5.4.11 Disease Outbreak

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the disease outbreak hazard in Hunterdon County.

2016 HMP Update Changes

- The disease outbreak hazard profile is new to the 2016 HMP update.

5.4.11.1 Profile

Hazard Description

An outbreak or an epidemic exists when there are more cases of a particular disease than expected in a given area, or among a specific group of people, over a particular period of time. An aggregation of cases in a given area over a particular period, regardless of the number of the number of cases, is called a cluster. In an outbreak or epidemic, it is presumed that the cases are related to one another or that they have a common cause (Center for Disease Control [CDC] 2004).

Of particular concern in Hunterdon County are arthropod-borne viruses (arboviruses), which are viruses that are maintained in nature through biological transmission between susceptible hosts (mammals) and blood-feeding arthropods (mosquitos and ticks). More than 100 arboviruses can cause disease in humans; over 30 have been identified as human pathogens in the western hemisphere (New Jersey Department of Health and Senior Services 2008). Hunterdon County has been impacted by various past and present infestations including: high population of mosquitoes (mosquito-borne diseases) and deer ticks (tick-borne diseases).

Mosquito-borne diseases are diseases that are spread through the bite of an infected female mosquito. There are approximately 36 species of mosquitos in Hunterdon County that have the potential to spread mosquito-borne diseases throughout the County (Hunterdon County Division of Health Services 2015).

Tick-borne diseases are bacterial illnesses that spread to humans through infected ticks. The most common tick-borne diseases in New Jersey are: Lyme disease, Ehrlichiosis, Anaplasmosis, Rocky Mountain spotted fever, and Babesiosis. These types of diseases rely on ticks for transmission. Ticks become infected by microorganisms when feeding on small infected mammals (mice and voles). People who spend a lot of time outdoors have a greater risk of being bitten by an infected tick and becoming infected themselves. It is possible to be infected with more than one tick-borne disease at a time. The three types of ticks in New Jersey that may carry disease-causing micro-organisms are the deer tick, lone star tick, and the American dog tick (New Jersey Department of Health 2013b).

In addition to arboviruses, Hunterdon County has been impacted by influenza outbreaks in the past five years. Most recently, Hunterdon County has been monitoring the Ebola virus and measles; however, there have been no cases in the County. For the purpose of this HMP update, the following disease outbreaks will be discussed in further detail: mosquito-borne (West Nile Virus), tick-borne (Lyme), influenza, measles, and Ebola.

West Nile Virus

West Nile Virus (WNV) encephalitis is a mosquito-borne viral disease, which can cause an inflammation of the brain. WNV is commonly found in Africa, West Asia, the Middle East and Europe. For the first
time in North America, WNV was confirmed in the New York metropolitan area during the summer and fall of 1999. WNV successfully over-wintered in the northeastern U.S. and has been present in humans, horses, birds, and mosquitoes since that time. 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 Jersey Department of Health 2014).

Lyme Disease

Lyme disease is an illness caused by infection with the bacterium *Borrelia burgdorferi*, which is carried by ticks. The infection can cause a variety of symptoms and, if left untreated, can be severe. Lyme disease is spread to people by the bite of an infected tick. In New Jersey, the commonly infected tick is the deer tick. Immature ticks become infected by feeding on infected white-footed mice and other small mammals. Deer ticks can also spread other tick-borne diseases (New Jersey Department of Health 2012b).

Influenza

The risk of a global influenza pandemic has increased over the last several years. This disease is capable of claiming thousands of lives and adversely affecting critical infrastructure and key resources. An influenza pandemic has the ability to reduce the health, safety, and welfare of the essential services workforce; immobilize core infrastructure; and induce fiscal instability.

