CMMCP AERIAL MOSQUITO LARVAL CONTROL PROGRAM

Photo by Tim Deschamps

Minuteman Airfield, Stow, MA

SPRING 2010

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ABSTRACT

In the spring of 2010, the Central Mass. Mosquito Control Project conducted an aerial application of *Bacillus thuringiensis israelensis* in the towns of Billerica, Boxborough, and Chelmsford for selected wetlands that are otherwise impractical to treat by ground larviciding. At established observation sites there was a 59.70% overall reduction found in the emergence of spring mosquito species found through pre- and post application larval monitoring.

OBJECTIVE

Come early spring, the eggs of several univoltine mosquito species hatch into larvae. These larvae are found in snow pools, which are temporary breeding sites creating by melted snow and are usually dry by summer. These "spring brood" species include *Ochlerotatus abserratus* and *Ochlerotatus excrucians*. Another species, *Ochlerotatus canadensis* has also been identified as univoltine, but surveillance depicts a possible delayed egg hatch later in the season. *Ochlerotatus canadensis* has been shown to be capable of carrying both Eastern Equine Encephalitis and West Nile Virus among others diseases (Andreadis 2005). All three of these species contribute heavily to human and other mammal discomfort upon emergence and are the primary species of interest for the CMMCP spring aerial larvicide. The goal of the 2010 spring aerial larvicide is to reduce the number of these species in the aquatic larval stage before they become flying adults, capable of negatively impacting residents and livestock in the surrounding areas.

MATERIALS AND METHODS

Bacillus thuringiensis israelensis (Bti), a "biopesticide," was used to during this aerial larvicide to reduce target mosquito larvae levels. VectoBac G® (EPA Reg. No. 73049-10), a granular form of Bti, is comprised of the non-reproducing soil bacterium which when ingested by the mosquito larvae generates target specific toxins (Extension Toxicology Network 1996). This product tends to be most effective when used before the mosquito larvae reach the 4th instar, as they begin to slow feeding and prepare for pupation. An application rate of 5lbs/acre was applied by the helicopter, well within the recommended application rate spectrum for VectoBac G® of 2.5-10lbs/acre (VectoBac G® label). This Bti product is identical to the one successfully used in the CMMCP ground larval control program (CMMCP 2009). North Fork Helicopters (Cutchogue, New York) was contracted to perform the

aerial application, their experience with CMMCP and the treatment areas beneficial.

Wetland bodies targeted for the aerial application were selected from historical larval surveillance data. These areas were each over 5 acres and categorized as being primarily wooded swamp, deciduous, conifer and mixed; shallow marsh; and shrub swamp through the use of GIS layers (MassGIS 2007). Potential mosquito breeding habitat under 5 acres were to be inspected during the CMMCP ground larvicide program, and treated accordingly.

A crucial aspect of a spring aerial larvicide application of mosquitoes is the timing in respect to the development stage of the target mosquito larvae. The growth of the mosquito larvae is influenced greatly by weather conditions. An early snow melt, higher than average temperatures and substantial rainfall can all lead to advanced larval development. Ideally the application should be performed when the larvae are in the 2nd or 3rd instar because these larvae tend to be the most susceptible. As larvae move toward the pupa stage they become less likely to acquire enough Bti granules to impact their development. Once larvae become pupa they are no longer controllable by Bti because they cease to feed and therefore cannot ingest the Bti particles.

The Billerica and Chelmsford portions of the aerial application were conducted on April 14th, while Boxborough was on the following day, April 15th. As in previous years, the loading/landing zones were at Warren Farm in Chelmsford for the Billerica and Chelmsford application and at the Minute Man Airfield in Stow for the Boxborough application. Acreage designated for the aerial larvicide was 557 acres for Billerica, 814 acres in Chelmsford, which was a 101 acre increase over previous years, and 995 acres in Boxborough. In accordance with 333CMR 13.04 (7), CMMCP placed legal notifications in local newsprint prior to the aerial larvicide (APPENDIX A). This notification was printed February 11th, 2010 in the Boston Globe, and additionally was also posted on the CMMCP website (http://www.cmmcp.org/).

