5.4.8 INFESTATION

This section provides a profile and vulnerability assessment for the infestation hazard.

HAZARD PROFILE

This section provides profile information including description, location and extent, previous occurrences and losses and the probability of future occurrences.

Description

An infestation is defined as a state of being invaded or overrun by parasites that attack plants, animals and humans. Insect, fungi and parasitic infestations can result in destruction of various natural habitats and cropland, impact human health, and cause disease and death among native plant, wildlife and livestock. An infestation is the presence of a large number of pest organisms in an area or field, on the surface of a host, or in soil. They result from when an area is inhabited or overrun by these pest organisms, in numbers or quantities large enough to be harmful, threatening or obnoxious to native plants, animals and humans. Pests are any organism (insects, mammals, birds, parasite/pathogen, fungi, non-native species) that are a threat to other living species in its surrounding environment. Pests compete for natural resources or they can transmit diseases to humans, crops and livestock. Human populations are generally impacted by insect or animal infestations that can result in health impacts and can lead to potential epidemics or endemics.

New York State has been impacted by various past and present infestations including: high population of mosquitoes (West Nile Virus); deer ticks (Lyme disease); Asian longhorned beetles; and hemlock woolly adelgid. Other infestations that have impacted the State include: Eastern Equine Encephalitis, La Crosse Encephalitis, Powassan Virus, St. Louis Encephalitis, Western Equine Encephalitis, Emerald Ash Borer, and Sirex Woodwasp. Not all of these infestations have occurred in Delaware County; therefore, the following infestations listed below, will further be discussed in this section.

West Nile Virus (WNV) is a mosquito-borne virus that can cause encephalitis (inflammation of the brain) or meningitis (inflammation of the lining of the brain and spinal cord). WNV is spread to humans by the bite of an infected mosquito. A mosquito becomes infected by biting a bird that carries the virus (New York City Department of Health, Date Unknown).

Lyme Disease is caused by the Lyme Disease Bacterium, *Borrelia burgdorferi*, which normally lives in mice, squirrels and other small animals. It is transmitted among these animals and to humans, through the bites of a certain species of ticks, particularly the deer tick. Lyme Disease infections can cause symptoms affecting the skin, nervous system, heart, and/or joints of an individual (NYSDOH, 2006).

Asian Longhorned Beetles (ALB) is an exotic pest, native to parts of Asia, threatening a wide variety of hardwood trees in North America, particularly in New York State, New Jersey and Chicago. The beetle is believed to have arrived in New York City in the 1980s, in wooden packing material used in cargo shipments from China. The ALB has the ability to infest certain hardwood trees, eventually destroying them. They are threat to public, private and commercial hardwood trees. The U.S. Department of Agriculture (USDA) believes this beetle can probably survive and reproduce in most sections of the country where suitable host trees exist.

Hemlock Woolly Adelgid (HWA) is native to parts of Asia and was first discovered in New York State in 1985. The Adelgid uses long mouthparts to extract sap and nutrients from hemlock foliage. This

prevents free growth and causes the needles to discolor and drop prematurely. The loss of new shoots and needs impairs the health of the tree. Infestation is usually fatal to the host after several years (NYS DEC, Date Unknown).

Eastern Equine Encephalitis (EEE) is a rare but serious viral disease spread by mosquitoes that can affect people and horses. It is transmitted by the bite of an infected mosquito. Mosquitoes become infected by feeding on infected birds. Infected mosquitoes will then occasionally feed on horses, humans and other mammals. The virus that causes EEE is spread only by mosquitoes. People and horses do not directly spread the disease to horses or people (NYSDOH, 2012).

La Cross Encephalitis (LAC) is transmitted to humans by the bite of an infected mosquito. Most cases of LAC occur in the upper Midwestern, mid-Atlantic and southeastern states. Many people infected with LAC have no apparent symptoms. Among people who become ill, initial symptoms include fever, headache, nausea, vomiting, and tiredness. Some of those who become ill develop severe neuroinvasive disease (Center for Disease Control [CDC], 2009).

Powassan Virus (POW) is related to some mosquito-borne viruses, including West Nile virus. The virus is named after Powassan, Ontario, where it was first discovered in 1958. POW virus is passed to people by ticks. Two types of Powassan virus have been found in North America. One type of POW virus is carried by Ixodes scapularis (known as the blacklegged tick or deer tick), the same tick that transmits Lyme disease, human anaplasmosis, and babesiosis. Another type of POW virus is carried by Ixodes cookei, a related tick species that usually feeds on woodchucks or other medium-sized mammals instead of humans (Minnesota Department of Health, 2011).

St. Louis Encephalitis (SLE) is transmitted to humans by the bite of an infected mosquito. Most cases of SLE disease have occurred in eastern and central states. Most persons infected with SLE have no apparent illness. Initial symptoms of those who become ill include fever, headache, nausea, vomiting, and tiredness. Severe neuroinvasive disease (often involving encephalitis, an inflammation of the brain) occurs more commonly in older adults (CDC, 2010).

Emerald Ash Borer (EAB) was first discovered in the U.S. in 2002 in southeastern Michigan. It was also found in Windsor, Ontario the same year. This Asian beetle infests and kills North American ash species including green, white, black and blue ash; making all native ash trees susceptible to EAB. Most trees die within two to four years of becoming infested. EAB is responsible for the destruction of over 50 million ash trees in the U.S. since its discovery in Michigan (NYSDEC, Date Unknown).

Sirex Woodwasp is a Eurasian native, which was first discovered in New York State in 2004. This was the first North American discovery of this exotic, invasive pest that is one of the top 10 most serious forest insect pest invaders worldwide. Native woodwasps utilize dead and dying pines, whereas the invasive sirex woodwasp attack healthy pines as well. Pines, with a diameter of six inches or greater, are susceptible; however, stressed, suppressed, and crowded pines are favored by the sirex woodwasp (New York Invasive Species [NYIS], Date Unknown). All pine species are believed to be at risk, particularly stressed Scots (or Scotch), red and eastern white pines (NYSDEC, Date Unknown).

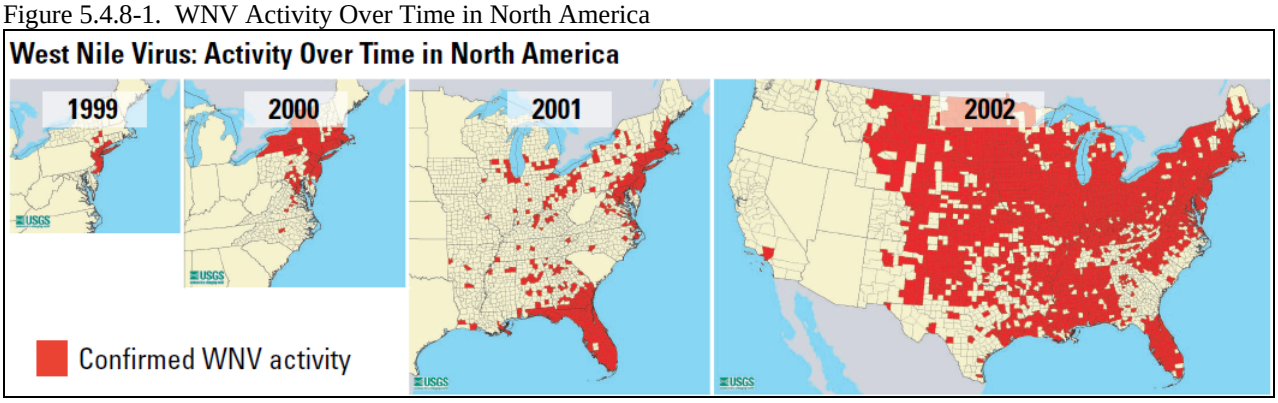
Extent and Location

The presence of disease-carrying mosquitoes and ticks and the presence of ALB, HWA, EEE, LAC, POW, SLE, EAB and sirex woodwasp have been reported throughout most of New York State and in Delaware County. Information regarding the location and extent of these pests is further discussed below.