Pandemic influenza is different from seasonal influenza (or "the flu") because outbreaks of seasonal flu are caused by viruses that are already among people. Pandemic influenza is caused by an influenza virus that is new to people and is likely to affect many more people than seasonal influenza. In addition, seasonal flu occurs every year, usually during the winter season, while the timing of an influenza pandemic is difficult to predict. A severe pandemic could change daily life for a time, including limitations on travel and public gatherings (Barry-Eaton District Health Department 2013).

At the national level, the CDC’s Influenza Division has a long history of supporting the World Health Organization (WHO) and its global network of National Influenza Centers (NIC). With limited resources, most international assistance provided in the early years was through hands-on laboratory training of in-country staff, the annual provision of WHO reagent kits (produced and distributed by CDC), and technical consultations for vaccine strain selections. The Influenza Division also conducts epidemiologic research including vaccine studies and serologic assays and provides international outbreak investigation assistance (CDC 2011).

Measles

Measles is caused by a virus and is normally passed through direct contact and through the air. The virus infects the mucous membranes and then spreads throughout the body. It is highly contagious and considered a very serious disease. In 1980, before widespread vaccination, measles caused an estimated 2.6 million deaths each year. It still remains as one of the leading causes of death among young children. In 2103, approximately 145,700 people died, worldwide, from measles, with a majority of deaths being children under age 5 (World Health Organization 2015).

More recently, in 2015, 178 people from 24 states and Washington D.C. were reported to have measles, with one measles-related death. Most of these cases were part of a large, ongoing outbreak linked to an
amusement park in California. The United States experienced a record number of measles during 2014, with 644 cases from 24 states reported (New Jersey Department of Health 2015)

Ebola Virus

Ebola, previously known as Ebola hemorrhagic fever, is a rare and deadly disease caused by infection with one of the Ebola virus strains. According to the CDC, the 2014 Ebola epidemic is the largest in history affecting multiple countries in West Africa. Two imported cases, including one death, and two locally-acquired cases in healthcare workers have been reported in the United States. CDC and partners are taking precautions to prevent the further spread of Ebola in the United States (CDC, 2014).

Location

Hunterdon County’s geographic location and demographic characteristics make it vulnerable to importation and spread of infectious diseases. In the past, the County has experienced the direct and indirect effects of pandemics and disease outbreaks. There are some densely populated municipalities in Hunterdon County, leading to the spread of influenza and measles more quickly compared to less densely populated communities. Additionally, due to the County’s abundance of waterbodies and forested land, these areas provide breeding grounds for infected mosquitos and ticks.

Mosquito-Borne Diseases

As noted earlier, there are approximately 36 mosquito species within Hunterdon County. Some species play a role in disease transmission, while others cause nuisance and some have no health implications. Each year, populations of each species are monitored throughout the county and abatement activities are implemented when necessary (Hunterdon County Division of Health Services 2015).

Tick-Borne Diseases

Disease-carrying ticks can be found throughout Hunterdon County. Deer ticks, who carry Lyme disease, can be found in shady, moist areas at ground level. They can also be found in lawns, gardens, and at the edge of wooded areas. Deer ticks will cling to tall grasses, brush and shrubs. The county has ideal climate and environmental conditions for ticks and continues to have one of the highest rates of Lymes disease in the United States (Hunterdon County Public Health Nursing and Education 2015).

Extent

The extent and location of disease outbreaks depends on the preferred habitat of the species, as well as the species’ ease of movement and establishment. The magnitude of disease outbreaks species ranges from nuisance to widespread. The threat is typically intensified when the ecosystem or host species is already stressed, such as periods of drought, and the ecosystem may be more easily impacted by the infestation. The disease-carrying mosquitos and ticks have been reported throughout Hunterdon County.

Mosquito-Borne Diseases

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). 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).
Hunterdon County Department of Health mosquito control team works to treat known hot spots of mosquitos to ensure that WNV-nuisance insect populations do not explode. However, it is difficult to predict how insect-borne viruses manifest from year-to-year. The County traps and tests mosquitos for WNV from over 100 public and private sites. In the past, WNV activity in the County typically increases toward mid- to late-July. To lower WNV risk and protect residents, the Team actively conducts mosquito abatement countywide throughout the year (Rainey 2015).