The Generic Environmental Impact Report (GEIR) (SRMCB website, http://www.mass.gov/agr/mosquito/), recommends that recoverable dip stations (RDS) be created to determine the success level of the aerial larvicide. These RDS are within target sites as well as untreated control sites, each containing 10 locations where larval surveillance is conducted, both before and after the application. Each location is flagged and numbered so that they can be rechecked following the application. Number of larvae present per sample is recorded as well as the instar stages of those larvae, and following the application the presence or absence of Bti granules is noted also. Larvae that are sampled are placed back into site as to not disturb the results from the application. Larvae are collected from the area to determine what

species are present. During the post-application surveillance, a technician will also note whether dead or moribund larvae were found. For every 250 acres treated there is to be a treatment RDS, according to the GEIR, as well as one untreated control RDS for each town. This procedure ensures that larval control can be observed in treatment sites with untreated control site observations to compare to.

RESULTS

The results from the treatment RDS indicate that for Billerica, Boxborough, and Chelmsford, the 2010 spring aerial larvicide had an overall observed larval reduction of 59.70% from pre-application levels. Following the application, the Billerica treatment RDS had an 87.31% decrease, Boxborough had a 45.83% decrease, and Chelmsford had a 51.74% decrease. For the untreated control RDS, Billerica had a slight increase (5.00%), while Chelmsford slightly decreased (-3.70%), and when observations were combined, created an overall observed change of zero percent (Table 1; Figures 1-4). Larvae samples collected in the areas of the RDS before the application indicate that several species were present including *Aedes cinereus*, *Ochlerotatus abserratus*, *Ochlerotatus canadensis*, and *Ochlerotatus excrucians*.

Table 1: Larval Surveillance of Treatment and Control RDS

Treatment Sites	Pre-application	Post-application	Observed Change
BIL108	46	4	-91.30%
BIL112	49	4	-91.84%
BIL409	39	9	-76.92%
BOX122	37	30	-18.92%
BOX128	14	8	-42.86%
BOX92	56	40	-28.57%
BOX8	61	13	-78.69%
CHM82	67	37	-44.78%
CHM24	41	28	-31.71%
CHM236	64	18	-71.88%
Overall:	474	191	**-59.70%**
Control Sites	**Pre-application**	**Post-application**	**Observed Change**
BIL227	40	42	5.00%
CHM146	54	52	-3.70%
Overall:	94	94	**0.00%**