West Nile Virus

Since it was discovered in the western hemisphere, WNV has spread rapidly across North America, affecting thousands of birds, horses and humans. WNV swept from the New York City region in 1999 to almost all of the continental U.S., seven Canadian provinces and throughout Mexico and parts of the Caribbean by 2004 (USGS, 2012). Figure 5.4.8-1 shows the activity of WNV over time in North America, from 1999 to 2002.

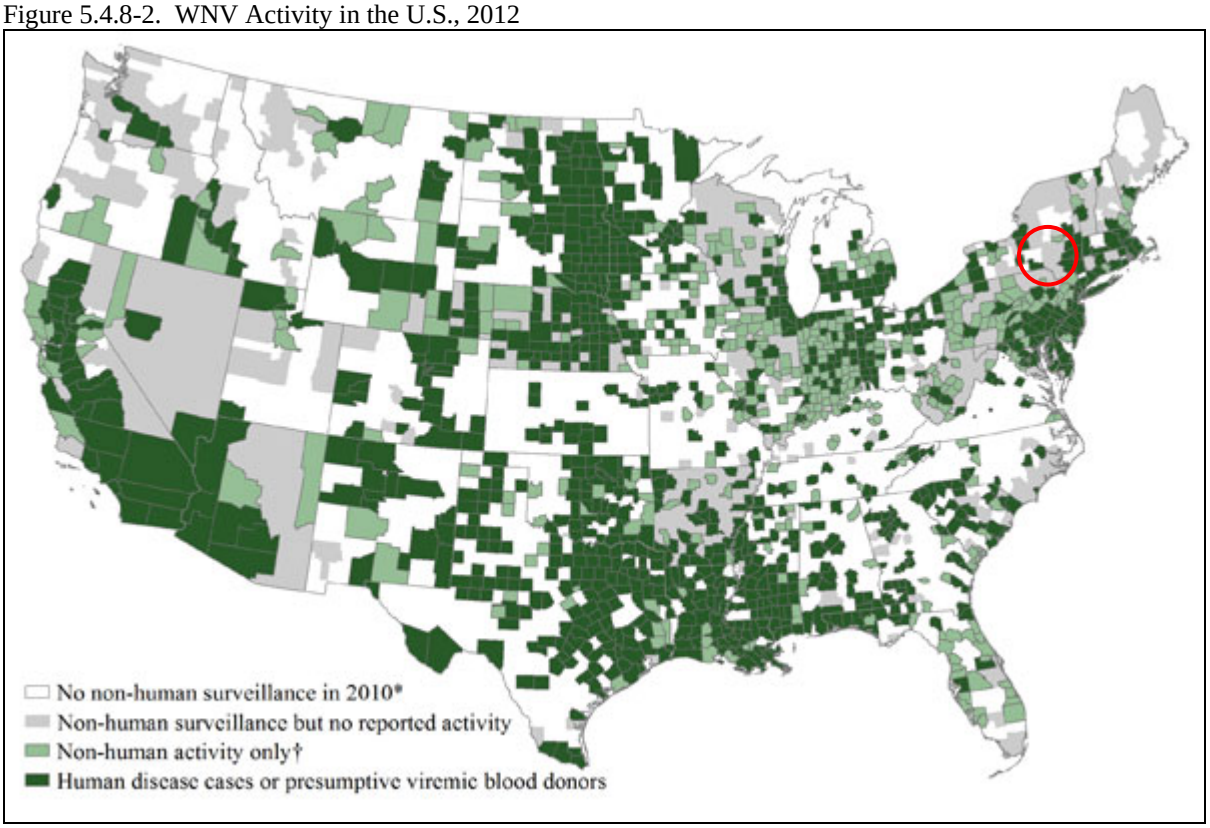
Figure 5.4.8-1. WNV Activity Over Time in North America



Source: USGS, 2012

The CDC has a surveillance program for WNV. Data is collected on a weekly basis and reported for five categories: wild birds, sentinel chicken flocks, human cases, veterinary cases and mosquito surveillance (CDC, 2011). Figure 5.4.8-2 illustrates WNV activity in the U.S. for 2012.