**Tick-Borne Diseases**

Lyme disease is the most commonly reported vector-borne illness in the U.S. In 2009, it was the fifth most common nationally notifiable disease. In 2014, 96% of Lyme disease cases in the U.S. were reported from 14 states, which included New Jersey (CDC 2015). Between 2000 and 2014, there were 5,173 confirmed cases of Lyme disease in Hunterdon County (CDC 2015). The Yale School of Public Health mapped Lyme disease risk for the northeast United States. According to their work, Hunterdon County is at high risk for Lyme disease in humans (Yale School of Public Health 2014).

**Influenza, Measles and Ebola**

The exact size and extent of an infected population depends on how easily the illness will spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in more densely populated areas. The Ebola virus is spread to others through direct contact; it is not spread through the air like influenza.

The severity and length of the next pandemic cannot be predicted. Based on previous pandemics and without medications or vaccines available, it is estimated that a severe pandemic could cause almost 2 million deaths in the United States, more than 9 million hospitalizations, and more than 90 million people ill (New Jersey Department of Health [NJDOH] 2012).

The CDC and Prevention Community Strategy for Pandemic Influenza Mitigation guidance introduced a Pandemic Severity Index (PSI), which uses the case fatality ratio as the critical driver for categorizing the severity of a pandemic. The index is designed to estimate the severity of a pandemic on a population to allow better forecasting of the impact of a pandemic, and to enable recommendations on the use of mitigation interventions that are matched to the severity of influenza pandemic. Pandemics are assigned to one of five discrete categories of increasing severity (Category 1 to Category 5) (NJDOH 2012). Figure 5.4.11-1 illustrates the five categories of the PSI.
In New Jersey, health and supporting agency responses to a pandemic are defined by the WHO phases and federal pandemic influenza stages, and further defined by New Jersey pandemic situations. The State’s situations are similar, but not identical to the United States Department of Homeland Security federal government response stages. Transition from one situation to another indicates a change in activities of one or more New Jersey agencies. Table 5.4.11-1 compares the federal and New Jersey pandemic influenza phases and situations.

Table 5.4.11-1. Federal and New Jersey Pandemic Phases and Situations

<table>
<thead>
<tr>
<th>Federal Pandemic Influenza Stage</th>
<th>New Jersey Situations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0  New domestic outbreak in at-risk country (WHO Phase 1, 2, or 3)</td>
<td>1 Novel (new) influenza virus in birds or other animals outside the U.S.</td>
</tr>
<tr>
<td></td>
<td>2 Novel (new) influenza virus in birds or other animals in the U.S./NJ</td>
</tr>
<tr>
<td>1  Suspected human outbreak overseas (WHO Phase 3)</td>
<td>3 Human case of novel (new) influenza virus outside of the U.S.</td>
</tr>
<tr>
<td>2  Confirmed human outbreak overseas (WHO Phase 4 or 5)</td>
<td>4 Human-to-human spread of novel (new) influenza outside the U.S. (no widespread human transmission)</td>
</tr>
<tr>
<td></td>
<td>5 Clusters of human cases outside the U.S.</td>
</tr>
<tr>
<td>3  Widespread human outbreak in multiple locations overseas (WHO Phase 6)</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5.4.11-1. Federal and New Jersey Pandemic Phases and Situations