Figure 1: Billerica Treatment RDS Results Pre- and Post Application

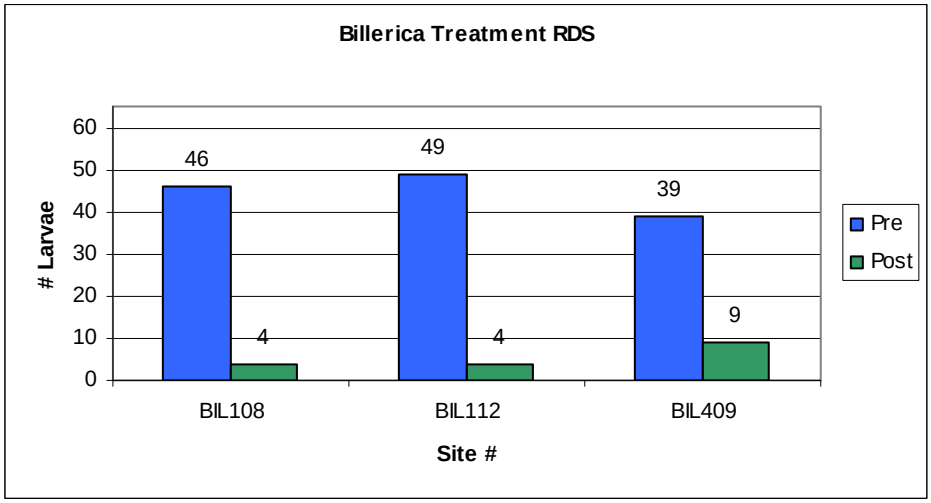


Figure 2: Boxborough Treatment RDS Results Pre- and Post Application

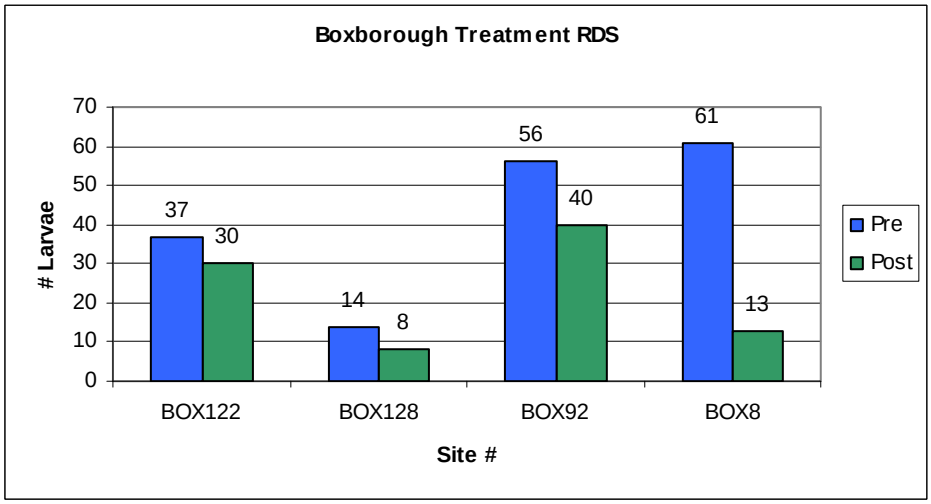


Figure 3: Chelmsford Treatment RDS Results Pre- and Post Application

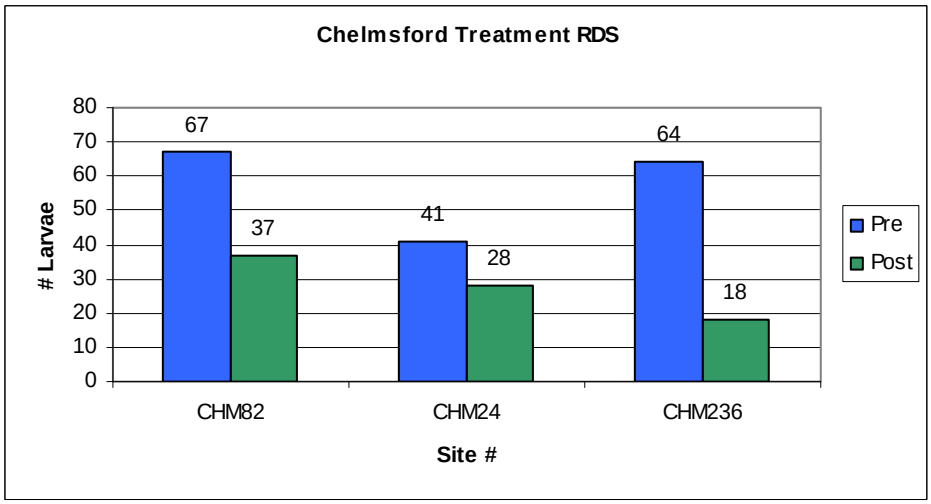
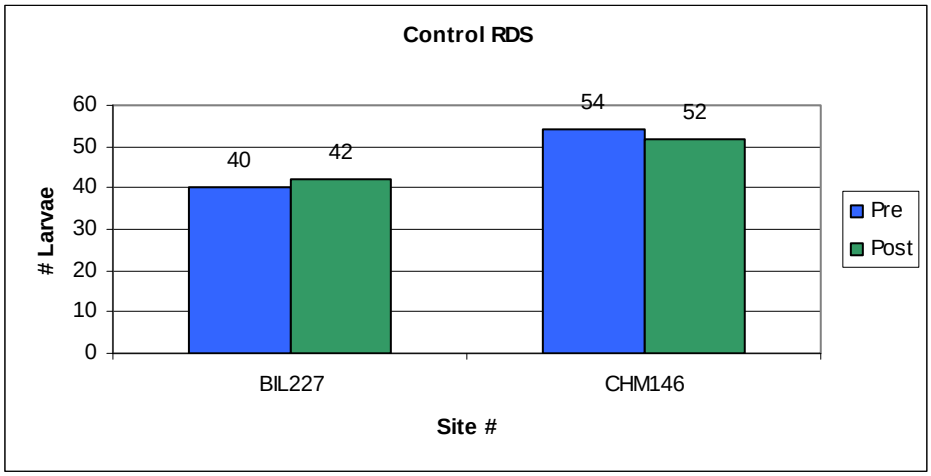


Figure 4: Control RDS Results Pre- and Post Application



DISCUSSION

With approximately 59.70% overall observed control, the 2010 spring aerial larvicide was a success. High spring temperatures contributed to early observed larval development, leading the aerial application to be conducted approximately a week earlier than usual. Larvae were routinely seen during pre- and post-application surveillance in mid to late instars. Because targeted mosquito larvae begin to slow their feeding during the 4th instar stage, and pupae are incapable of ingesting the Bti, control may not have been achieved on all larvae present before the application. Because of this possibility, the application could very well have been preformed even a couple days before that, despite the already advanced timing of the application. This would have increased the probability that the larvae present would have been more susceptible, earlier instar larvae.

