little as four days. Salt marsh mosquitoes are known for their aggressive biting behavior even in the heat of daylight hours. If not controlled salt marsh mosquitoes can be present in large numbers from April through to September.

Ground larviciding is a site specific application of an insecticide by hand to potential and/or realized mosquito larval habitat (i.e., wetland) also designed to control mosquitoes in their aquatic stages before they emerge as adult mosquitoes. The Operations Manager assigns Field Technicians to specific areas within District territory. Field Technicians inspect and treat known larval development sites from the District's data base within their assigned area.

Please give the time frame for this program: March - October

Describe the areas that this program is used: Fresh water wetlands, upland, salt marsh and artificial structures.

Do you use:
☒ **Ground applied (includes hand, portable and/or backpack)**
☒ **Helicopter applications**
☒ **Other (please list): Source Reduction, Tire Removal / Recycling**

Comments: See description below "Source Reduction" for details describing these activities.

What products do you use in – (please use product name and EPA#)

Wetlands: Vectobac G #275-50; Altosid Pellets #2724-448-64833; Vectobac 12 AS #73049-38
Catch basins: Vectolex WSP #73049-20; VectoMax WSP #73049-429; Fourstar Briquets (180 day) #83362-3; Altosid XR Briquets (150 day) #2724-421; Altosid WSP #2724-448; Altosid Pellets #2724-448-64833; Agnique MMF G PAK 35 #53263-30
Containers: VectoMax WSP #73049-429; Vectobac G #275-50; Altosid WSP # 2724-448; Vectolex WSP #73049-20; Altosid Pellets #2724-448-64833; Agnique MMF G PAK 35. #53263-30
Other (please list):

Please list the rates of application for the areas listed above:

Wetlands: Vectobac G & Altosid Pellets (2.5 - 10 lbs/acre); Vectobac 12 AS (1qt./acre)
Catch basins: Vectolex WSP (1 pkt./basin = 10gr.); Vectomax WSP (1 pkt./ basin = 10 gr.); Fourstar Briquets (180 day) (1 briquet/basin = 37.4 gr.); Altosid XR Briquets 150 (1 briquet/basin); Altosid WSP (1 pkt./basin = 7gr.), Altosid Pellets (0.25 oz./basin); Agnique MMF G PAK 35 (1pkt./basin)
Containers: (application rate / container type & size)
Other: storm water structures - (application rate / type & size)

What is your trigger for larviciding operations? (check all that apply)

☒ Larval dip counts – please list trigger for application: one or more per dip depending on type of mosquito, type of habitat, type of conditions and relativte proximity to human polpulations.

☒ Historical records
☒ Best professional judgment

Comments: _____

***Please attach a link to maps of treatment areas if possible.**

ADULT MOSQUITO CONTROL:

Do you have an adult mosquito suppression program? Yes

If yes, please describe the purpose of this program: To limit mosquito population size, control species specific for vectoring West Nile Virus and Eastern Equine Encephalitis (EEE) and to reduce nuisance mosquito populations in response to resident complaints.

Please give the time frame for this program: one half hour after sunset to one half hour before sunrise (as conditions warrant and allow)

Describe the areas that this program is used: Outdoors and only in communities that participate in the NEMMCWMD's program per city/town and resident request. Adult mosquito control occurs as outlined in individual municipality Best Management Practice Plans, BMPs and as advised by the NEMMCWMD based on surveillance data and/or MDPH information or other applicable conditions.

Do you use:
☒ **Truck applications**
☐ **Portable applications**
☐ **Aerial applications**
☐ **Other (please list):**
Comments: _____

Please list the names of the products used with EPA #:
1). Duet #1021-1795-8329
2). Suspend SC #432-763
3).
4).
5).
6).

Please list your application rates for each product:
1). Duet : 0.41 fl oz. / acre ULV variable flow. (15 mph = 3.7 fl oz. / min.)
2). Suspend SC : 1 oz. / gal. water (1 Gal / min.)
4).
5).
6).

Please describe the maximum amounts or frequency used in a particular time frame such as season and areas

As requested but not to exceed once / week or as otherwise specified on the label.

What is your trigger for adulticiding operations? (check all that apply)

☐ Landing rates - please list trigger for application
☒ Light trap data - please list trigger for application - increasing amount of disease carrying vectors
☒ Complaint calls - please list trigger for application - 2 or more on street or in neighborhood.
☒ Arbovirus data
☒ Best professional judgment

Comments: ADULTICIDING - ULTRA LOW VOLUME:

Ultra Low Volume Applications (ULV) applications are done in response to surveillance data, multiple resident requests, municipal Health Department or other approved board request in accordance with the individual municipality BMP. The District uses truck mounted ultra low volume (ULV) non-thermal aerosol sprayers for selective, targeted and wide area applications. These high tech sprayers atomize the product resulting in droplets in the range of 8 to 15 microns. A small pickup truck drives along the road travelling between 5 and 20 miles per hour. A computerized variable flow system automatically calibrates the correct amount of material applied and dispenses a mist like swath. Depending on wind direction the swath of tiny droplets can drift off the road up to 300 feet and impinge upon the flying mosquitoes and vegetation that they rest on. All ULV machines are independently calibrated and certified for accuracy on an annual basis.

Selective and Targeted ULV Applications: The District expects a minimum of two residential requests from the same vicinity before ground adulticiding. ULV application targets are determined by location and number of complaints and may include a street, section of a street, neighborhood, block or specified area as requested by the Health Department.

Wide Area ULV Applications: The District may make recommendations for a wide area ULV application in response to surveillance data and specific vector/virus threats in accordance with the District's VMP.

Timing of Application: ULV applications will be conducted during evening hours, ½ hour after sunset to ½ hour before sunrise and as weather conditions permit. If any circumstances prevent safe or effective evening application then predawn application may be considered.

Post Application Security: Field Technicians will disable and cover the ULV sprayer when not in use.

ADULTICIDING - GROUND BARRIER:

Pesticides used in barrier applications have a longer residual effect and thereby reduce the need for repeated ULV applications. Barrier applications are used on public use areas such as, parks, play grounds, athletic fields and school grounds in response to requests from school officials and municipal health departments or other approved board in accordance with individual municipality BMP or the District's VMP. Since barrier applications may be performed within areas that children frequent, all applications are conducted in strict accordance with the MA Children's Protection Act. The District only uses EPA registered pesticides approved by the MA Pesticide Bureau and in compliance with federal and state regulations.

Application: Barrier applications will be done by means of backpack or truck mounted barrier spray equipment. Truck mounted sprayers will be capable of delivering 1 gallon of mixed product per minute.

Applications on School Property: Prior to the application the applicator will obtain a copy of the School's IPM plan to insure the materials to be used are listed and will have the IPM plan on hand during the application. The applicator will make sure that no student/child is present or that any student/child remains minimally at least 150 feet away from the treatment area. At the time of the application the applicator will post

approved signs at conspicuous points of access to the treated areas. The signs will be removed by the NEMMCWMD personnel no less than 72 hours after the application.

Timing of Application: Barrier applications will be conducted during evening hours, ½ hour after sunset to ½ hour before sunrise and as weather conditions permit. If any circumstances prevent safe or effective evening application then predawn application may be considered.

Post Application Security: Field Technicians will disable and cover the barrier sprayer when not in use.

***Please attach a link to maps of treatment areas if possible.**

SOURCE REDUCTION

Do you perform source reduction methods such as tire/container removal? Yes

If yes, please describe your program:

SOURCE REDUCTION
The District conducts source reduction activities typically by hand and as necessary during inspections, treatments, ditch maintenance, or in conjunction with organized wetlands management projects and clean ups. Emptying, tipping over or removal of containers prone to attract ovipositon by mosquitoes has long been a practice of the District. The District performs activities such as but not limited to: hooking; removal of debris/vegetation that causes obstruction of flow from waterways as well as clearing outfall and inlet grates etc.

TIRE REMOVAL/RECYCLING
Tires have historically been dumped/abandoned in any number of locations including public and private properties in both upland and wetland environments. Once a pile is started it can quickly grow into a substantial public health issue in terms of mosquito proliferation but also as a potential fire hazard or worse; a source of toxic fumes once ignited that can be extremely difficult to extinguish.

Used tires almost always hold water and are a prime location for artificial container breeding mosquito species, most notably Culex pipiens and Aedes japonicus. Culex pipiens is considered a key vector species of West Nile Virus. Aedes japonicus is a relatively new species to the Massachusetts area, since 2000, and was originally thought to have been imported to the United States in tires. Aedes japonicus has tested positively for West Nile virus.

The District has facilitated the removal and proper disposal of used tires from its service area for many years during the course of coordinated clean-ups and petitioned wetland management projects. This practice is considered an important part of the District's source reduction efforts and a strong component to their integrated pest management (IPM) approach. Tire disposal can be costly and increased economic woes may be adding to the problem as more and more people look for ways to cut expenses. For these reasons the District will be offering on a limited basis a tire removal and disposal program for some of its member communities. The District hopes this pilot program will be well received amongst its communities and that it may some day find a valuable place amongst other mosquito control best management practices area wide.

The District may select tire piles from locations in its data base but will primarily accept petitions requesting removal of non-commercial tire piles according to the process outlined in the District's Policy and Procedures for Mechanized Wetland Management (revised January 2011). Small piles (under 250) are considered on an individual basis. As necessary the District will coordinate with appropriate local boards i.e., the Conservation Commission to address any concerns prior to removal. All tires will be collected and removed to a state approved recycling facility. The District will conduct these projects between November and March or otherwise as time allows.