Figure 5.4.8-2. WNV Activity in the U.S., 2012

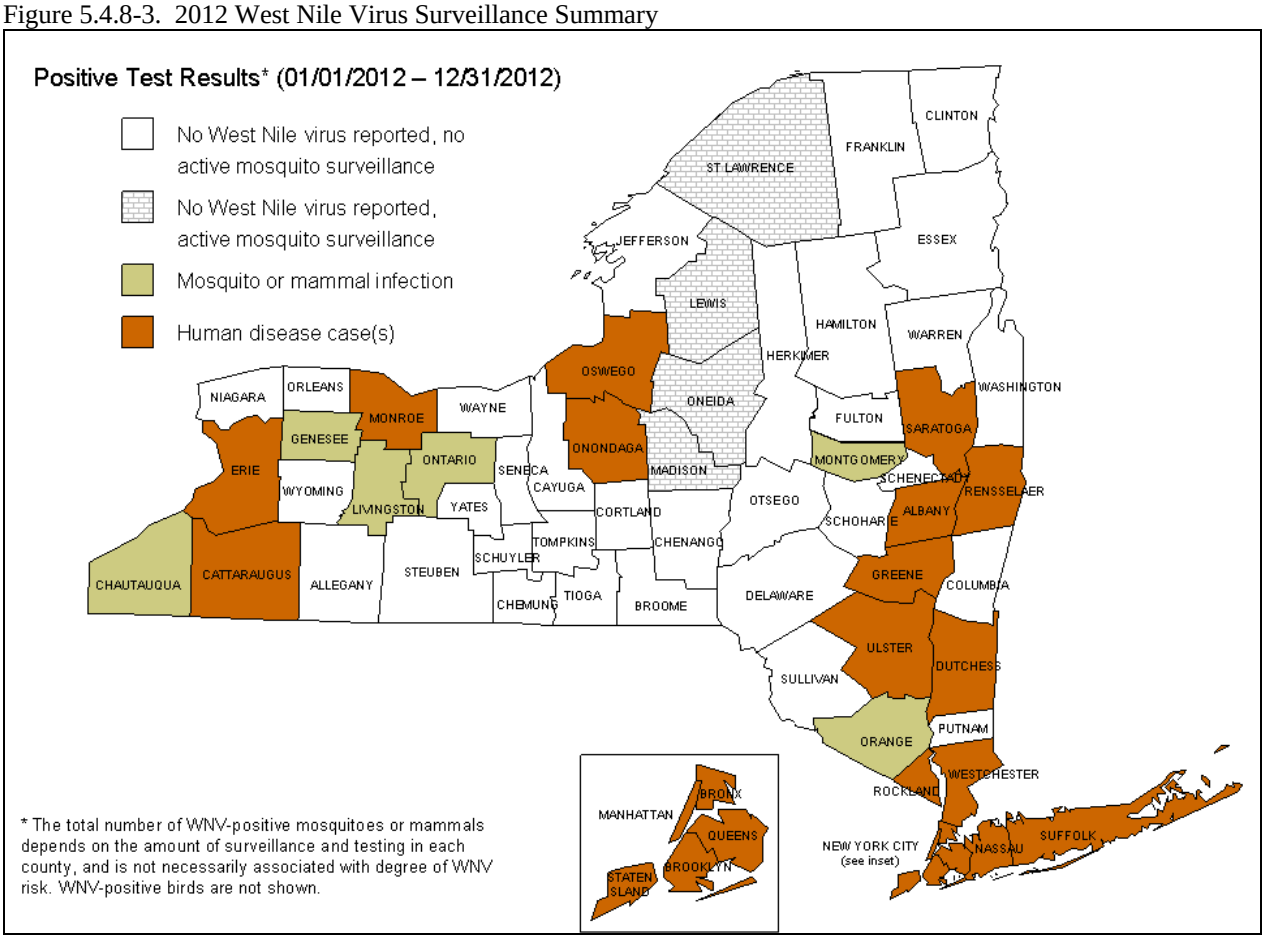


Source: CDC, 2012

Note: The circle indicates the approximate location of Delaware County. Delaware County is indicated has having non-human surveillance of WNV but no reported activity.

WNV has been present in Delaware County since 2000. Based on information provided by the New York State Department of Health (NYSDOH), all of Delaware County has experienced WNV cases from 2000 to present (NYSDOH, 2012). Specific information regarding the location of the cases was not made available. Figure 5.4.8-3 illustrates the location of positive test results of WNV in New York State for 2012. Delaware County was shown as having no reports of WNV and no active mosquito surveillance for 2012.

Figure 5.4.8-3. 2012 West Nile Virus Surveillance Summary



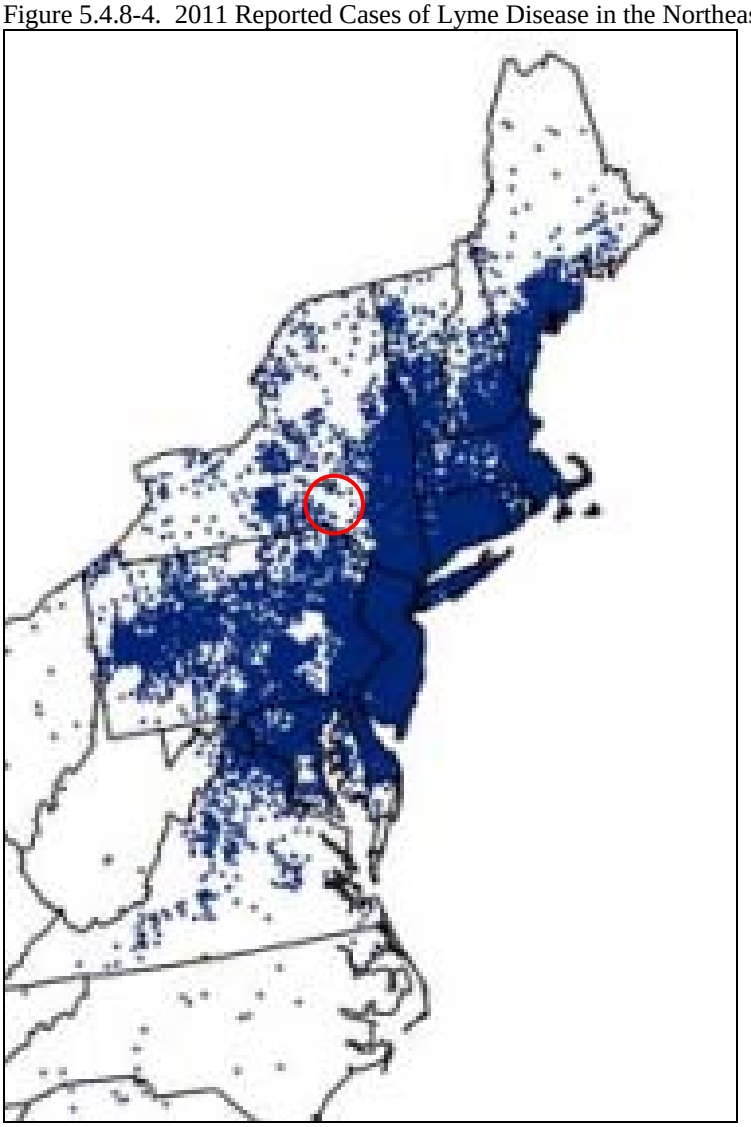
Source: NYSDOH, 2012

Note: The total number of WNV-positive mosquitoes/mammals depends on the amount of surveillance and testing in each county and is not necessarily associated with degree of WNV risk. This figure does not include WNV-positive birds.

Lyme Disease

Lyme disease is the most commonly reported vectorborne illness in the U.S. In 2009, it was the fifth most common nationally notifiable disease. In 2010, 94-percent of Lyme disease cases were reported in 12 states – Connecticut, Delaware, Maine, Maryland, Massachusetts, Minnesota, New Jersey, New Hampshire, New York, Pennsylvania, Virginia, and Wisconsin (CDC, 2011). Figure 5.4.8-4 shows the reported cases of Lyme disease in the northeast U.S. for 2011.

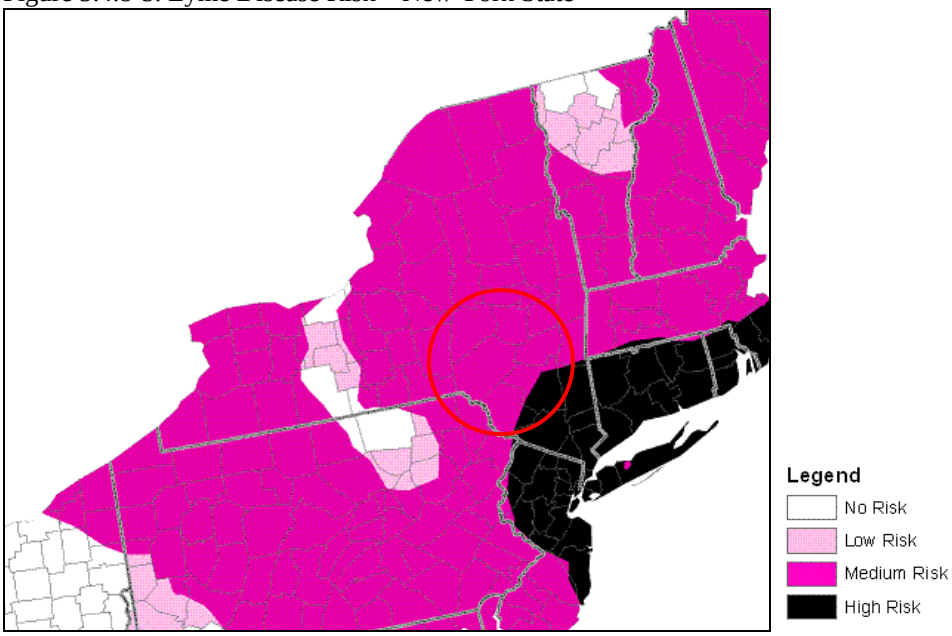
Figure 5.4.8-4. 2011 Reported Cases of Lyme Disease in the Northeast U.S.