Despite an over 50% level of control, the results were lower than anticipated when compared to previous years. Observations showed that some of the RDS did not have Bti visibly present following the application, and anecdotally, there seemed to be less product coverage than in the past. Target bodies could have been greatly expanded due to record rainfall earlier in the spring, which may have led to less available product for the increased target sizes. The timing of the application was good in that several target species were identified prior to the application including *Aedes cinereus*, *Ochlerotatus abserratus*, *Ochlerotatus canadensis*, and *Ochlerotatus excrucians*. Historically, *Oc. canadensis* begins development slightly later than *Oc. abserratus* and *Oc. excrucians*.

The target mosquito larvae control achieved through this aerial larvicide will help reduce the negative impacts of these spring brood mosquito species and also the need for as many adulticide service calls from these areas. Possible additions of

towns and acreage to this program would further increase relief to area residents. Helicopter flight tracks, target wetlands and other components of the aerial larvicide program will be assessed to ensure continued success with the CMMCP spring aerial larvicide.

ACKNOWLEDGEMENTS

The authors would like to thank the towns of Billerica, Boxborough, and Chelmsford; North Fork Helicopters for conducting the application; Clarke Mosquito Control Products for supplying the Vectobac G®; Minute Man Airfield, Stow and Warren Farm, Chelmsford for the use of loading zones; the CMMCP Commission, and the CMMCP field staff for larval monitoring, larval identification, site selection, map development and assisting with the helicopter application.

REFERENCES

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Extension Toxicology Network. 1996. *Bacillus thuringiensis* [Internet]. Extoxnet [accessed April 27, 2009]. Available from: http://extoxnet.orst.edu/pips/bacillus.htm

MassGIS [Office of Geographic and Environmental Information, Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs]. 2007. *DEP Wetlands (1:12,000)* [Internet]. MassGIS [accessed April 1, 2010]. Available from http://www.mass.gov/mgis/wetdep.htm

United States Environmental Protection Agency. 1998. *Bacillus thuringiensis subspecies israelensis strain EG2215 (006476) Fact Sheet* [Internet]. Washington, D.C.: United States Environmental Protection Agency [accessed April 27, 2009]. Available from: http://www.epa.gov/pesticides/biopesticides/ingredients/factsheets/factsheet_006476.htm

APPENDIX A

(7) Exemptions for Aerial Application of Mosquito Larvicides. Mosquito larvicide applications made by mosquito control programs approved by the State Reclamation and Mosquito Control Board are exempt from 333 CMR 13.04(4) and 333 CMR 13.04(6) if all of the following conditions have been met:

(a) Notice of the proposed application has been published in a newspaper of general circulation in the affected municipality between February 1st and March 1st of the year the application is intended to be made. The notice shall include the following information:

1. Purpose of control program;
2. Method of application;
3. Area of application if known;
4. Name and EPA Registration Number of the pesticide product to be applied; and
5. Phone number of a contact person from whom additional information can be obtained.

Within seven calendar days of publication, a copy of the notice shall be provided to the Department and the Board of Health in the municipality where the application is to be made.