A maximum number of tires slated for removal / disposal as agreed upon by the District and member municipality may be specified for in the annual Best Management Practices for a member municipality. This number will be reviewed annually. Curbside collection or "drop off days" up to a maximum specified amount may be considered on an individual municipality basis.

What time frame during the year is this method employed? Year round and as time allows.

Comments: _____

DITCH MAINTENANCE

Do you have a ditch maintenance program? Yes

Please check all that apply:
☒ Inland/freshwater
☒ Saltmarsh

If yes, please describe: The District's "Ditch Maintenance Program" has been replaced in kind with the more holistic Wetland Management Program (see details below). Ditch maintenance projects, once common throughout the District's territory, became subject to intense regulatory scrutiny several years back. Changes of the interpretation of the definition for an "existing ditch", inconsistancy in regulatory agency review and

misinterpretation of the District's legislated authority has been the demise of the ditch maintenance program. Additionally, forced compliance to ambiguous "policies" (despite the District's broad sweeping authority) directly conflict with our agencies ability to offer these services in a cost effective or meaningful program.
Depsite regulatory pressures, the District's Wetland Management Program continues to incorporate a range of wetland management activities in accordance with Massachusetts General Laws Chapter 252, in compliance with established federal guidelines and in coordination with local Conservation Commissions and municipal officials. (Whenever possible the District participates in larger scale permitted projects to incorporate mosquito control interests through developed and time tested partnerhsips). The objectives of the District's Wetlands Management Program are to abate mosquito populations, decrease potential mosquito larval habitat and reduce insecticide applications as part of its integrated pest management, (IPM) strategy. The District offers both mechanized and manual strategies for fresh and salt water habitats whenever possible.

Fresh water activities include small scale ditch maintenance (pre-existing ditches), problem beaver management as well as fresh water restoration which aims to improve flow, reduce flooding and enhance predator access and habitat. The salt water program includes selective salt marsh ditch maintenance (pre-existing ditches) and salt marsh restoration which aims to improve tidal hydrology and enhance predator access and refugia. The District is a strong advocate for encouraging partnerships with other local, state and federal agencies that incorporate mosquito control activities while simultaneously improving the ecological integrity of fresh and salt water wetlands.

Policy and Procedure for Mechanized Wetland Management
Revised January 7, 2011

Introduction:
Although Mosquito Control Districts are considered state agencies, they are unique in the fact that they are directly accountable to member municipalities. As such, the needs and concerns of participating communities drive operational policy and strategies. For several years now our program has been in transition from what once was considered a primarily nuisance mosquito control program, to a primarily public health based program. Transmission and transplantation of world-wide mosquito-borne viruses to the United States is on the increase. West Nile virus (WNV) is now endemic to northeast Massachusetts. And since 2004, Eastern Equine Encephalitis virus (EEEV) has a presence here as well. In response, the District has enhanced its Adult Mosquito Surveillance Program. Warmer weather trends have also contributed to an increase in significant virus activity beyond the traditional "season". This results in extending control operations by about two months annually. The extent of the District's Wetland Management Program capacity has also been restricted by ever tightening regulations for operating in aquatic habitats. This problem is further compounded by an increase in site complexity as aging infrastructure, lack of maintenance and decreased funding for DPWs contribute to long term neglect of drainage statewide. Increased demands on

the District's resources have limited the District's availability and ability to conduct mechanized and manual wetlands management, i.e. ditch maintenance, as well as the ability of the District to fund these operations through standard member municipality annual assessment. Water management expenses have increased considerably; purchases of specialty equipment and associated maintenance and fuel costs fluctuate dramatically.

Site Specific Appropriation:
In some cases, the District may propose mechanized wetland management projects that necessitate a request for member municipality funding by means of separate and additional appropriation. Though the District understands that this may be a burden to some communities, project solutions will be proposed which consider as many non-funded activities as possible. In order to ensure equal opportunity for each member municipality projects of this type will be considered by the following petition process only.

Petition:
The District operates under the authority of Chapter 252 of the General Laws of the Commonwealth of Massachusetts. To be consistent with the provisions of Chapter 252 and because of reasons described above, wetlands management projects by means of specialized low ground pressure equipment will be considered by site specific petition only. A petition is simply a brief written request from a municipality's Petitioning Body requesting District investigation into a site specific ditch maintenance project or particular location. A municipality may petition for one project at a time and no other petitions will be considered from that municipality until the District deems that project complete.

Petitioning Body:
In an effort to avoid confusion municipalities should consider designating a petitioning body. In the event a municipality wishes to change their designated petitioning body they may do so once annually. Changes should be made at the time of the annual review of each municipality's Best Management Practice Plan (BMP), usually around the end of March or first of April. The District suggests that the local Board of Health, (BOH) is the most appropriate designee. In the event a municipality does not designate a petitioning body, the District will default to the BOH as the petitioning body.

Wetlands Management Proposal:
Once a petition is received by the District a site number will be issued and we will begin an evaluation process. The District will make recommendations to the Petitioning Body regarding wetlands management strategies for the petitioned site. If necessary, the District will develop a site specific proposal outlining the proposed project including but not limited to a site description, site history, scope of services and a "not to exceed" projected cost for implementing said project. The proposal will be submitted to the Petitioning Body for distribution to other appropriate municipal authorities for review, comments and approval indicating the acceptance of the terms and conditions of said project as put forth in the Proposal before implementation of any such project will

commence. All wetland management projects will be conducted in accordance with Massachusetts General Law Chapter 252, established federal guidelines and in coordination with local Conservation Commission and municipal officials.

FRESH WATER

The District has evolved its wetland management activities over the years to reflect the most effective and environmentally sensitive best management practices (BMPs). These BMPs are based on the accumulation of years of lessons learned in the field, suggestions provided by regulatory representatives and others in the professional industry, current trends, evolving equipment sophistication, and increased knowledge of environmental response. The District followed recommendations outlined in its own Standards for Ditch Maintenance for years. Since the latest GEIR update it now follows the recommendations outlined in the "Massachusetts Best Management Practices and Guidance for Freshwater Mosquito Control" and "Mechanized Wetland Management Activity Post Monitoring Guidelines" as applicable.

Problem Beaver Management

Policy and Procedure for Problem Beaver Management

(Originally an amendment to the District's Policy and Procedures for Mechanized Ditch Maintenance, Revised: 01/07/04, 02/23/05, 11/08/05 and 01-06-2011)

Introduction:

Since the adoption of the anti-trapping ballot referendum in 1996, the beaver population in Massachusetts has nearly tripled. Waterways subject to beaver activity are often altered from free flowing systems to large, slow or no flow systems. As a result, many areas adjacent to wetlands have now become flooded, resulting in the potential of increased breeding habitat for mosquitoes. The District established a pilot program to investigate the relationship between mosquito breeding habitat and beaver habitat; their potential impacts on increased mosquito populations and mosquito borne viruses and their relevance to human populations.

Observations revealed that in many instances beaver active waterways were not of tremendous concern in terms of mosquito development. Water depths typically increase with beaver presence and can promote populations of mosquito predators. In some cases however, local topography supports habitat that is more suitable for mosquito development and likely increases prevalence for flooding of adjacent areas which can be more prone to larval activity. Careful examination of each site is warranted. The District will continue to investigate the correlations between beaver, mosquito and predator.

Petition:

Municipalities may petition the District to investigate locations associated with beaver activity in accordance with the District's Policy and Procedures for Wetlands Management. Upon determination that mosquito breeding or a potential for mosquito breeding exists, the options listed below may be recommended to the Petitioning Body (PB). All wetland management activities conducted on beaver impacted wetlands and

waterways will be performed in full cooperation with the Massachusetts Division of Fisheries and Wildlife as well as in partnership with the petitioning municipality.

A. Trapping: Removal of beavers from an area will occur prior to beginning any wetland management activity. Trapping can be done by certified District personnel.

B. Ditch Maintenance: Dams, dikes, blockages, etc. may be cleared from existing ditches to manage the level of water within a wetland or waterway.

C. Water-Flow Devices: In certain circumstances, depending on the site, water-flow devices may be installed to maintain a desired level of water within a wetland or waterway while still allowing beavers to remain in the system.

SALT WATER
In lieu of Coastal Zone Management's decision to issue a negative determination for federal consistency on Open Marsh Water Management, the District's federal permit renewal application was denied in 2008 and we have begun evaluating sites for selective salt marsh ditch maintenance. Parameters for selecting sites include mosquito prone areas that are difficult to treat by helicopter (see Aerial Salt Marsh Larviciding Program) and/or that are subject to salt marsh haying. Reclamation of ditches in hayed areas promotes drainage and firmer ground conditions, alleviating potentially damaging operation of equipment which lends itself to creation of larval habitat.

The District will also be working to strengthen restoration project partnerships which promote coastal resiliency and wetland suatinability in lieu of climate change and sea level rise.

Please check off all that apply INLAND DITCH MAINTENANCE:

☒ **Hand tools**
☒ **Mechanized equipment**
☐ **Other (please list):**
Comments: The District maintains a fleet of highly specialized, custom fabricated, low ground pressure equipment.