<table>
<thead>
<tr>
<th>Federal Pandemic Influenza Stage</th>
<th>New Jersey Situations</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 First human case in North America (WHO Phase 6)</td>
<td>6 Human case of novel (new) influenza virus (no human spread) in the U.S./NJ</td>
</tr>
<tr>
<td>5 Spread in the U.S. (WHO Phase 6)</td>
<td>7 First case of human-to-human spread of novel (new) influenza in the U.S./NJ</td>
</tr>
<tr>
<td></td>
<td>8 Clusters of cases of human spread in the U.S./NJ</td>
</tr>
<tr>
<td></td>
<td>9 Widespread cases of human-to-human spread of novel (new) influenza outside the U.S./NJ</td>
</tr>
<tr>
<td>6 Recovery and preparation for subsequent waves (WHO Phase 5 or 6)</td>
<td>10 Reduced spread of influenza or end of pandemic</td>
</tr>
</tbody>
</table>

*Source: Homeland Security Council 2006; NJDOH 2012
NJ New Jersey
U.S. United States
WHO World Health Organization*

### Previous Occurrences and Losses

For this 2016 Plan Update, known disease outbreaks that have impacted Hunterdon County between 2003 and 2015 are identified in Appendix G. Between 1954 and 2014, the State of New Jersey was included in one disease outbreak-related emergency (EM) declaration, classified as a virus threat due to West Nile Virus impacting the State (EM-3156, May – November 2000). Hunterdon County was included in this declaration (FEMA 2015).

### Probability of Future Occurrences

Predicting the future occurrences of disease outbreaks is difficult; however, based on the history of occurrences in Hunterdon County, it is likely the county will be impacted in the future. Additionally, an increase in population and population density in Hunterdon County have the potential to increase exposure and susceptibility of its residents to outbreaks. Infected mosquitos and ticks will continue to inhabit and impact Hunterdon County.

According to the New Jersey Department of Health, Hunterdon County experienced 9,544 reported diseases (influenza, Lyme disease, West Nile Virus, and mumps) between 1950 and 2015. The table below shows these statistics, as well as the annual average number of events and the percent chance of these incidents occurring in Hunterdon County in future years (New Jersey Department of Health 2015). Based on information readily available, Hunterdon County can anticipate a reportable disease to occur each year.

### Table 5.4.11-2. Probability of Future Occurrences of Disease Outbreak

<table>
<thead>
<tr>
<th>Hazard Type</th>
<th>Number of Occurrences Between 1950 and 2015</th>
<th>Rate of Occurrence or Annual Number of Events (average)</th>
<th>Recurrence Interval (in years) (# Years/Number of Events)</th>
<th>Probability of Event in any given year</th>
<th>% chance of occurrence in any given year</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Nile Virus</td>
<td>4</td>
<td>0.06</td>
<td>16.50</td>
<td>0.06</td>
<td>6.06</td>
</tr>
<tr>
<td>Lyme Disease</td>
<td>9,116</td>
<td>140.25</td>
<td>0.01</td>
<td>138.12</td>
<td>13812.12</td>
</tr>
</tbody>
</table>
### Hazard Type

<table>
<thead>
<tr>
<th>Hazard Type</th>
<th>Number of Occurrences Between 1950 and 2015</th>
<th>Rate of Occurrence or Annual Number of Events (average)</th>
<th>Recurrence Interval (in years) (# Years/Number of Events)</th>
<th>Probability of Event in any given year</th>
<th>% chance of occurrence in any given year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.03</td>
<td>33.00</td>
<td>0.50</td>
<td>50.00</td>
</tr>
<tr>
<td>Influenza</td>
<td>422</td>
<td>6.49</td>
<td>0.16</td>
<td>6.39</td>
<td>639.39</td>
</tr>
<tr>
<td>Ebola</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>9544</td>
<td>146.83</td>
<td>0.01</td>
<td>144.61</td>
<td>14460.61</td>
</tr>
</tbody>
</table>

*Source: New Jersey Department of Health 2015*

In Section 5.3, the identified hazards of concern for Hunterdon County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for disease outbreaks in the county is considered ‘frequent’ (likely to occur within 25 years, as presented in Table 5.3-3).