Source: CDC, 2011
Note: The red circle indicates the approximate location of Delaware County.

Between 1992 and 2006, Delaware County has reported 30 cases of Lyme disease (CDC, 2011). Specific information regarding the location of the cases was not made available. Figure 5.4.8-5 shows the risk of Lyme disease in New York State, including Delaware County. The figure indicates the Delaware County is at medium risk for Lyme disease.

Figure 5.4.8-5. Lyme Disease Risk – New York State



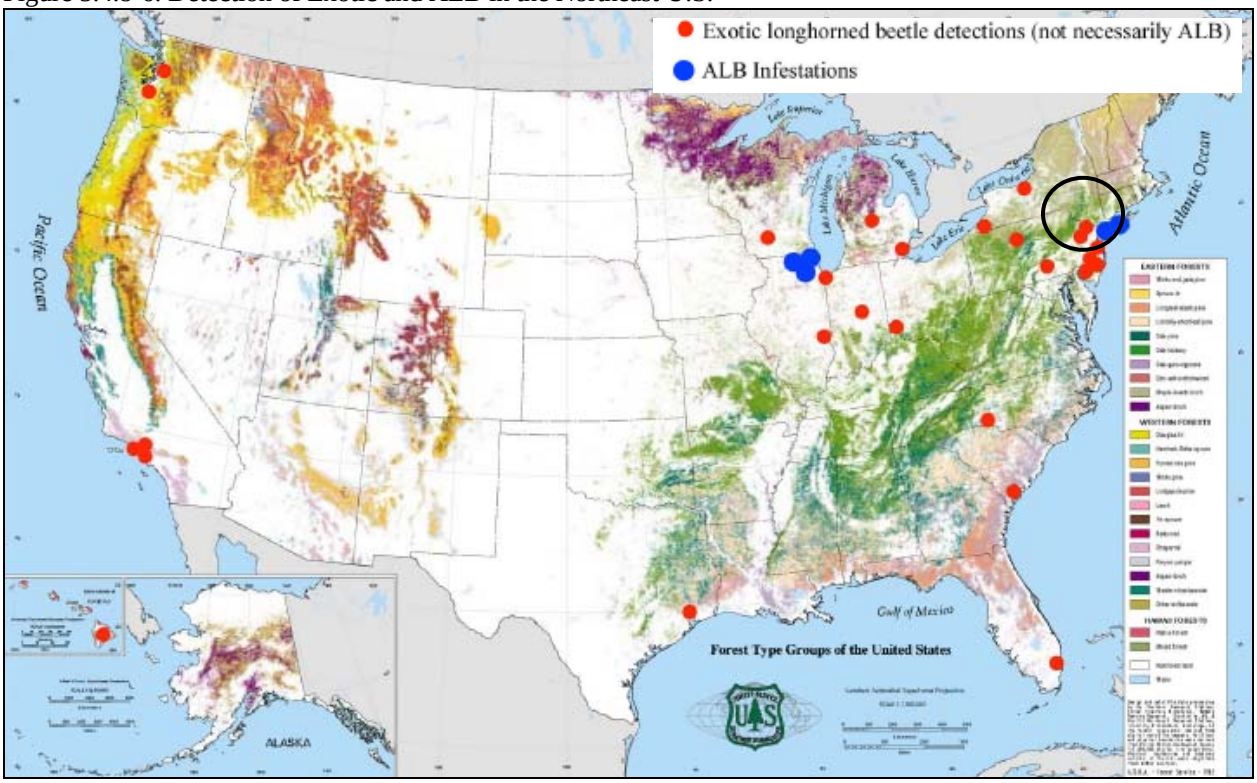
Source: CDC, 1999
Note (1): The red circle indicates the approximate location of Delaware County.
Note (2): **High Risk:** High density of host-seeking nymphal I.scapularis ticks.
Medium Risk: Medium density of host-seeking nymphal I.scapularis ticks or where at least 2-percent of I. pacificus ticks have been shown to be infected with B. burgdorferi.
Low Risk: Areas where I. scapularis or I. pacificus ticks have been reported, but host-seeking nymphs are extremely rare (I. scapularis) or infection prevalence is low (I. pacificus).
No Risk: No reports of I. scapularis or I. pacificus ticks.

Asian Longhorned Beetles (ALB)

Although it is believed that this beetle arrived in the U.S. between the 1980s and 1990s, the ALB was first discovered in McCarren Park of Greenpoint, Brooklyn on August 19, 1996 and soon after in Amityville, Long Island in September 1996. The ALB currently has active regulated areas in Brooklyn, central Long Island, Staten Island and northern New Jersey. The species prefers hardwoods such as red maple, sugar maple, boxelder, Norway maple, sycamore maple, silver maple, horse chestnut, willows, and American elm. It is speculated by NYIS, if the species spreads beyond the current range, millions of acres of hardwood could be killed. This is theorized to be more harmful than Dutch elm disease, chestnut blight, and gypsey moths. The ALB infestation can have negative impacts on forest dependent industries including lumber, maple syrup, wooden furniture, and commercial horticulture (NYIS). The Catskill Regional Invasive Species partnership (CRISP) estimate damages due to losses could be in multi-billion dollar figures. Additionally, the USDA's Animal and Plant Health Inspection Service (APHIS) detected ALB in 26 warehouses and residential sites in 14 states. This detection led to actions that prevented the ALB from getting outdoors.

According to the University of Vermont (UVM) Entomology Research Laboratory, a 2001 map was provided indicating the location of detected ALB infestations throughout the U.S (Figure 5.4.8-6).

Figure 5.4.8-6. Detection of Exotic and ALB in the Northeast U.S.



Source: University of Vermont, 2001

Note: Black Circle represents the approximate location of Delaware County. ALB Infestations were not detected in the County.

The USDA-APHIS Plant Protection and Quarantine (PPQ) has implemented quarantine and control strategies and restrictions in New York State, Illinois, and New Jersey that seek to eradicate this serious pest from the U.S. Quarantine areas have been established where beetles or their damage have been found, as a legal measure taken by a state of federal agency to prohibit the spread of a pest from one area to another. Code of Federal Regulations (e-CFR), Title 7: Agriculture, PART 301—Domestic Quarantine Notices, have been developed by the USDA-APHIS for handling wood and planting trees in these ALB quarantine zones. The Nature Conservancy has indicated that if ALBs were to break out of the established quarantine areas and spread into upstate New York State and New England, they could cause a devastating economic blow to the sugar maple, tourism, timber, and forest product industries. Over 1.5 billion trees are susceptible across New England (The Nature Conservancy, 2007).

Hemlock Woolly Adelgid (HWA)

The HWA, first detected in Virginia in 1950's, was not detected in New York State until the early 1980s. The infestation spread from Long Island and Hudson valley to areas of the Catskill Mountains and Finger Lakes. HWA feed within plant tissue by tapping into the tree's food storage cells. The disruption of nutrient flow leads to eventual death of the tree.

Eastern Equine Encephalitis (EEE)

In the U.S., EEE is reported to the CDC an average of 6 human cases per year (CDC 2010.) In New York State, between 1964 and 2010, there were four cases to the CDC. NYDOH reported five human cases between 1971 and 2011. All cases were fatal.