Please check off all that apply SALTMARSH DITCH MAINTENANCE:

☒ **Hand cleaning**
☒ **Mechanized cleaning**
☐ **Other (please list):**
Comments: _____

Please give an estimate of cumulative length of ditches maintained from the list above **INLAND**:

Hand cleaning 4,241 linear feet
Mechanized cleaning : 534 linear feet
Other (please list):

Comments: _____

Please give an estimate of cumulative length of ditches maintained from the list above **SALTMARSH**:

Hand cleaning
Mechanized cleaning: 209 linear feet
Other (please list):

What time frame during the year is this method employed? Year round and dependent on site specific environmental considerations and conditions.

Comments: _____

***Please attach a link to maps of ditch maintenance areas if possible.**

MONITORING (Measures of Efficacy)

Please describe monitoring efforts for each of the following:

Aerial Larvicide – wetlands:

FRESH WATER

Pre-treatment Surveillance: The Operations Manager will assign Field Technicians to designated areas. Field Technicians observe fresh water wetland conditions relating to flooding scope and rainfall events. Field Technicians survey potential larval development habitat dipping randomly as needed to determine location, developmental stage and extent of the mosquito brood. Field Technicians establish 10 fully recoverable dip stations (RDS) for their designated area. Prior to application each RDS is sampled. Larval stage and number are recorded on the Aerial Larviciding Survey – Pre Treatment form.

Post-treatment Surveillance: Mosquito larval sites targeted during the application will be surveyed 24 hours after the application. Numerous random dip samples are taken as is necessary to determine the overall efficacy of the application. Previously sampled fully

recoverable dip stations are revisited and count numbers recorded for comparison with pre-treatment survey.

SALT WATER

Pre Treatment Surveillance: The Operations Manager will assign Field Technicians to designated areas. Field Technicians observe salt marsh conditions relating to tidal flooding and rainfall events. Field Technicians survey potential larval development habitat dipping randomly as needed to determine location, developmental stage and extent of the mosquito brood. Field Technicians establish 10 fully recoverable dip stations (RDS) for their designated area. Prior to application each RDS is sampled. Larval stage and number are recorded on the Aerial Larviciding Survey – Pre Treatment form.
Post Treatment Surveillance: Field Technicians will survey sprayed sites after 24 hours post application. Field Technicians randomly dip as needed to determine the overall efficacy of the application. The 10 pre-selected RDS are sampled. Larval stages and number of dead/live/moribund are recorded on the Aerial Larviciding Survey – Post Treatment form for efficacy comparisons.

Two Biological materials Vectobac 12AS and Vectobac G were used as larvicides on the Salt Marsh. Vectobac 12AS, a liquid BTI was the material used in our Aerial applications with an efficacy rate average of 98.6% using Pre and Post application data from various site locations. Vectobac G, a dry granular form of BTI was used for hand treatments with an efficacy of 100%.

Larvicide – catch basins: Pre treatment Inspection: Field Technicians inspect each basin for condition; presence of water, flowing water, ability to hold water, and ability to dry back before treatment. Field Technicians use their best professional judgment when determining whether to treat a basin or not.

Formal efficacy testing was not conducted in 2013, however, spot checking of catch basins was conducted to determine efficacy throughout the season.

Larvicide-hand/small area: Data was collected by District technicians prior to treating sites containing mosquito larvae.

Pre-Treatment Inspection: Field Technicians sample for immature aquatic mosquito stages by taking 10 dips of water with a standard white 250 – 300 ml dipper. Field Technicians are trained to identify and select the most suitable mosquito habitat for each dip location. All immature mosquito stages are counted for each dip and recorded on a Larviciding Report (including location). A maximum of thirty (30) larvae/pupae per dip are counted. Ultimately Field Technician uses their best professional judgment to determine whether or not a site will be treated but many factors are considered including; # of mosquitoes, stage of mosquito, amount of water, water temperature, time of season, possibility of site to dry back prior to emergence and anticipated weather conditions at the site.

Ground ULV Adulticide: **Efficacy tests for adulticiding products were not conducted in 2013 due to virus activity in the District, necessitating extensive intervention efforts.**

Source Reduction: **As applicable in accordance with the "Mechanized Wetland Management Activity Post Monitoring Guidelines"**

Open Marsh Water Management: **N/A**

Other (please list): **N/A**

Provide or list standard steps, criterion, or protocols regarding the documentation of efficacy, (pre and post data) and resistance testing (if any): **see above**

OPEN MARSH WATER MANAGEMENT

Do you have an OMWM program? No

If yes, please describe:

Please give an estimate of total square feet or acreage:

What time frame during the year is this method employed?

Comments: OMWM Update:
In 2008 the District was denied the renewal of its federal permit to conduct Open Marsh Water Management, (OMWM) for the first time since the programs inception in 1983, marking the end of an era for long term control of salt marsh mosquitoes. Over those 20 + years the District was able to evaluate over 140 sites and complete approximately 70 OMWM sites. At issue were the original Standards for Open Marsh Water Management. The scientific community felt the Standards were insufficiently rigorous. The District worked diligently to resolve the issue and helped develop a new Standard. However, the new Standards call for extensive monitoring beyond the resources of this District's funding. The District is considering re-applying for its OMWM permit at a later date, keeping in mind that separate funding would be essential for project implementation.

History:

The following information comes directly from the District's "Fact Sheet 10: Open Marsh Water Management" revised 1-07-2011.

Open Marsh Water Management was originally developed in New Jersey as an environmentally sensitive alternative to grid ditching salt marshes and has also been in

1982; a collaborative effort with mosquito control, the Town of Rowley Massachusetts, the Manomet Bird Observatory and the Massachusetts Audubon Society. Based upon positive results demonstrated in this study a program was developed incorporating Standards based on the principles established in New Jersey and the Mid Atlantic States but specific to the needs of salt marshes in New England.

The objective of OMWM is to abate mosquito populations and reduce the need for insecticides by enhancing the tidal food web and providing refugia for predatory fish within previously ditched, altered or degraded salt marshes. The OMWM Program is implemented in strict accordance to the Standards for OMWM; a step by step guide defining proper methodology for personnel to follow including data collection, timing, and types of alteration. After a site is monitored the data is analyzed and if necessary a site plan is developed with specific alterations that address mosquito concerns specific to the location. OMWM uses site specific alterations that enhance existing characteristics and/or creates new features such as ponds, pools and pans. These improved habitats not only serve as refugia for mosquito eating fish but also offer water fowl and wading shore bird improved feeding opportunities. Installation of shallow radial ditch connectors to improve predatory fish movement provides direct access to identified mosquito larval habitat on the marsh's surface. Designed alterations are implemented by customized low ground pressure equipment which is environmentally sensitive and ensures minimal impact to the salt marsh substrate.

***Please attach a link to maps of OMWM areas if possible.**

ADULT MOSQUITO SURVEILLANCE

Do you have an adult mosquito surveillance program? YES

Please list the number (not location) of MDPH traps in your service area: N/A

Please check off all the types of surveillance that apply to your program:

☒ Gravid traps	
☒ Resting boxes	
☐ CDC light traps	☐ Canopy
☒ CDC light traps w/CO_2	☐ Canopy
☐ ABC light traps	☐ Canopy
☐ ABC light traps w/CO_2	☐ Canopy
☐ NJ light traps	☐ Canopy
☒ NJ light traps w/CO_2	☐ Canopy

Other (please describe): **New Jersey Light traps baited with CO2 instead of LIGHT.**

Please describe the purpose of this program:

To monitor species, both nuisance but especially vector species for 1) management of populations, & 2) testing for disease arboviruses.

Do you maintain long-term trap sites in any of your areas? **YES**

If yes, please describe how you chose these long-term sites.
Proximity to population centers; access to electrical power, & security of trap sites

From Introduction to "Best Managament Plans":
"Our focus is to collect a representative sample of mosquitoes in a city or town. We collect mosquitoes in areas where substantial portions of municipality residents live because we need to determine whether local mosquitoes may be transmitting viruses dangerous to people. Human impact on natural mosquito-breeding habitats may dramatically lower their populations but, if there is an unusual rise in populations in residential areas, then you know something indeed is going wrong!"

Please check off the species of concern in your service area:

- ☐ *Ae. albopictus*
- ☒ *Ae. cinereus*
- ☒ *Ae. vexans*
- ☒ *An. punctipennis*
- ☒ *An. quadrimaculatus*
- ☒ *Cq. perturbans*
- ☒ *Cx. pipiens*
- ☒ *Cx. restuans*
- ☒ *Cx. salinarius*
- ☒ *Cs. melanura*
- ☒ *Cs. morsitans*
- ☐ *Oc. abserratus*
- ☒ *Oc. canadensis*
- ☒ *Oc. cantator*
- ☒ *Oc. excrucians*
- ☐ *Oc. fitchii*
- ☒ *Oc. j. japonicus*
- ☐ *Oc. punctor*
- ☒ *Oc. sollicitans*
- ☒ *Oc. stimulans*
- ☒ *Oc. taeniorhynchus*
- ☒ *Oc. triseriatus*
- ☒ *Oc. trivittatus*
- ☒ *Ps. ferox*
- ☐ *Ur. sapphirina*

☐ Other (please list):

Do you participate in the MDPH Arboviral Surveillance program? **YES**

How many pools did you submit this year? **1315 pools submitted**

Please check off the arboviruses found in your area **this** year:

- ☒ West Nile Virus
- ☒ Eastern Equine Encephalitis
- ☐ Other Please list:

Did the above listed diseases (viruses) cause human or horse illnesses? **YES**

Please explain:
EEEV: Horse in West Peabody & Alpaca in Newbury (Byfield) in 2009: Human cases (& fatalities) in Amesbury & Georgetown AND Horse in Georgetown & Horse in Essex (Essex is not District member) in 2012

WNV - Human case in Revere in 2010, Human case in Peabody in 2011, three human cases in 2013 (Revere, Salem, & Haverhill)

From "**2013 Vector Management Plan**" (Note: Figures, tables, and references cited not included; contact our office for a copy of this plan with all figures, tables, & references):

Introduction:
The U.S. Centers for Disease Control and Prevention (CDC) declared that the 1999 introduction of West Nile Virus (WNV) into the United States tested the preparedness of public health agencies to identify and respond quickly to outbreaks of vector-borne disease. The CDC concluded that "mosquito control is the most effective way to prevent transmission of West Nile" and that "the most effective and economical way to control mosquitoes is…through locally funded abatement programs"(1).