### Climate Change Impacts

The State of New Jersey has observed an increase in average annual temperatures of 1.2°F between the period of 1971-2000 and the most recent decade of 2001-2010 (ONJSC 2011). Winter temperatures across the Northeast have seen an increase in average temperature of 4 °F since 1970 (Northeast Climate Impacts Assessment [NECIA] 2007). By the 2020s, the average annual temperature in New Jersey is projected to increase by 1.5°F to 3°F above the statewide baseline (1971 to 2000), which was 52.7°F. By 2050, the temperature is projected to increase 3°F to 5°F (Sustainable Jersey Climate Change Adaptation Task Force 2013).

The ONJSC indicates that northern New Jersey, which includes Hunterdon County, has become wetter over the past century. Northern New Jersey’s 1971-2000 precipitation average was over five inches (12%) greater than the average from 1895-1970. Average annual precipitation is projected to increase in the region by 10% by the 2020s and up to 13% by the 2050s. Most of the additional precipitation is expected to come during the winter months (New York City Panel on Climate Change [NPCC] 2015). In addition, heavy precipitation events have increased in the past 20 years.

Warmer temperatures and changing rainfall patterns provide an environment where mosquitos can remain active long, greatly increasing the risk for animals and humans. Lyme disease could also expand throughout the United States as temperatures warm, allowing ticks to move into new areas of the country. The changes in climate can also allow tropical and subtropical insects to move from regions where diseases thrive into new places (Natural Resources Defense Council 2015).

An increase in temperature and humidity may also lead to a larger number of influenza outbreaks. Studies have shown that warmer winters led to an increase in influenza cases. During warm winters, fewer people contract influenza which causes a large number in population to remain vulnerable into the next season. This causes an early and strong occurrence of the virus (Spross 2013).
5.4.11.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable to the identified hazard. For disease outbreaks, all of Hunterdon County is considered exposed to the hazard. Therefore, all assets in the county, as described in the County Profile (Section 4), are exposed and potentially vulnerable. The following text evaluates and estimates the potential impact of disease outbreaks on Hunterdon County including:

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

Overview of Vulnerability

Disease outbreaks are a significant concern to Hunterdon County, mainly due to its impact on public health and natural resources. Estimated losses are difficult to quantify; however, disease outbreaks can impact the County’s population and economy. Areas with a higher population density will have a higher exposure to disease outbreaks, especially those populations living in areas prone to mosquitoes and ticks. Additionally, vulnerable populations such as the young and elderly are considered at higher risk.

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

The entire population of Hunterdon County is exposed and potentially vulnerable to the disease outbreak hazard. Healthcare providers and first responders have an increased risk of exposure due to their frequent contact with infected populations.

Impact on General Building Stock and Critical Facilities

No structures are anticipated to be directly affected by disease outbreaks.

Impact on Economy

The impact disease outbreaks have 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 disease outbreaks 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.

Effect of Climate Change on Vulnerability

The relationship between climate change and infectious diseases is somewhat controversial. The notion that rising temperatures will increase the number of mosquitoes that can transmit malaria or other diseases among humans (rather than just shift their range) has been the subject of debate over the past decade. Some believe that climate change may affect the spread of disease, while others are not convinced.
However, many researchers point out that climate is not the only force at work in increasing the spread of infectious diseases into the future. Other factors, such as expanded rapid travel and evolution of resistance to medical treatments, are already changing the ways pathogens infect people, plants, and animals. Climate change accelerates may likely to work synergistically with many of these factors, especially in populations increasingly subject to massive migration and malnutrition (Harmon 2010).

Impact of 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 disease outbreak hazard because the entire planning area is exposed and vulnerable.

Additional Data and Next Steps

For the HMP update, any additional information regarding historic costs incurred to conduct surveillance, prevent, treat and eradicate disease outbreaks may help with quantifying losses, given a margin of uncertainty. This data will be developed to support future revisions to the plan. Mitigation efforts could include building on existing New Jersey, Hunterdon County, and local efforts.