La Cross Encephalitis

In the U.S., between 80 and 100 cases of La Cross Encephalitis are reported to the CDC. The New York State has 58 reported cases of La Cross Encephalitis between 1964 and 2010.

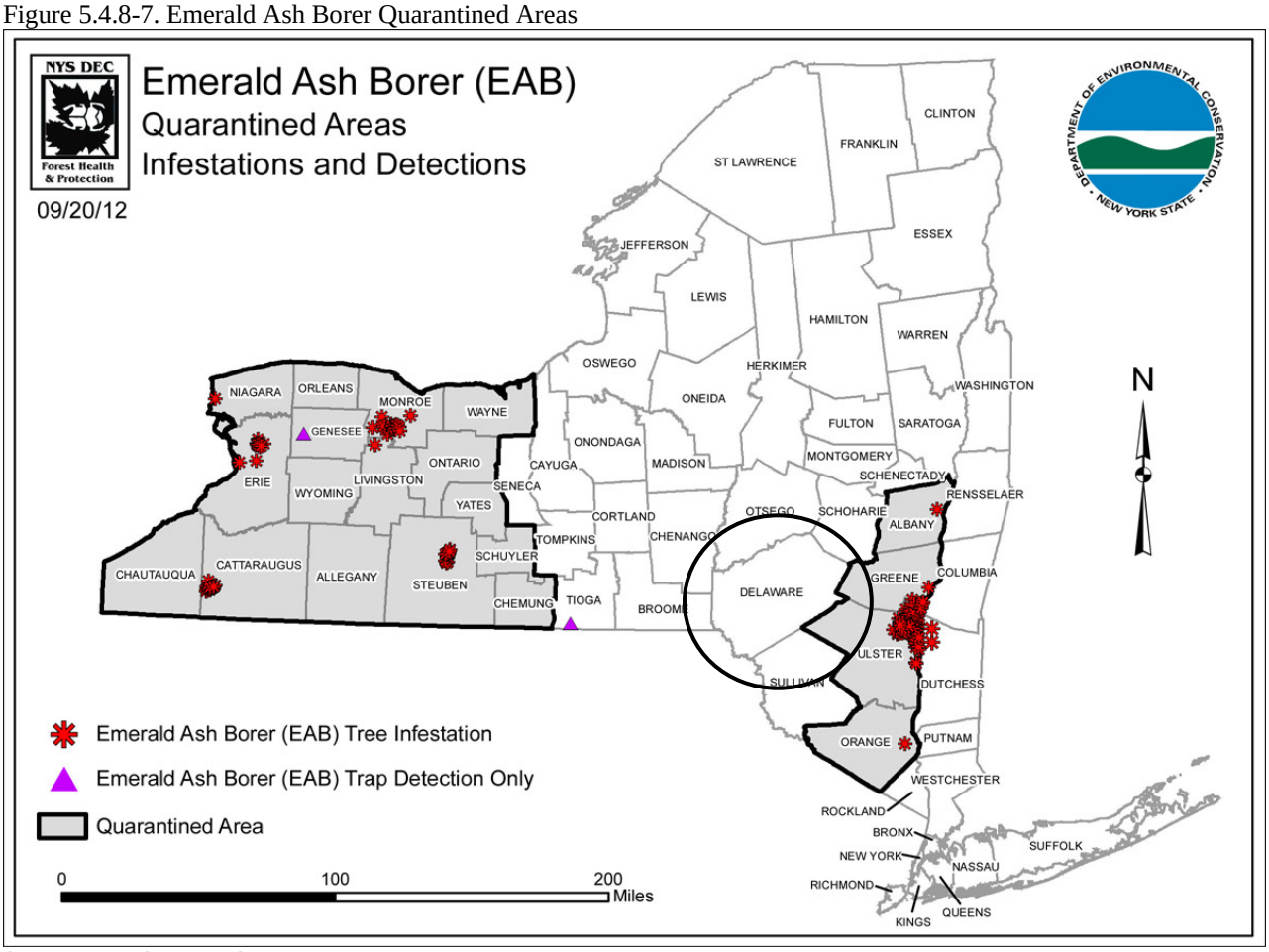
St. Louis Encephalitis (SLE)

In the U.S., there have been over 4,000 confirmed cases of SLE. Since 1964, the average number of cases per year is 193.

Emerald Ash Borer (EAB)

Infestation area is currently 18 states ranging from Kansas to Maryland and Tennessee to Wisconsin. The rapid spread of the EAB is most likely caused by the transportation of infested firewood (NYIS). New York State has prohibited the movement of firewood, mulch, and wood chips larger than one-inch within and beyond the quarantined counties without certification and compliance agreements. New York State counties that are currently the quarantined areas include: Alleghany, Chemung, Erie, Genesee, Greene, Livingston, Monroe, Niagara, Ontario, Orange, Orleans, Schuyler, Steuben, Ulster, Wayne, Wyoming, and Yates. Figure 5.4.8-7 illustrated Delaware County's eastern border is at risk for EAB infestation.