Unique among state agencies are Massachusetts Mosquito Control Projects and Districts (MCP/D) in that they are accountable directly to subscribing member communities. It is the needs and concerns of member communities that drive MCP/D operational policy and strategies. This has been the operational “mantra” of the Northeast Massachusetts Mosquito Control District for twenty years. There are currently thirty-two cities and towns that subscribe to the District.

As the needs of our communities change and evolve, so have the services we provide. With the invasion and establishments of new arthropod-borne viruses (“arboviruses”) in our communities since 2000, we have transformed our primary operational strategy from control of nuisance mosquito to protecting public health. The World Health Organization’s (WHO) defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”(2). Thus, it is not an exaggeration to say that high numbers of mosquitoes is not just a nuisance, but an issue of health! Furthermore, the Federal Insecticide, Fungicide and Rodenticide Act defines “vector” as “any organism capable of transmitting the causative agent of human disease or capable of producing human discomfort or injury, including mosquitoes…”(3). Therefore, by this definition, all mosquitoes are potential vectors and all mosquito control activities are conducted in the interest of public health.

West Nile virus first appeared in Essex County in 2000 and since then, almost 200 detections of this virus have been recorded in tested samples of county mosquitoes; there have been five cases of serious virus-generated illness requiring hospitalization in county residents. Eastern Equine Encephalitis virus, once a rarity north of Boston, has

been detected five of the past nine years in the District and it claimed its first two District mortalities in 2012 (Georgetown & Amesbury). Some may contend that number of fatalities caused by arboviruses is too small to warrant attention. However, with the knowledge, personnel, and technology readily available at a relatively small cost, it is worth the effort to protect the lives of our more vulnerable citizens engaged in innocent everyday outdoor activities. It has been documented (4) that for the protection of the public's health, the costs for mosquito control and its emphasis on prevention of disease far outweighs the costs (and suffering) of treatment of the sick and distress.

The purpose of this Vector Management Plan (VMP), updated for 2013, is to summarize our mosquito control and arbovirus surveillance strategies. This 2013 VMP also outlines our specific responses to arboviruses, and how our limited resources will be directed effectively and efficiently toward implementing these responses.

Regional Adult Mosquito Surveillance:
The District operates its surveillance of mosquito populations based on protocols established by the CDC and Massachusetts Department of Public Health (MDPH). The District maintains thirty-four historical trapping stations (HTS) across the District at the same locations for an entire season every year. There is at least one HTS in each subscribing municipality and each HTS has two different surveillance traps (see Figure 1). The stations are usually located at a secure municipal-owned facility, with access to electrical power, in the general vicinity of major population centers. The traps operate from early May through the beginning of October, running twice a week with each collection cycle lasting twenty-four hours. Mosquito-filled trapping receptacles are retrieved by District personnel at the end of each collection cycle and all collected mosquitoes are identified and tallied. Fifty-one species of mosquitoes are known to breed, develop, and survive in Massachusetts.

The first of the two traps is the CO2-baited "New Jersey trap" (Figure 2). To attract mosquitoes, carbon-dioxide (the same chemical as in our exhaled breath) is released from a pressurized cylinder into hoses located at the top of the trap. The mosquitoes approach the hose's opening, then drawn inside the cylinder by an internal fan, and are forced into a hanging container or "basket" found below. With this trap, the principal human-biting and disease-carrying species in a community are identified and monitored. Because the traps are placed at the same locations every year, population trends can be studied and compared between years, as well as during the year.

The other is the Reiter-Cummings gravid trap (Figure 3), our principal West Nile virus detection tool. This trap is designed to attract container-breeding mosquitoes in which two of these, Culex pipiens and Cx. restuans are the key carriers of West Nile virus (hereafter, "WNV") in the District. This trap is baited with rank-smelling aged organic material-filled water, held in a pan below the trap, to attract female mosquitoes. 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 inside. The contents are collected, identified, tallied, and WNV-vector species are separated and sent to the state labs to be tested for the presence of viruses.

When necessary, additional battery-operated gravid traps are deployed in areas with disturbing Culex population trends and in communities with recent histories of WNV. Cx. pipiens & Cx. restuans breed proficiently in heavily urbanized areas so additional gravid traps will be set on an “as need” basis in these more congested urbanize areas. In the short term, these additional trappings provide us with more data on Culex population distributions and densities in these communities; over the long term, better historical information is obtained to study trends on vector populations and viral activity. See Figure 4 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-carrying vector, resting boxes are not placed at the HTS. Instead, resting boxes are situated in the vicinity of cedar and maple swamps where Culiseta melanura (Figure 5) resides. Cs. melanura is the principal vector of Eastern Equine Encephalitis virus (hereafter, EEEV). Resting boxes are designed to simulate the tree holes and cavities these mosquitoes normally rest in during the day after they feed on blood. Resting boxes (Figure 6) are visited twice weekly from June through the end of September; the contents are collected, identified, tallied, and Cs. melanura, and the closely related Cs. morsitans, are separated to be later tested for the presence of viruses.

An “epicenter” of EEEV activity has developed in southeastern New Hampshire and now monitoring for EEEV-vectors has become another component of our surveillance program. Since 2005, we have maintained resting box stations in fixed historic locations in District communities bordering southeastern New Hampshire. These include Methuen, Haverhill, Merrimac, Amesbury, and Salisbury; ten stations (two in each town) are located along this “line” with eight boxes in each station. Since 2006, resting box stations have also been set in the Boxford, Topsfield, Hamilton, Newbury, and Wenham in response to EEEV infections in mosquitoes, horses, alpacas, or humans in these communities. New stations may be established in Georgetown in 2013. 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, as demonstrated this past year.

Whereas Cs. melanura rarely bites humans, they bite and infect local birds which, in turn serve as blood-meal sources for other mosquito species. These other EEEV-infected species can then bite humans. These additional species with the potential of infecting humans are known as “bridge vectors”. To determine whether infected bridge vectors are present, portable CDC-CO2 traps (Figure 7) are placed at resting boxes locations when infected Cs. melanura mosquitoes have been collected. These traps collect other species which upon identification, are tested. Knowing the “infection status” of bridge vectors in EEEV-known habitats can result in more effective targeted adulticiding responses.

Risk Communications and Public Relations:
Dissemination of mosquito and arbovirus information is paramount to 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. To that end, the District continues to improve its communication regarding mosquito species, potential arboviral threats, and details of larviciding and adulticiding operations.

At the end of every winter, the District sends detailed “Best Management Practice Plans” (BMP’s) to each District subscribing municipality (Figure 8). 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. Every spring, the District conducts a “Mosquito/Arbovirus Surveillance Workshop” (at Endicott Park in Danvers; Figure 9), for health agents and Boards of Health members of District communities. This workshop informs on the potential mosquito and arboviral threats and how the District plans to combat these threats. The District operates a website (http://www.northeastmassmosquito.com; Figure 10) with all relevant information on mosquitoes, arboviruses, and operations. Also, when necessary, “District Bulletins” (Figure 11) are prepared periodically and sent electronically to all subscribing Boards of Health describing current and potential mosquito and arboviral issues and warning, as well as current control operations. And finally, our phone lines remains open at all times and while we are often unable to respond immediately, being that we are all in the field, we do return all calls!

Emergent Exotic and Recent Immigrant Mosquito Species:
The possibility of exotic mosquito species becoming established in our area cannot be dismissed. Thus, as we monitor our local mosquitoes, we are sensitive to the appearance of new species. Within the past ten years, we have seen the appearance and rapid spread of an exotic species, Aëdes japonicus, the "Japanese Rock Pool Mosquito", throughout our District (Figure 12). 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.

Another competent disease vector and notorious daytime human-biting species is Aëdes albopictus, the “Asian Tiger Mosquito” (Figure 13); it could 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 (5) through the importation of used automobile tires. Discarded water-filled tires simulate tree-holes where this species tends to lay its eggs. It was first found in the U.S. in Houston in 1985 and has spread nationwide as far north as Connecticut; it has become the dominant mosquito species in New Jersey. Aë. albopictus is a great concern to public health because of its ability to transmit many arboviruses that cause serious disease in humans including Chikungunya and Dengue (discussed below). Aë. albopictus has been collected in Bristol County on repeated occasions throughout the 2011 and 2012 (6) in tire-collection facilities. It may soon become established there and spread throughout eastern Massachusetts.