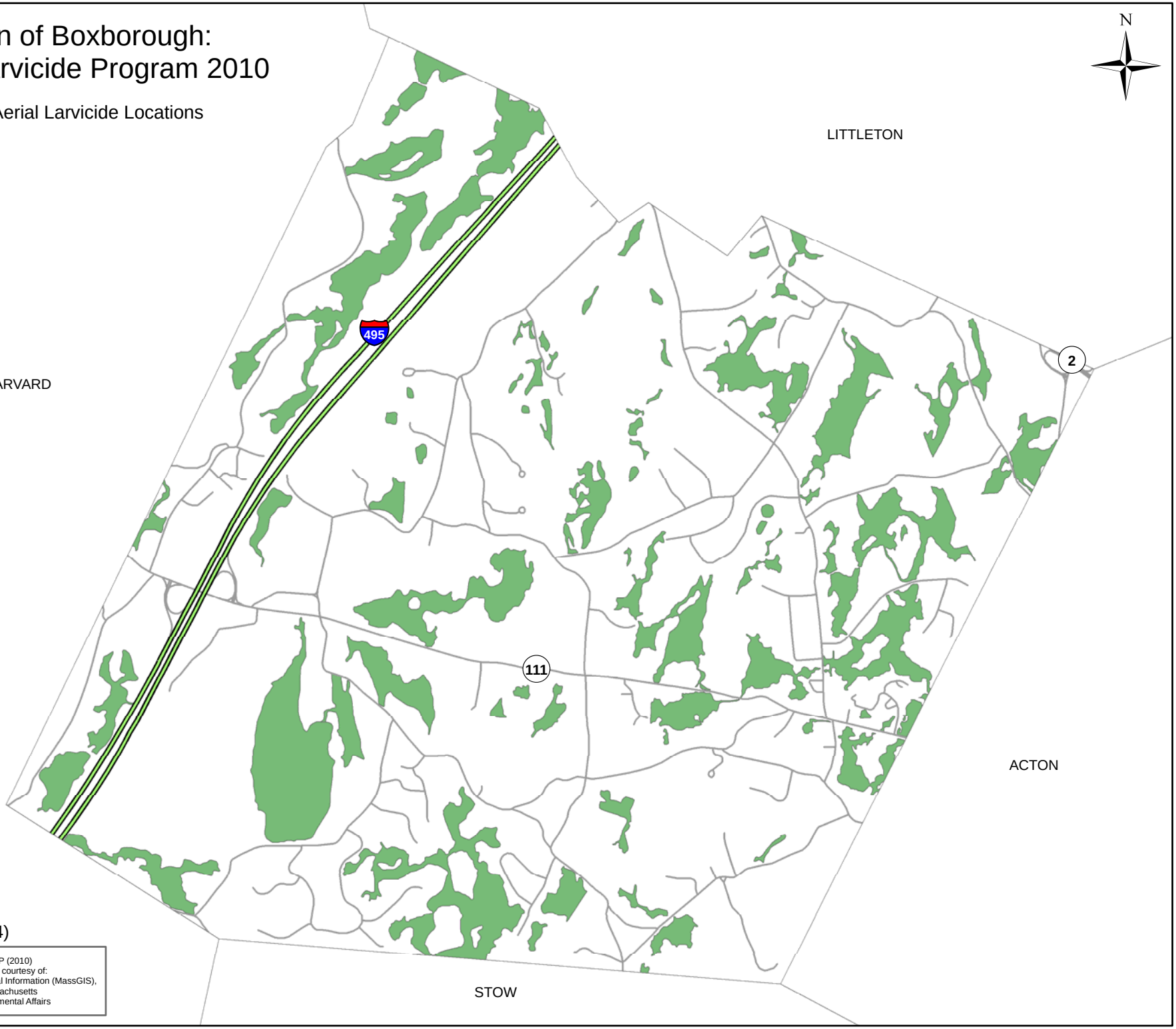
(b) Notice of the proposed application has been provided to the Department and the Board of Health in the municipality where the application is to be made prior to the application. The notice shall include the following information:

1. Purpose of control program;
2. Method of application;
3. Area of application;
4. Date and time of application;
5. Name and EPA Registration Number of the pesticide product to be applied; and
6. Name of the applicator and phone number of a contact person from whom additional information can be obtained.