Figure 5.4.8-7. Emerald Ash Borer Quarantined Areas

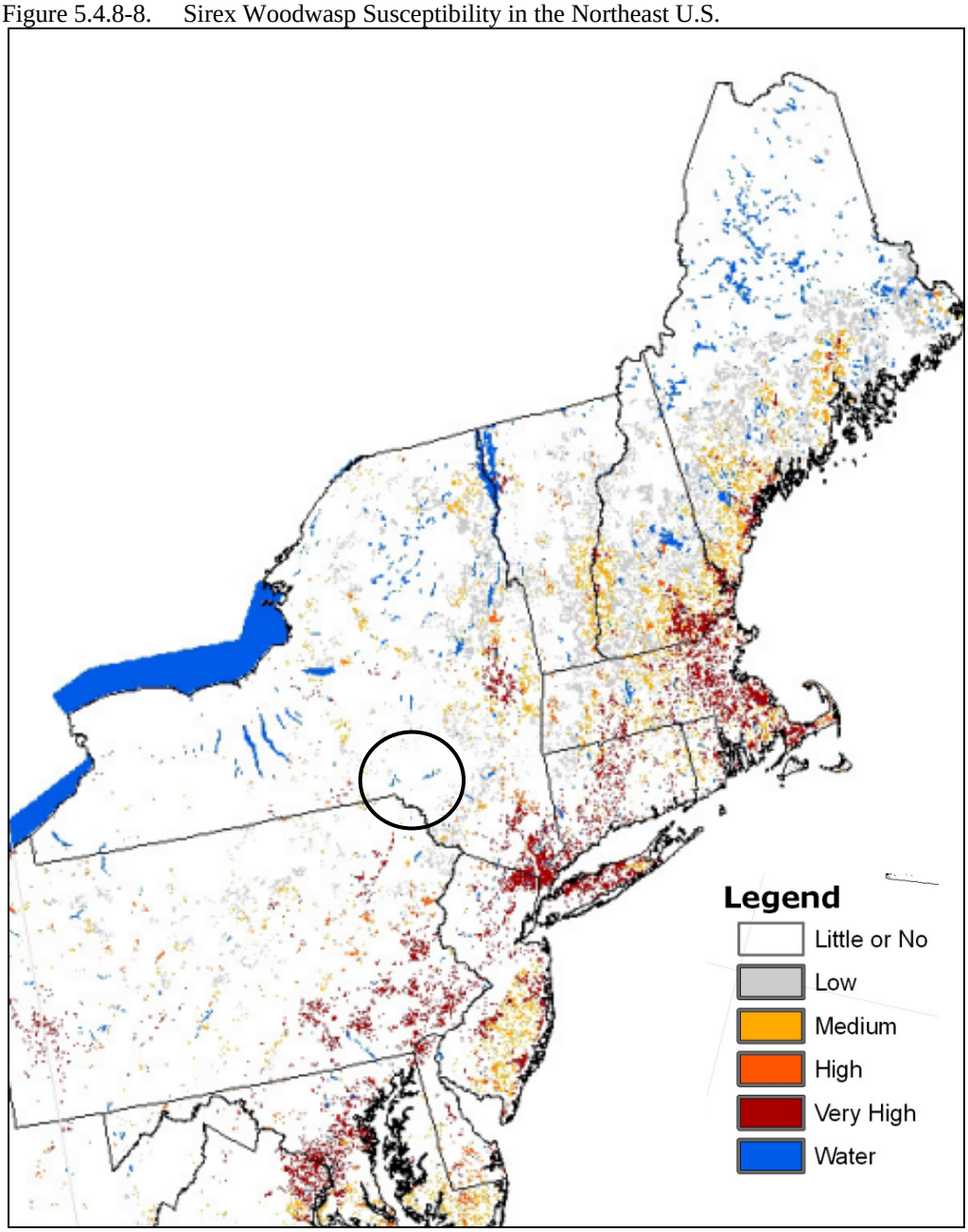


Source: NYIS, NYDEC

Sirex Woodwasp

The species is native to Europe, Asia, and North Africa. It can now be found within the northeast U.S. ranging from Michigan to New Hampshire. In New York State, the most affected species are scots pine, Austrian pine, and red pine from plantations dating to the mid 1900's. The damage to the underperforming trees has a minimal economic effect to the state. However, the economic damage potential is much larger if the species were to spread to southern and Pacific Northwest regions of the U.S. Estimates of potential damages are greater than $17 billion. Figure 5.4.8-8 displays Sirex Woodwasp susceptibility in the northeast U.S.

Figure 5.4.8-8. Sirex Woodwasp Susceptibility in the Northeast U.S.



Source: NYIS, USDA Forest Service
Note: The black circle indicates the approximate location of Delaware County. It appears Delaware County has little to no

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with infestation events throughout New York State and Delaware County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

Between 1954 and 2012, FEMA declared that New York State experienced one infestation-related emergency (EM) classified as a virus threat. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Delaware County was included in this declaration (FEMA, 2012).

Based on all sources researched, known infestation events that have affected Delaware County and its municipalities are identified in Table 5.4.8-1. With infestation documentation for New York State being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.8-1 may not include all events that have occurred throughout the County and region.

Table 5.4.8-1. Infestation Events in Delaware County

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
1996	ALB	N/A	N/A	ALB first detected in New York in the Greenpoint neighborhood of Brooklyn and Amityville.	USDA APHIS
1999	ALB	N/A	N/A	ALB was detected in the Bayside area of Queens County and the Islip are of Long Island, New York	USDA APHIS
2000	WNV	EM-3155	Yes	On October 11, 2000 an Emergency Declaration was federally declared for WNV outbreak. NYSDOH reported 210 birds, 121 mosquito pools, and 8 horses tested positive. FEMA provided up to $5 million in federal funds to reimburse the cost of emergency measures.	FEMA
2002	WNV	N/A	N/A	Total number of West Nile virus positive specimens for New York for the year: 1410 dead birds, 445 mosquito pools, 45 live birds, 36 horses, 83 humans (5 deaths), and 2 squirrels. 8 of the specimen were in Delaware County	NYSDOH
2006	WNV	N/A	N/A	In Delaware County, there were two reports and no cases of WNV, and no deaths related to WNV. Bird samples were submitted; however, there were no positive test results.	Delaware County Public Health, NYSDOH, USGS
2006	Lyme Disease	N/A	N/A	In Delaware County, there were 19 reports and one case of Lyme disease.	Delaware County Public Health
2006 – 2011	St. Louis Encephalitis	N/A	N/A	SLE virus activity has been reported historically in Delaware County; however, no positive test results have been reported or no surveillance has occurred between 2006 and 2011. SLE was not monitored in veterinary.	USGS
2006 – 2011	Eastern Equine Encephalitis	N/A	N/A	EEE virus activity has been reported historically in Delaware County; however, no positive test results have been reported or no surveillance has occurred between 2006 and 2011.	USGS
2006 – 2011	Western Equine Encephalitis	N/A	N/A	WEE virus has not been reported in New York State.	USGS
2006 – 2011	Dengue Fever (locally acquired)	N/A	N/A	Dengue Fever (locally acquired) virus activity has been reported historically in Delaware County; however, no positive test results have been reported or no surveillance has occurred between 2006 and 2011.	USGS
2006 – 2011	Dengue Fever (imported)	N/A	N/A	Dengue Fever (imported) virus activity has been reported historically in Delaware County; however, no positive test results have been reported or no surveillance has occurred between 2006 and 2011.	USGS

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
2006 – 2011	La Crosse Encephalitis	N/A	N/A	LCE virus activity has been reported historically in Delaware County; however, no positive test results have been reported or no surveillance has occurred between 2006 and 2011. LCE was not monitored in bird, sentinel or veterinary.	USGS
2006 – 2011	Powassan Virus	N/A	N/A	POW virus activity has been reported historically in Delaware County; however, no positive test results have been reported or no surveillance has occurred between 2006 and 2011.	USGS
2006 - 2010	Hemlock Woolly Adelgid	N/A	N/A	Delaware County is among the infested counties in New York State.	USFS
2007	WNV	N/A	N/A	In Delaware County, there were two reports and no cases of WNV, and no deaths related to WNV. Bird samples were submitted; however, there were no positive test results.	Delaware County Public Health, NYSDOH, USGS
2007	Lyme Disease	N/A	N/A	In Delaware County, there were 25 reports and four cases of Lyme disease.	Delaware County Public Health
2008	WNV	N/A	N/A	In Delaware County, there was one report and no cases of WNV and no deaths related to WNV. Bird samples were submitted; however, there were no positive test results.	Delaware County Public Health, NYSDOH, USGS
2008	Lyme Disease	N/A	N/A	In Delaware County, there were 37 reports and nine cases of Lyme disease.	Delaware County Public Health, NYSDOH
2009	WNV	N/A	N/A	In Delaware County, there were no cases of WNV or deaths related to WNV. Bird samples were submitted; however, there were no positive test results.	NYSDOH, USGS
2009	Lyme Disease	N/A	N/A	In Delaware County, there were nine cases of Lyme disease.	NYSDOH
2009	Forest Tent Caterpillar	N/A	N/A	The forest tent caterpillar was the most significant defoliator in New York in 2009; approximately 500,000 acres were confirmed defoliated, with damage in the Catskills and west throughout the central portion of the State	USFS
2009	Gypsy Moth	N/A	N/A	In 2009, approximately 30,000 acres were defoliated due to the gypsy moth, with damage concentrated in the western Finger Lakes, southern Catskills and Hudson Valley	USFS
2010	WNV	N/A	N/A	In Delaware County, there were no reports of WNV and no deaths related to WNV.	NYSDOH
2011	WNV	N/A	N/A	In Delaware County, there were no human, bird, mosquito, sentinel or veterinary reports of WNV and there were no deaths related to WNV.	USGS, NYSDOH