In 2007, District personnel collected specimens believed to be Aë. albopictus and attempts were made in 2008 to collect additional specimens and locate breeding sites. Towards this endeavor, the District deployed a new type of surveillance trap, "BG Sentinel trap" to enhance collection. However, no Aë. albopictus were collected. (In fact, it was these same BGS traps that were loaned to Bristol County MCP in which they collected their Aë. albopictus!) Nonetheless, we continue surveying for Aë. albopictus in facilities that hold used/discarded tires.

Virus Testing:
Specimens of the principal WNV- and EEEV-vectors from our trap collections are sent weekly to Arbovirus Surveillance Laboratories of the Department of Public Health in Jamaica Plain in Boston, to be tested for the presence of encephalitis viruses. On average, 50 pools of mosquitoes are sent each week to the State Labs. We are currently investigating the options of testing other common mosquito species for all arboviruses reported in New England. The arbovirus laboratory of the Connecticut Agricultural Experiment Station in New Haven CT have the facilities and experience to engage in this enhanced testing if we wish to contract them.

Emergent Virus:
The threat of mosquito-borne disease is on the rise world-wide (7, 8). The potential for invasion, transmission, and establishment of new arboviruses in the United States is on the increase. The possible 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.

The most recent new arboviral concern is Dengue virus (DENV). 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 when a New York resident visiting Key West, Florida contracted Dengue in September 2009. By December 2010, there have been 55 confirmed cases of locally-acquired Dengue in Key West (9). Six cases of locally-acquired Dengue were confirmed in Florida for 2011 (10) and four more in 2012. Containment of viral transmission is not easily facilitated when at the same time there are 133 imported cases of Dengue (infections of patients when traveling outside the US) in 2011 and 100 more in 2012. With the vectors readily present in Florida, Aë. aegypti and Aë. albopictus, it will not take much for the virus to be easily transmitted from an imported case to a resident (Figure 14).

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 (11). While Dengue is a disease of the tropics to the sub-tropics, the virus could mutate to a form that can be easily acquired and transmitted by temperate mosquitoes. If Aë. albopictus becomes established in Massachusetts, it can acquire DENV from an infected returning traveler, and transmit the virus locally, causing a public health havoc. See Figure 15 for

recent records of imported cases of Dengue in New England. Symptoms of Dengue symptoms include high fever, severe headache, severe pain behind the eyes, joint pain, muscle and bone pain, rash, and mild bleeding (12). A more dangerous manifestation of this disease is Dengue hemorrhagic fever, which after the fever declines, persistent vomiting, severe abdominal pain, and difficulty in breathing may ensue. This can be followed by excessive bleeding into the body cavities leading to circulatory failure and shock, followed by death. There is no specific medication for prevention or treatment of a Dengue infection.

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 (7, 8). 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 (7,8).

After Dengue, the arboviral disease that can become most easily established in the U.S. is Chikungunya. While Chikungunya is rarely fatal, it has the potential to infect large numbers of people very quickly. It is a debilitating illness, causing excessive and prolonged fatigue and extreme pain in joints lasting up to several weeks (13). 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 (14). There is still a Chikungunya pandemic in South Asia and along the Indian Ocean basin (with 2 million people infected).

Even more alarming was the outbreak of Chikungunya in northern Italy in September of 2007 (with over 200 cases); the Italian epidemic is the first known outbreak of this virus outside the tropics (15). The Chikungunya virus (CHIKV) was vectored by a new strain of Aë. albopictus adapted to competently transmit CHIKV. Since 2006, there have been over 100 imported cases of Chikungunya in the U.S. (8) demonstrating the potential for imported cases to serve as sources of CHIKV for domestic Aë. albopictus to acquire and transmit. Since New Jersey is experiencing an “explosion” of Aë. albopictus, with a large percentage of residents who travel to Chikungunya-endemic regions, do not be surprised if you read in the near future that a locally-acquired Chikungunya outbreak has broken out in New Jersey!

Rift Valley fever virus (RVFV) causes a fast-developing (“acute”) fever that affects livestock animals and humans (16). Whereas RVF is devastating to livestock, the degree of virulence will vary among humans. Many infected persons will not exhibit symptoms, but others may develop fever, generalized weakness, back pain, dizziness and extreme weight loss. Some will manifest liver abnormalities while a small percentage may suffer hemorrhagic fever (17). Approximately 1% to 10% of affected patients may have some permanent vision loss. Approximately 1% of RVF-infected humans die of the disease. 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 has historically been confined primarily in eastern and southern Africa; there was a recent outbreak in South Africa with 172 human cases and 15 deaths (8). 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 (Aëdes species). While no mosquitoes have been found in the U.S. infected with RVFV, common species such as Aë. vexans and Cx. pipiens, have demonstrated the capacity to transmit RVFV (18, 19).

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 between 30,000 to 50,000 cases annually; children are most at risk to infection (19). Al-though its principal vectors are not found in the U.S., Aë. japonicus has been shown to transmit JEV (20) and as discussed earlier, this species has become prevalent in Massachusetts.

We will continue to monitor for these potential threats. Our partnerships with the State Labs and Connecticut Agricultural Experiment Station and affiliations with mosquito control associations provide us with the necessary expertise to assist us in developing and implementing intervention strategies if and when required.

Endemic virus: 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 almost 37,000 persons in the United States (Table 1; Table 2 shows WNV cases/ fatalities in Massachusetts). Whereas it is estimated that about 80% of all West Nile virus infections in humans are not symptomatic, approximately 20% of infections are manifested as some form of fever; less than 1% of the remaining infections display varying degrees of serious neurological ailments. These neurological diseases include acute febrile paralysis, encephalitis, and meningitis resulting in death to about 9% of all neurological cases. Of the almost 16,000 neuroinvasive cases since 1999, there have almost 1,500 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.

WNV, primarily an avian virus, has been far deadlier to birds with dramatic declines in seven species (22) and many avian populations have yet to recover.

It was thought that WNV-associated neurological ailments were short-lived and affected only a small percentage of those infected. However, recent studies suggest that neurological disorders may be more prolonged and serious, affecting more victims than originally thought (23, 24). Another recent study has shown that renal disease can be

manifested in patients several years after infection with WNV and whom were have thought to have recovered (25).

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", "disappear into the landscape", and not appear again for several years or decades, in the manner exhibited historically by EEEV. So you can imagine the surprise when the numbers of WNV-infected mosquito samples ("pools") in Massachusetts began to increase in 2010 and continued to increase further in 2011 and 2012 (Table 3). There were human infections in the District in 2010 and 2011 (Revere and Peabody) manifested as meningoencephalitis and meningitis respectively. Both patients "recovered", but the extent of their recovery has not been disclosed.

Mosquitoes of the species Culex pipiens are primarily responsible for the transmission of WNV to birds and humans in endemic areas in the northeast US (26); Cx. restuans is also responsible for the virus's spread, but this species almost exclusively bites birds. These species develop in "high-organic content" water that accumulate in containers and large water-holding structures which are in far greater abundance in urbanized areas. Therefore, the District has developed strategies to combat the vector mosquitoes by first attacking where they "breed" to reduce both adult emergence and disrupt the bird-to-mosquito-to-bird WNV cycle. If efforts to reduce/eliminate larvae are not fully successful, then operations to reduce adult populations during periods of high WNV-risk to humans are recommended and effected. These strategies are outlined below:

Catch Basin Treatments:
Spraying against infected adult mosquitoes is the short-term approach for immediate risk reduction. However, the preferred long-term and more cost-effective 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 in the District is in the estimated 80,000 catch basins (Figure 16). The basins are well utilized for breeding by the two principal urban Culex mosquitoes, Cx. pipiens and Cx. restuans. These species 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).

Treating of catch basins consist of the application 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 and 92% of the species breeding in the basins were Cx. pipiens/ restuans (27). It is preferred that basins be treated in the late spring or early summer to

maximize the effects of the larvicidal agents. However, this is not always possible in all towns. Applications of larvicides are often delayed until basins are emptied of debris by municipalities. Basins filled with organic debris will diminish the effect of the larvicides to the extent they may be rendered useless.

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. Fewer Culex adults transmitting virus translates to reduced risk of WNV infection to District residents. Early-season basin-treatment strategy will continue as best as possible in 2013. 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 2013 will be prioritized as follows. First to be treated will be those basins in District municipalities directly north of Boston and surrounding Lawrence. These two cities are suspected of being the prime WNV foci (plural of "focus") in northeast Massachusetts. The District municipalities adjacent to these two cities had the most intense WNV activity last year and possess the most habitats that favor the breeding of the vector species; treatments of basins in these communities will begin in May. Basins will be next treated in Ipswich and surrounding towns that had WNV detected in 2012. Time, availability of material, and extent of other District operations will determine the remainder of basins to 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 do not and cannot penalize any persons or agencies for providing breeding habitats. We are not a regulatory agency. 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. This is evident by a study conducted in California in 2007 in which there was a 276% increase in the number of human WNV cases in association with a 300% increase in home foreclosures (28). 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.