The full text of these regulations can be found at this link: http://www.mass.gov/agr/legal/regs/pesticides_regulations_list.htm

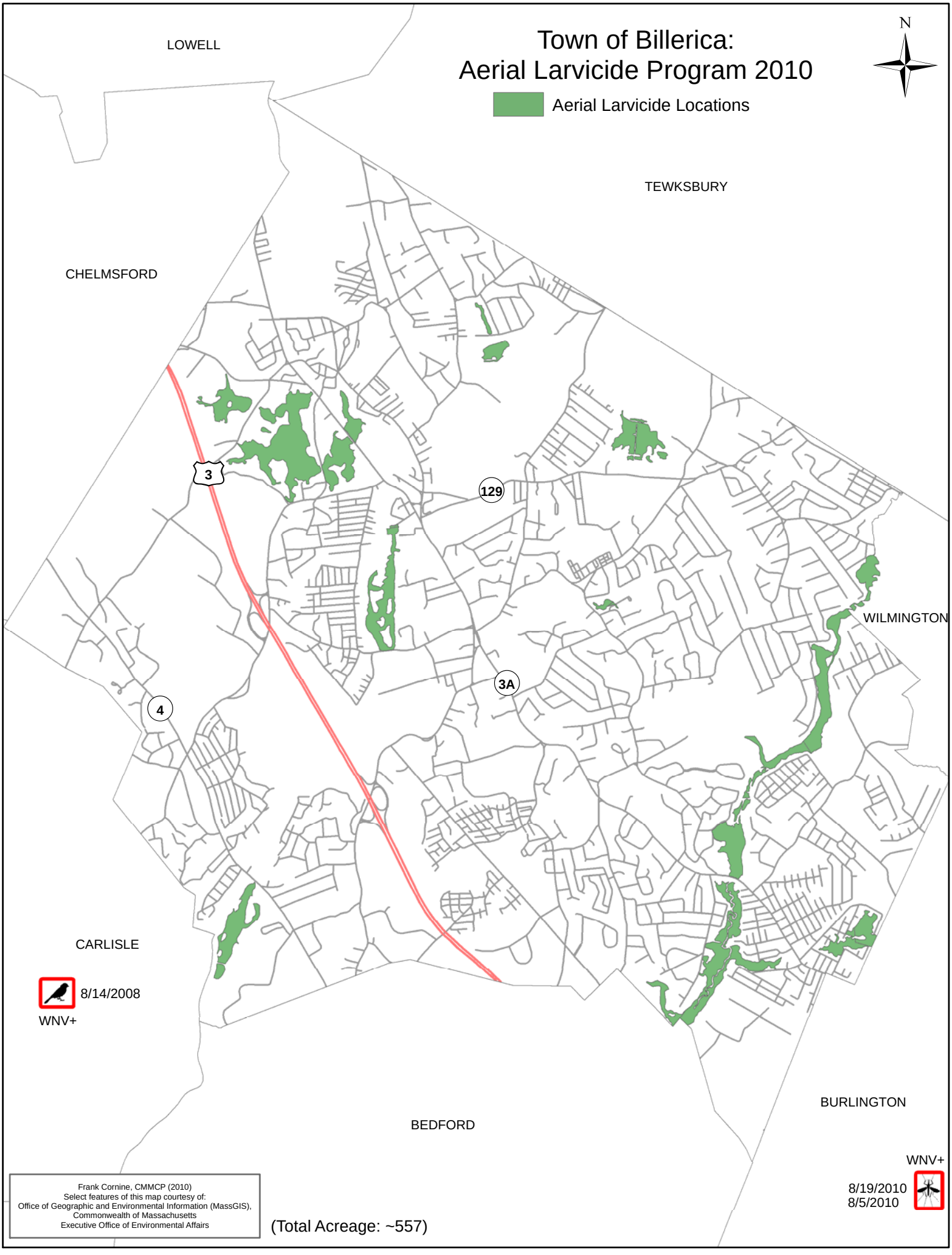
Town of Boxborough:
Aerial Larvicide Program 2010

Aerial Larvicide Locations



(Total Acreage: ~994)

Frank Cornine, CMMCP (2010)
Select features of this map courtesy of:
Office of Geographic and Environmental Information (MassGIS),
Commonwealth of Massachusetts
Executive Office of Environmental Affairs