EEE	Eastern Equine Encephalitis
FEMA	Federal Emergency Management Agency
LAC	La Crosse Encephalitis
N/A	Not Applicable
NYSDOH	New York State Department of Health
POW	Powassan Virus
SLE	St. Louis Encephalitis
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WEE	Western Equine Encephalitis
WNV	West Nile Virus

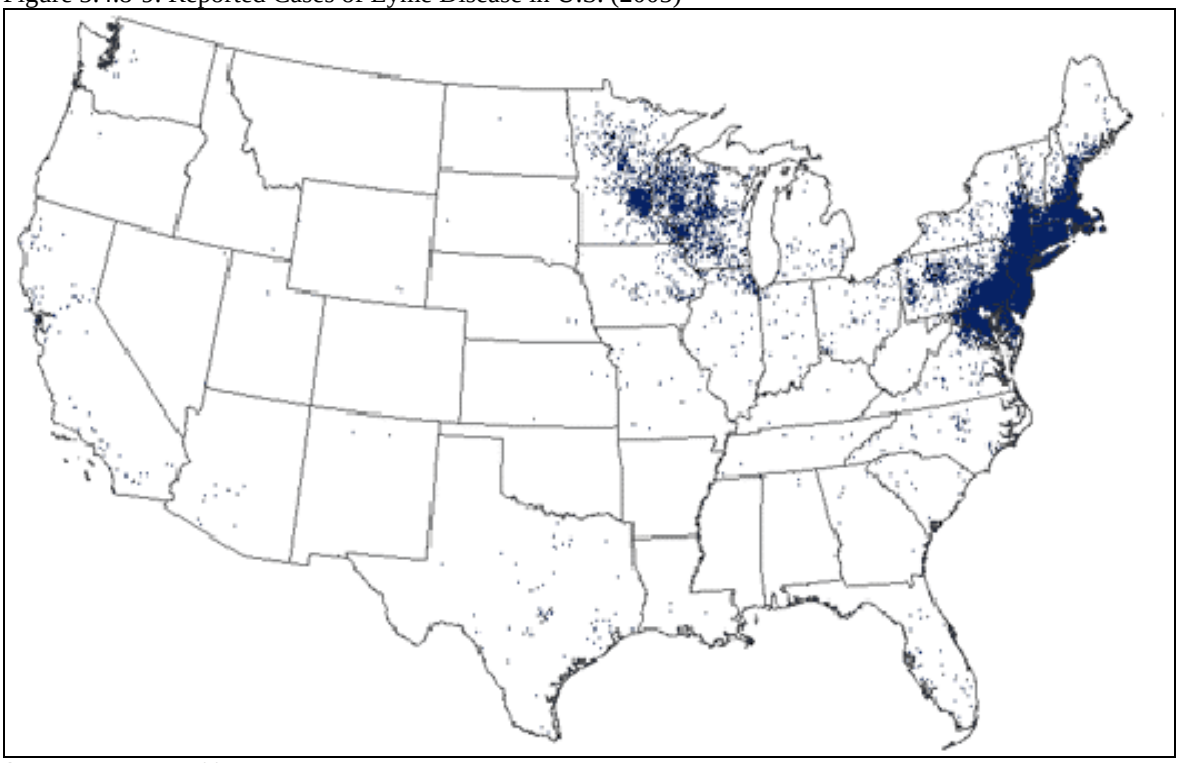
West Nile Virus (WNV and other mosquito-borne diseases)

According to the CDC, since 1999 more than 30,000 people have been reported being sick with WNV. As of December 2012, New York State ranks in the top 13 states for WNV infections. Multiple New York State counties, including Delaware County, have received an Emergency Disaster (EM) Declaration for a WNV outbreak during the summer of 2000, on October 11, 2000 (EM 3155). This EM provided up to $5 million in federal funds to reimburse affected local governments for the cost of emergency measures that were taken to save lives and ensure public health and safety. According to NYSDOH, there have been no reported cases in Delaware County since 2005, but 19 confirmed samples between 2000 and 2004.

Lyme Disease

In 2011, Lyme Disease was the most commonly reported vector-borne illness in the U.S., according to CDC. As of November 2006, over 72,000 cases have been reported for New York State to the NYSDOH since Lyme Disease became reportable in 1986 (NYSDOH, 2006). Since 2003, New York has a reported an average of over 4,500 cases per year (CDC, 2012). Delaware County reported 30 cases of Lyme Disease between the years of 1992 to 2006. Figure 5.4.8-9 identifies that the southeastern portion of New York State had the most reported cases during 2005.

Figure 5.4.8-9. Reported Cases of Lyme Disease in U.S. (2005)



Source: DVBID, 2007
Note: The shaded blue area represents single dots placed randomly within a county of residence for each reported case.

Asian Longhorned Beetle (ALB)

ALBs have caused serious tree losses in both New York State and Illinois, particularly in New York City. According to Mark Buccowich of the USDA Forest Service on November 15, 2001, ALB infestations were responsible for the destruction of a combined 7,900 trees in the quarantined areas in New York State and Illinois between 1998 and 2001. As of 2005, the New York ALB Cooperative Eradication Program

reports that New York State agricultural officials removed and destroyed more than 7,190 trees in and around New York City and Long Island. However, this number of tree losses differs amongst various sources. According to Senator Hillary Clinton in April 2007, the ALB puts 35 percent of American urban trees at serious risk, at a combined replacement value of $669 billion. The threat is even greater in New York City, with 47 percent of its 5.2 million trees susceptible to ALB infestation (Clinton, 2007). Actual monetary losses associated with the destruction, removal and replanting of trees has not been clearly identified for New York State or Delaware County review of available documentation.

Probability of Future Events

Based on historical documentation, increased incidences of infestation throughout New York and the overall impact of changing climate trends, it is estimated that Delaware County and all its jurisdictions will continue to experience infestation events that may induce secondary hazards and health threats to the County population if infestations are not prevented, controlled or eradicated effectively. The Planning Committee views this as a "frequent" hazard of concern (hazard event that occurs more frequently than once in 25 years) (see Table 5.3-3 in Section 5.3).

West Nile Virus (WNV)

WNV, never seen on this continent until eight years ago, has infected more than 21,000 people in the U.S. and Canada and killed more than 800 (Struck, 2006). Based on available data, it is expected that many more incidences will occur in the future throughout the U.S., including New York State.

Lyme Disease

Disease-carrying ticks will continue to inhabit the northeast, including Delaware County, creating an increase in Lyme Disease and other types of infections amongst the county population if not controlled or prevented. Ecological conditions favorable to Lyme disease, the steady increase in the number of cases, and the challenge of prevention predict that Lyme disease will be a continuing public health concern. Personal protection measures, including protective clothing, repellents or acaricides, tick checks, and landscape modifications in or near residential areas, may be helpful. However, these measures are difficult to perform regularly throughout the summer. Attempts to control the infection on a larger scale by the eradication of deer or widespread use of acaricides, which may be effective, have had limited public acceptance. New methods of tick control, including host-targeted acaricides against rodents and deer, are being developed and may provide help in the future (Steere, Coburn, and Glickstein, 2004). Currently and in the future, control of Lyme disease will depend primarily on public and physician education about personal protection measures, signs and symptoms of the disease, and appropriate antibiotic therapy. Based on available information and the ongoing trends of disease-carrying tick populations, it is anticipated that Lyme disease infections will continue to be a threat to Delaware County.