In recent years we have received requests from Boards of Health to inspect abandoned properties (Figure 22). Given the current economic climate and likelihood of properties still being abandoned, the District in 2014 will continue to approach aggressively to property inspections. In the course of our routine activities, we will be "on the lookout" and inspect and report on the status of 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 to WNV infections, the District may recommend selective and targeted adulticiding applications to reduce Culex populations when WNV-infected mosquitoes are discovered. The District uses "Ultra Low Volume" (ULV) for ground adulticiding applications which dispense minute amounts of pesticides over a large area (Figure 23). Due to the nature of the pesticides employed, ground-based adulticiding is done at night. The District may recommend a selected or "targeted" application within a municipality (several streets or a neighborhood) based on the following criteria: two or more WNV-mosquito isolations in close proximity; 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 adulticiding operations be commenced. These operations would only be recommended only during high WNV-transmission periods (late July through September) in communities with historical WNV activity.

Ground Adulticiding Exemption:
Following what was begun in 2011, we are making the following request to all Boards of Health. Residents who want their property excluded from all pesticide applications (including larviciding as well as adulticiding) 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. No exclusions will be allowed after March 1st nor will property owners be allowed to make such a request by telephone. The deadline of Marsh 1st is to insure that residents requesting exemptions are not subjected to springtime larviciding operations, as well as truck-spraying later in the season if adulticiding is mandated. There is no option of selecting what control operations are exempted.

Truck-spraying is done routinely in many communities without issue and has been so for decades. However, in communities that only allow spraying as a virus-intervention measure, it has become "a new event" often causing undue concern among residents in those communities. The announcement of spraying often triggers responses from residents unfamiliar with the process, resulting in requests to exclude their property. The abundance of calls made prior to an area-wide operation often causes an administrative nightmare in trying to keep track of all the no-spray requests. Calls would

continue sometimes up to the minute the spraying commences, making the logistics in effecting the operation extremely difficult.

The District anticipates that those Boards of Health of communities that allow virus-intervention-only truck-sprays agree that this policy change is a necessary and prudent step. If the Boards agree on this change, the District recommends that each Board hold a public hearing prior to March 1 to announce their intention to adopt such a policy and give those residents who wish to legally exclude their property ample notice to do so.

Barrier Treatment:
While ULV is a cost-effective means of reducing mosquito populations on a large scale, it only affects those mosquitoes active at the time of the application; repeated applications are sometimes necessary to sustain population reduction. 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 needed.

Special Circumstance: Droughts:

During intense drought seasons, "all bets are off" regarding normal development and distributions of Cx. pipiens/restuans. Prolonged droughts together with periods of intense heat result in "explosions" of these species, as was seen in our District in 2010. 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.

What is going on? Whereas the availability of standing water diminishes during droughts and most mosquito species suffers 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 of "high organic content". Artificial containers filled with such water are catch basins, as mentioned earlier. You would think that that these basins in urbanized areas become dry during a drought. However, people continue to water their 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, on private properties, we may not know of their existence and thus, they remain untreated and become a continual source of Culex mosquitoes throughout the season.

Cx. pipiens/restuans mosquitoes do not breed in great abundance in wetlands and definitely do not in any 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. While mosquitoes do not breed in moving water, these bodies gradually slow and decrease in volume during droughts. 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.

Any large body of water dries, containers and tires dumped into these bodies (as trash) when full of water now become exposed (Figure 26). Being filled with polluted water, these also become ideal breeding sites for Culex. Debris-filled empty holes and depressions (either naturally-occurring or artificial) can become filled with water in a sudden downpour and become instant breeding habitats for these species. What all this means is that breeding areas for "urbanized" Culex mosquitoes are always in abundance, even in the middle of the worst drought! Unfortunately, all these unexpected breeding areas cannot all be treated, even by mosquito control projects with un-limited 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 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. Research has been done looking at changes in local mosquito fauna (species diversity and populations) and results have been so far inconclusive. Butts (29, 30, 31) reported declines in populations and in some cases reduction in species diversity in beaver pond habitats in central New York State; Wilson (32) concluded that there was no evidence that the presence of beavers will increase overall mosquito populations in Connecticut however, their presence influenced what types of mosquitoes were present.

On the other hand, in Warren County New Jersey, steady increases in permanent- and flood- water mosquito species and populations have been noted since the appearance of a beaver dam and the subsequent flooding (33). Although sampling for mosquitoes in the "open water" of beaver ponds may not have demonstrated increases in mosquito populations, what has not been thoroughly explored is the role of "edge breeding", those areas subjected to periodic receding and re-flooding, together with dense aquatic vegetation found there. How inundated forests could become development sites for cryptic breeding EEEV vectors has not been investigated. Nor how the abundance of dead decaying trees in flooded forest swamp pools contribute to breeding of WNV vectors has not been studied either.

We will continue to monitor beaver pond habitats with the hope to identify whether and where arbovirus vectors may be taking advantage of these habitats to enhance their populations and improve their status as public health nemeses.

Endemic virus: Eastern Equine Encephalitis Virus

Introduction:
Prior to 2004 there were never serious concerns about Eastern Equine Encephalitis in Essex County. EEEV seemed to be restricted to southeast Massachusetts and its vector, the Cedar Swamp mosquito, Culiseta 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 was Cs. melanura ever collected here in any abundance. Then in 2004 and 2005 came reports of EEEV-infected mosquitoes, birds, horses, and humans from southeast New Hampshire, just over the border from Essex County. And the more EEEV that was reported in New Hampshire, the more the virus began to "spill over" into our District beginning in 2005 (Tables 4a & b). Infected mosquitoes were collected from one or more of our border towns annually from 2005 through 2009 (Figure 29). While no EEEV-infected mosquitoes were collected in 2010 and 2011, we believed that EEEV has become an endemic public health threat in our area. And our fears were realized in 2012 when EEEV was detected in seven municipalities, three of them never having reported with EEEV until last year. Furthermore, most of these detections were in towns at a distance away from the New Hampshire border. And, these infections were in mosquitoes whose numbers were lower than usual due to the summer-long drought.

EEE infections manifest symptoms similar to West Nile encephalitis and while the human infection rate is lower, the fatality rates are much higher, about 33%. Also, the recovery rates from EEE disease are longer and most often are incomplete when compare to recovery from West Nile-associated ailments. EEEV seems to attack the young as readily as the elderly unlike WNE which the elderly are far more susceptible (34).

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 (34). Like WNV, EEEV is an avian virus, transmitted from bird-to-bird principally by Cs. melanura. While Cs. melanura mosquitoes are primarily responsible the amplification of virus in bird populations, they typically do not bite humans. It is other mosquito species, with wider host preferences, when infected (after biting infected birds) can transmit EEEV to humans; these species, as discussed earlier, are termed "bridges vectors". 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.

Southeast Massachusetts, the original "hotbed" for EEEV activity in New England, continues to experience serious problems with EEEV. In 2010, the much-higher-than-normal detections in both enzootic and bridge vectors culminating in an aerial adulticiding application in August. In 2011, detections of virus in mosquitoes were elevated again, but the state elected not to order an aerial operation. As can be seen in Tables 4a and b, Southeastern Massachusetts exhibited record numbers of EEEV-infected mosquito pools as well as infected animals and human cases. Last year, the Department of Public Health deemed the EEEV threat more dangerous to the state's residents with at least eight different species of mosquitoes infected with EEEV. The state authorized two fixed-wing adulticidal air sprays over much of Bristol and Plymouth counties in July and August.

Whereas only WNV was encountered in the District in 2011, in 2012 both WNV and EEEV were detected in abundance and distribution (see Figure 27). The unprecedented District-wide viral activity resulted in extensive larvicidal and adulticidal responses to a degree also unprecedented. Sadly, there were two fatalities in the District caused by EEEV (in Georgetown and Amesbury). There were also two animal fatalities resulting from EEEV, both horses (Georgetown and Essex; Essex is not a subscribing municipality). Although it was suspected that WNV presence was going to be high due to the dry and hot summer experienced, the presence and spread of EEEV in the District was a greater surprise, being that EEEV-vector populations were unusually low and no EEEV was reported in southeastern New Hampshire for most of the summer.

The extremely low presence of floodwater mosquitoes in late summer may have been the principal reason why EEEV was not as prevalent in Essex County as compared to Plymouth and Bristol counties. These mosquitoes, principally Aëdes vexans and Aë. canadensis, are also notorious human-biting mosquitoes and can effectively transmit EEEV. Had their populations in Essex County achieved the levels found south of Boston, there would have been more human disease cases here!

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 2013 in several resting box sites that lower than usual populations of Cs. melanura can be found to transmit EEEV. 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 28 & 29). These habitats are in relative abundant in northeast MA, although they exist 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 batter 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 are limited at best. Therefore to reduce risk, adulticiding operations will be recommended to a municipality when the any one of following criteria are met: above average Cs. melanura populations; one EEEV detection in Cs. melanura mosquitoes; one EEEV isolations in horses; one human EEE cases. 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 infection risk level 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 (35). Fixed-winged aircraft would be employed to release adulticides over targeted areas. For this aerial application to be implemented, a consensus must be reached by the District, the State Reclamation and Mosquito Control Board (SRB), the Massachusetts Department of Health (MDPH), 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 circumstances. These data can be quickly downloaded into an aircraft's navigation system to then direct the aircraft to areas to be sprayed and 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.