Town of Billerica:
Aerial Larvicide Program 2010
Aerial Larvicide Locations
N
LOWELL
TEWKSBURY
CHELMSFORD
WILMINGTON
CARLISLE
BEDFORD
BURLINGTON
3
129
3A
4
8/14/2008
WNV+
WNV+
8/19/2010
8/5/2010
Frank Cornine, CMMCP (2010)
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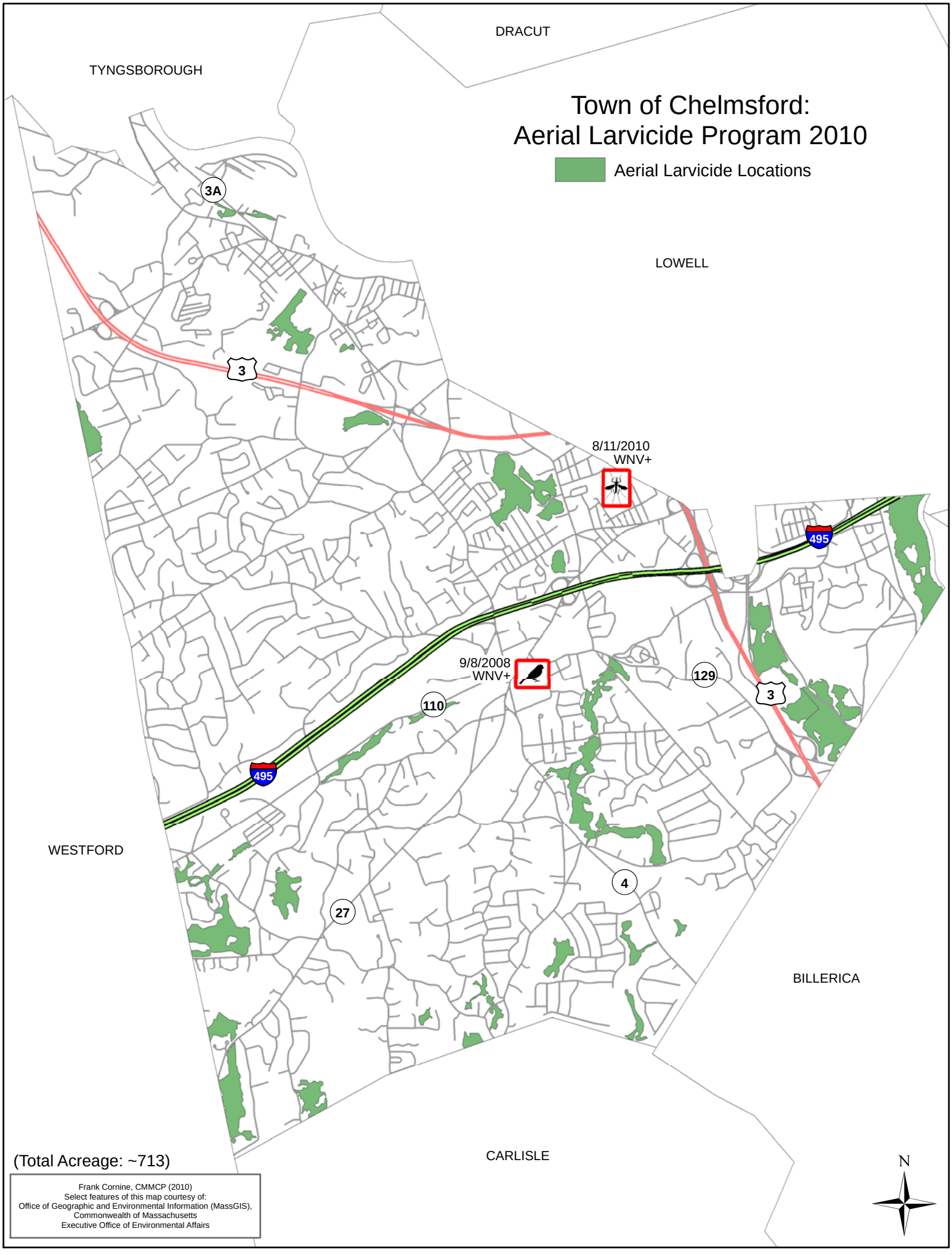
Commonwealth of Massachusetts
Executive Office of Environmental Affairs
(Total Acreage: ~557)


DRACUT
TYNGSBOROUGH
Town of Chelmsford:
Aerial Larvicide Program 2010
Aerial Larvicide Locations
3A
LOWELL
3
8/11/2010
WNV+
495
9/8/2008
WNV+
129
110
3
495
WESTFORD
4
27
BILLERICA
CARLISLE
(Total Acreage: ~713)
Frank Cornine, CMMCP (2010)
Select features of this map courtesy of:
Office of Geographic and Environmental Information (MassGIS),
Commonwealth of Massachusetts
Executive Office of Environmental Affairs
N