Asian Longhorned Beetle (ALB)

The spread of ALB to other tree populations should be preventable if USDA quarantine restrictions are followed with the ongoing monitoring of area trees for rapid detection of beetle infestations. According to the USDA APHIS, surveys, regulatory measures and control that the ALB problem can and should be eradicated. However, the USDA also indicates that if this beetle continues to spread, potential damage is significant throughout the U.S., including New York State.

The Role of Climate Change on Infestation

Climate change, if it occurs at the level projected by current global circulation models and current resources, may have direct and indirect effects on disease-carrying and nuisance pest infestations and the spread of infectious diseases, especially those transmitted by poikilothermic arthropods such as mosquitoes and ticks, and a variety of other insects (Colwell et. al., 1998). Insects are cold-blooded organisms, where the temperature of their bodies is approximately the same as that of the environment. Therefore, temperature is probably the single most important environmental factor influencing insect behavior, distribution, development, survival, and reproduction. Since insects have proven to be highly adaptable to temperature, they can cope with a variety of environmental changes, including relatively recent changes in the world's climate. It appears that insect species that adapt to warmer climates also will increase their maximum rates of population growth because they have higher metabolic rates and reproduce more frequently, which is likely to have widespread effects on agriculture, public health and conservation (Stricherz, 2006).

Many health experts indicate that climate changes (e.g., global warming), with an accompanying rise in floods and droughts, is fueling the spread of infestations and epidemics (e.g., WNV, Malaria, Lyme Disease). Mosquitoes, ticks, and other nuisance and disease-carrying organisms (e.g., ALB) are surviving warmer winters and expanding their range, bringing increased health threats, creating economic hardships and disrupting agriculture and natural ecological communities as they spread (Struck, 2006). According to the USDA Forest Service, climate directly increases insect populations as longer, warmer, growing seasons permit more annual insect generations, and permit insects to expand their geographic distribution upward in elevation and far north of their historic ranges. Climate indirectly increases insect population densities by increasing temperature and drought stress on trees, reducing trees' ability to resist insect attacks, much like the attacks of the ALB throughout the northeast (USDA, 2007). Although some climate change temperature effects might tend to depress insect populations, most researchers seem to agree that warmer temperatures in temperate climates will result in more types and higher populations of insects (Petzoldt and Seaman, Date Unknown).

As historic and current documentation indicates, mosquitoes and ticks and various other pest organisms flourish throughout New York State. If conditions become warmer and wetter, as predicted, mosquito and tick populations could increase throughout the state, thereby increasing the risk of infestation and transmission of disease to humans and wildlife populations (USEPA, 1997). However, continuous research of climate change on insect populations and distribution and the implementation of public health measures, surveillance, and prevention and control measures will play a large role in determining the future existence or extent of infestations and/or infections within a given region.

The recent outbreaks of WNV across the U.S. (during the 2002 drought) are a preview of how a changing climate could threaten human health. Many mosquito-borne diseases are known to be sensitive to climatic conditions, including increased temperature, among other factors. Now there are indications that climate variability, not just higher temperatures, can also contribute to increased disease. While other factors come into play, WNV outbreaks have been related to a combination of heat and drought followed by heavy downpours. And that kind of weather pattern, according to The Intergovernmental Panel on Climate Change (IPCC), is likely to occur more often with global warming. When WNV first emerged in the U.S., conditions were ideal for an outbreak. The U.S. had never had a documented case of WNV before it was introduced from overseas in 1999. That year, New York City experienced its driest and hottest spring and summer in a century. Stagnant and polluted pools of water throughout the city became the perfect breeding grounds for the mosquito vector, *Culex pipiens*. Mosquitoes fed on birds, drawn to the shrinking pools of water, infecting them with WNV and killing many of them in the process. Uninfected birds flew to wetter habitats as the drought deepened and mosquitoes within the city then had to turn to humans for their next blood meals. The heavy downpours that eventually broke the drought that summer created new breeding sites. The mosquito populations soared and the virus spread. At the end of

the epidemic, more than 8,000 people had been infected, 62 had fallen ill to the virus, and seven died (Despommier and Bloomfield 2002).

Most scientists agree that global climate change will influence infestations and infectious vector-borne disease transmission dynamics; however, the extent and/or severity of the influence is uncertain (Colwell et. al., 1998). Scientists have warned for more than a decade that climate change would broaden the range of insect distribution, infestation and transmission of many diseases. However, the spread of infestation and disease is affected by many uncertainties, including unforeseen resistance to various control measures (e.g., insecticides, pesticides, antibiotics in humans), failures of public health systems, population movement, yearly climate fluctuations and natural insect adaptations to a changing climate. For that reason, some scientists have been cautious about the link between infestations, disease and global warming. Although many uncertainties do exist, the preponderance of evidence indicates that there will be an overall increase in the number of outbreaks of a wider variety of insects and pathogens as a result of climate change throughout the U.S. Therefore, New York State, including Delaware County, will most likely be subject to the on-going presence of these disease-carrying and nuisance pest species in the future as a result of climate change (Petzoldt and Seaman 2006).

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For infestation, Delaware County has been identified as the hazard area. Therefore, all assets in Delaware County, as described in the County Profile section, are vulnerable to infestation. The following text evaluates and estimates the potential impact of infestation on Delaware County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact, including: (1) impact on life, safety and health of county residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time
- Overall vulnerability conclusion

Data and Methodology

Due to a lack of quantifiable loss information, a qualitative assessment was conducted to evaluate the assets exposed to this hazard and the potential impacts associated with this hazard.

Impact on Life, Health and Safety

All of Delaware County's residents are vulnerable to infestation. According to the 2010 U.S. Census, Delaware County had a population of 47,980 people. Persons over the age of 50 are considered most susceptible of becoming seriously ill from a WNV infection. According to the 2000 U.S. Census, there are 8,904 people over the age of 65 in Delaware County (the U.S. Census does not specify the number of people over the age of 50) (U.S. Census, 2000).

Impact on General Building Stock

No structures are anticipated to be directly affected by infestation.

Impact on Critical Facilities

No structures are anticipated to be directly affected by infestation.

Impact on Economy

Infestation's impact on the economy and estimated dollar losses are difficult to measure and quantify. Costs associated with the activities and programs implemented to conduct surveillance and address infestation have not been quantified in available documentation. Instead, activities and programs implemented by the County to address this hazard are described below, all of which could impact the local economy.

Steps taken to address and eradicate ALB may be costly to local governments and impact the economy. As stated earlier, these steps include: (1) quarantine infested areas; (2) cut, chip and burn infested trees; (3) apply of insecticide treatments to decrease beetle populations and prevent future tree loss; and (4) survey impacted areas. Additional costly actions to address ALB include the replanting of trees to make up for the trees removed or destroyed. Lastly, the clean-up and removal of tree debris as a result of severe weather may be prolonged and more costly due to the need to adhere to quarantine areas.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by the infestation hazard because the entire planning area is exposed and vulnerable.

Additional Data and Next Steps

Obtaining historic costs incurred to conduct surveillance, prevent, treat and eradicate infestation may help with quantifying losses, given a margin of uncertainty.

Overall Vulnerability Assessment

Infestation can significantly impact the County's population and economy. The overall hazard ranking determined for this Plan for the infestation hazard is "low" (see Table 5.3-6).