At what arbovirus risk level did the year begin in your area? (If more than one please list)

WNV:
EEE:

District Municipality	EEEV	WNV
Amesbury	Moderate	Low
Andover	Remote	Low
Beverly	Remote	Low
Boxford	Low	Low
Danvers	Remote	Low
Georgetown	Moderate	Low
Groveland	Low	Low
Hamilton	Moderate	Low
Haverhill	Low	Low
Ipswich	Low	Low
Lynn	Remote	Low
Lynnfield	Low	Low
Manchester	Remote	Low
Marblehead	Remote	Low
Merrimac	Low	Low
Methuen	Low	Low
Middleton	Remote	Low
Nahant	Remote	Low
Newbury	Low	Low
Newburyport	Low	Low
North Andover	Remote	Low
Peabody	Low	Low
Revere	Remote	Low
Rowley	Low	Low
Salem	Remote	Low
Salisbury	Low	Low
Saugus	Remote	Low
Swampscott	Remote	Low
Topsfield	Low	Low

Wenham	**Remote**	**Low**
West Newbury	**Low**	**Low**
Winthrop	**Remote**	**Low**

At what arbovirus risk level did the year end in your area? (If more than one please list)

WNV:
EEE:

District Municipality	**EEEV**	**WNV**
Amesbury	**Moderate**	**Moderate**
Andover	**Remote**	**Low**
Beverly	**Remote**	**Moderate**
Boxford	**Low**	**Low**
Danvers	**Remote**	**Moderate**
Georgetown	**Moderate**	**Moderate**
Groveland	**Low**	**Moderate**
Hamilton	**Moderate**	**Moderate**
Haverhill	**Low**	**Moderate**
Ipswich	**Low**	**Low**
Lynn	**Remote**	**Moderate**
Lynnfield	**Low**	**Moderate**
Manchester	**Remote**	**Low**
Marblehead	**Remote**	**Low**
Merrimac	**Low**	**Moderate**
Methuen	**Low**	**Moderate**
Middleton	**Remote**	**Moderate**
Nahant	**Remote**	**Moderate**
Newbury	**Low**	**Moderate**
Newburyport	**Low**	**Moderate**
North Andover	**Remote**	**Low**
Peabody	**Low**	**Moderate**
Revere	**Remote**	**Moderate**
Rowley	**Low**	**Moderate**
Salem	**Remote**	**Moderate**
Salisbury	**Low**	**Moderate**
Saugus	**Remote**	**Moderate**
Swampscott	**Remote**	**Low**
Topsfield	**Low**	**Low**
Wenham	**Remote**	**Moderate**
West Newbury	**Low**	**Moderate**
Winthrop	**Remote**	**Moderate**

Comments: _____

***Please attach a link to maps of surveillance areas if possible.**

EDUCATION, OUTREACH & PUBLIC RELATIONS

Do you have an education/public outreach program? **YES**

If yes, please describe:

General: The District provides educational outreach on mosquito & tick control and related environmental science to schools, civic organization and public officials upon request.

Website: The District maintains a Website (www.northeastmassmosquito.com) which will provide general information about operational strategies and procedures.

Other Media: The District has various hand-outs, posters, presentations and DVD's available which will be provided to schools and civic groups, etc. upon request.

Outreach Programs: During the off season the District's Entomologist, Wetlands Project Coordinator and /or Biologist will present educational programs tailored to the specific needs of schools, civic organization and public officials.

Please check off all that apply:

☐ School based program
☒ Website
☒ PR brochures/handouts
☒ Community events
☐ Science fairs
☒ Meeting presentations
☒ Other (please describe): **As requested by schools / municipal goverments / associations / agencies / boards of health etc.**

Please give an estimate of attendance/participants in this program: **5 to 500**

Please list some events you participated in for the year of this report:
Rowley Board of Health Public Meeting (8 April)
Boxford Board of Health Public Meeting (10 April)
Rockport Board of Health Public Meeting (23 April)
Swampscott Board of Health Public Meeting (15 May)
Rowley Board of Health Public Meeting (23 April)
Manchester Board of Health Public Meeting (16 May)

"Cape Ann Mosquito Forum: Health Risks and Control" (27 March)
"Mosquito/Arbovirus Workshop" at Endicott Park in Danvers (9 May)
“Mosquitoes and the Diseases they Transmit: How you can protect yourself” (recorded in following towns for presentation on public access TV: Peabody on 10 June; Rowley on 1 July; Ipswich on 15 July)

What time frame during the year is this method employed? Year-round

Have you performed any research projects, efficacy, bottle assays, etc.? Not at this time

If yes, please elaborate on your research projects:

Are you involved in any collaboration with academia, industry, environmental groups, etc.? The District continues to build partnerships with other local, state and federal agencies in the interest of building mosquito control components into restoration projects.

If yes, please elaborate on your collaborations this past year: Castle Neck River Restoration, Ipswich, MA (Division of Ecological Restoration) and the Crooked Pond Brook Culvert Restoration (Trout Unlimited and the Town of Boxford).

Please provide a list of technical reports, white/grey papers, publication in journal or trade magazines, etc.

Does your staff participate in educational opportunities? Yes

If yes, please list the training and education your staff received this year:
NMCA Annual Conference; Clarke Mosquito: Community Mosquito Control Update Workshop; NMCA Field Day; Excavation Safety Seminar

Please list the certifications and degrees held by your staff:
Associate's of Applied Science; Bachelor of Science; Ph.D. degrees; (Associate's of Applied Science in Urban Forestry; The Grassroots Project – Sterling College, VT, The Roughed Grouse Society’s Coverts Program)

Comments: _____

BIOLOGICAL CONTROL EFFORTS

Do you have a biological control program? Yes

If yes, please describe: Enhancement of mosquito predator habitat is an essential component to all District wetland management projects. Improvement to wetland and waterway connectivity, riparian zones, restoration of natural drainage characteristics, removal of artificial debris, existing fill, and providing recommendations for better storm water control and upgrade of outdated infrastructure is high on the District's priority list.

Is this program the introduction of mosquito predators or the enhancement of habitat for native predators? Largely enhancement, MA Fish and Wildlife do not allow introduction of mosquito eating fish.

Please check off all that apply:

☒ Predatory fish
☒ Predatory invertebrates
☐ Other (please describe):

What time frame during the year is this method employed? Year-round

Comments: _____

INFORMATION TECHNOLOGY

Does your program use (check all that applies):

☒ Computers
☒ GIS mapping
☒ GPS equipment
☒ Computer databases
☐ Aerial Photography
☐ Other (please describe):

Please describe your capabilities in these areas: The District utilizes a central network server for storing all data. District personnel have access to desktops for job related duties including, but not limited to, data entry, downloading GIS data, downloading adulticiding data from the Sentinel system and bookkeeping. The District continues to grow in its computer capabilities by encouraging employees to learn new programs.

Please describe your current GIS abilities: Intermediate

Give details if possible on your GIS abilities: The District currently has ArcMap 9.3 and 10.1 for all mapping. District employees have taken and continue to take the initiative in learning how to use the programs and create maps needed for the many aspects of mosquito control.

Please describe any changes/enhancements in this area from the previous year: The District added Mesa and Juno handheld devices utilizing the Sentinel field data collection system for mosquito control. This new program allows the District to collect and map more accurate adulticiding and larviciding data, along with giving field personnel up to date and accurate maps depicting protected areas, larviciding areas and spray exclusions.

Comments: ____

REVENUES & EXPENDITURES

Please give a concise statement of revenues & expenditures for the prior fiscal year ending June 30.

FY13 Budget and Spending Plan July 1, 2012 - June 30,2013	July 1, 2012 - June 30, 2013		Final Draft 6-14-12
Proposed Budget Minus Furloughs	$1,589,537.00		$1,589,537.00
Account 2520/1500	Line Item Budget		Spending Plan Encumbrances
Full Time Payroll - 43%	$686,953.03	FT Payroll	$686,953.03
Travel -	$2,000.00		$2,000.00
Com/Contract Employees -	$63,880.08	Com Meetings	$3,002.00
		Contract Emp	$60,878.08
Retire/Ins/Fringe - 21%	$334,476.86		
Retirement 12% increase			$121,546.73
Group Ins estimated		FY12 + 5%	$188,388.59
Terminal Leave		FY12 + 5%	$8,586.90
Unemployment Insurance		FY12 + 5%	$2,896.61
Universal Health Insurance		FY12 + 5%	$548.24
Medicare Tax		FY12 + 5%	$11,509.79
Office and Administration 1%	$18,620.00		
Network maintenance		No contract	$3,000.00
Computers/accessories		Dell	$3,000.00
Office Supplies		NE Office Supply	$3,500.00
Office Supplies		Office Max	$2,000.00
Printing		G&G Printing	$1,000.00

Postage		U.S. Post Office	$600.00
Legal Notice		Eagle Tribune	$2,000.00
Pre registration/dues NMCA		Associations	$3,520.00
Litigation	$0.00		$0.00
Facility Operations Utilities - 1%	$17,825.69		
Electric service		National Grid	$5,000.00
Propane gas heat		Osterman Gas	$2,500.00
Heat Oil		Dennis K Burke	$0.00
Dumpsters		Allied Waste	$2,000.00
Water Bill		Town of Andover	$300.00
Water Bill		City of Newburyport	$300.00
Long distance phone		AT&T	$200.00
Internet service		Comcast	$830.00
Cell and direct connect service		Nextel	$5,195.69
Office Phones		Verizon	$1,500.00
Facility Maintenance - 1%	$15,500.00		
		Home Depot	$13,000.00
		Heat/AC	$2,500.00
Ops Fleet Maint/Repair - 5%	$86,758.52		
Vehicle Maintenance/repair		Fleet Response	$31,000.00
Welding		Gunderson Welding	$5,000.00
Wetlands Equip maint/repair		Kassbohrer	$19,758.52
Hydraulic hoses & connections		Tech Hydraulics	$2,000.00
Equip hauling/towing/maint			
Vehicle accessories		MHQ	$1,000.00
Excavator maint/repair		Chadwick BaRoss	$21,000.00
Misc equip/parts/supplies		Granger	$3,500.00
Auto Glass		J.N. Phillips	$500.00
Misc equip/parts/supplies		Napa Auto Supplies	$1,500.00
Tires		Goodyear	$2,500.00
Operations Fleet Fuel -3%	$41,000.00		
Fleet Fuel gas/diesel		Wright Express	$41,000.00
Ops Support/Contractors - 9%	$137,998.00		
Helicopter Contract		JBI Helicopter	$100,000.00
Co2 surveillance		Airgas	$4,000.00

Virus Testing		DPH	$20,000.00
Airport user Fee		Plum Island Airport	
Field equipment & Supplies		Forestry Suppliers	$6,998.00
Surveillance/Lab supplies		Fisher Scientific	$2,000.00
Surveillance/Lab supplies		Bio Quip	
Surveillance/Lab supplies		BioSensory	$1,500.00
Erosion Control materials		no contract	$2,000.00
Work gear / uniforms		Aramark	$1,500.00
Ops Pest/Spray equip - 10%	$152,925.06		
Pesticides / Sprayer parts		Clarke	$127,925.06
Pesticides / Sprayer parts		Adapco	$25,000.00
Lease/Purchase	$0.00		$0.00
Capital Equipment - 2%	$31,599.76		$31,599.76
Total Spending	$1,589,537.00		$1,589,537.00

List each **member municipality along with the corresponding (cherry sheet) funding assessment** dollar amount for the prior fiscal year.

Municipality	**FY13 District Assessment**
Amesbury	**41,963**
Andover	**114,084**
Beverly	**69,776**
Boxford	**72,477**
Danvers	**53,758**
Georgetown	**40,075**
Groveland	**27,720**
Hamilton	**45,532**
Haverhill	**114,286**
Ipswich	**98,336**
Lynn	**53,792**
Lynnfield	**37,896**
Manchester	**35,073**
Marblehead	**35,294**
Merrimac	**26,091**
Methuen	**80,967**
Middleton	**44,752**
Nahant	**6,744**
Newbury	**71,183**
Newburyport	**37,797**
No. Andover	**90,159**
Peabody	**73,930**

Revere	**33,802**
Rowley	**54,321**
Salem	**40,706**
Salisbury	**48,026**
Saugus	**46,143**
Swampscott	**18,327**
Topsfield	**39,553**
Wenham	**24,202**
W. Newbury	**39,703**
Winthrop	**13,431**

Totals	**1,629,899**
SRB Budget	**39,933**
Proposed Budget	**1,589,966**

Comments: _____

PESTICIDE USAGE

Please total your pesticide usage with information from your Mass. Pesticide Use Report, WNV Larvicide Use records and contracted pesticide applications. Applications methods include; hand/backpack, aerial, ULV, mistblower, other (please explain)

Product Name: Altosid Pellets
EPA Reg. #: 2724-448-64833
Application method: Hand
Targeted life stage: Larvae
Total amount of concentrate applied: 353.4 lbs.
Comments: 0.25 ozs. / catch basin

Product Name: VectoMax WSP
EPA Reg. #: 73049-429
Application method: Hand
Targeted life stage: Larvae
Total amount of concentrate applied: 123.4 lbs
Comments: 10 grams / WSP (single basin application)

Product Name: VectoLex WSP
EPA Reg. #: 73049-20
Application method: Hand
Targeted life stage: Larvae
Total amount of concentrate applied: 147.5 lbs.
Comments: 10 grams / WSP (single basin application)

Product Name: Vectobac G
EPA Reg. #: 73049-10
Application method: Hand
Targeted life stage: Larvae
Total amount of concentrate applied: 1,330.2 lbs.
Comments: _____

Product Name: Fourstar 180 day Briquets
EPA Reg. #: 83362-3
Application method: Hand
Targeted life stage: Larvae
Total amount of concentrate applied: 1,087.5 lbs.
Comments: 37.4 grams / catch basin

Product Name: Agnique MMF G Pak 35
EPA Reg. #: 53263-30
Application method: Hand
Targeted life stage: Larvae/pupae
Total amount of concentrate applied: 89 WSP pouches
Comments: For single basin application

Product Name: Duet
EPA Reg. #: 1021-1795-8329
Application method: ULV Truck Sprayer
Targeted life stage: Adult
Total amount of concentrate applied: 132.5 gals.
Comments: _____

Product Name: Suspend SC
EPA Reg. #: 432-763
Application method: Truck Barrier Sprayer
Targeted life stage: Adult
Total amount of concentrate applied: 64.25 ozs.
Comments: _____

Product Name: Vectobac 12AS
EPA Reg. #: 73049-38
Application method: Aerial
Targeted life stage: Larvae
Total amount of concentrate applied: 1,980 gals.
Comments: Applied by JBI Helicopters (contracted pesticide applicator)

Product Name: Escort
EPA Reg. #: 352-439
Application method: Hand/Backpack
Targeted life stage: Invasive Perennial Pepperweed Control

Total amount of concentrate applied: 1.485 ozs.
Comments: 0.33 ozs. / 10 gals. water

LARGE AREA EXCLUSIONS

Do you have large areas of pesticide exclusion, such as estimated or priority habitats? No

If yes, please explain, and attach maps or a web link if possible.

SPECIAL PROJECTS

Do you perform any inspectional services such as inspections at sewage treatment facilities or review sub division plans? Yes

If yes, please elaborate: Annual or as needed inspections of waste water treatment plants and municipal compost facilities.

Do you work with DPW departments or other local or state officials to address stormwater systems, clogged culverts or other areas that you have identified as man-made mosquito problem areas? Yes

If yes, please elaborate: The District continues to engage local, state and federal agencies as projects are brought to our attention requiring issues of this sort.

Have you worked with these departments on long term solutions? Yes

If yes, please elaborate: Whenever possible the District advocates for improved road/wetland crossings and thoughtful design in areas of new development. The District evaluates and informs municipalities of all site deficiencies prior to making recommendations for ditch maintenance. In some cases we do not conduct wetland management projects unless current conditions are suitable for improved flow and connectivity and predator survivability.

Did you conduct or participate in any cooperative research or restoration projects? Yes

If yes, please elaborate: Castle Neck River Restoration, Ipswich, MA (Division of Ecological Restoration) and the Crooked Pond Brook Culvert Restoration (Trout Unlimited and the Town of Boxford).

Did you or participate in any **State/Regional/National workgroups or panels or attend any meeting pertaining to the above?** Yes

If yes, please elaborate: Great Marsh Revitalization Task Force, MA-NH-ME Invasive Workgroup

CHILDREN AND FAMILIES PROTECTION ACT

Is your program impacted by the Children and Families Protection Act? Yes

If yes, please explain: Pesticide materials used by the District are required to be listed on a school's IPM plan to allow the District to treat the property. In recent years, the District has been asked by local Boards of Health to spray town fields including school properties for adult mosquitoes, particularly in the event of virus outbreaks. Many of the schools have not included mosquito control as part of their IPM plan resulting in delays of efficient and expedient treatment and/or an inability to provide a proactive approach by treating the school property for mosquito larvae.

If you have data on compliance with this Act and your program, please list here: The District contains 580 public schools or programs within public schools and 246 day care programs and 644 family day care programs. We consider an IPM plan complete if it includes mosquito and a complete list of materials used by the District. That being said, our data shows 4.4% of all schools/day cares in the District have a complete plan and 7.3% have some mention of mosquito control in their IPM plans. If we separate the public schools from the day cares we find that 8.6% of schools and 6.5% of day cares (excluding family day cares) have a complete plan, while 13.9% of schools and 10.9% of day care have some mention of mosquito control in their plans. Additionally we have a number of member municipalities in which no school or day care has an IPM plan filed with the state.

If you had difficulties with implementation of your program due to this law, please elaborate here: Although we reach out to all the schools/day cares in our district on an annual basis asking that they update/file an IPM plan with the state, we find that many do not bother to come into compliance with the law. This creates problems with being able to provide proactive mosquito control in many of our municipalities as we are not able to treat school properties that do not have our products listed in their plan. Non-compliance of schools also creates problems when we are asked by local Boards of Health to spray town properties for adult mosquitoes, particularly during times of virus outbreaks. Non-compliance by school administrators results in a lack of efficiency, the possibility of increased virus for the surrounding towns, and increased costs to the District.

Comments: Despite continued efforts to help the schools/day cares in our district complete their IPM plan by providing annual reminders, examples of text to include mosquito control in their plan and a complete list of our products, most of the schools/day cares remain non-compliant. One complaint that we hear is that the state's IPM website is daunting and confusing. Many school administrators are unaware that they are required to complete the plan and that our email/letters to them are the first time they are hearing about it. And many others take the easy way out by stating that they do not use any products outdoors. Although many schools/day cares may be small and do not feel that mosquito control applies to them, we often find that there may be treatable areas on their property, such as catch basins, that we are unable to treat due to their non-compliance.

NPDES SECTION

Did your program note any adverse incidents during this reporting period? No

If yes please list any corrective actions here: _____

GENERAL COMMENTS

Please list any comments not covered in this report: _____