4.3.2 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 Sussex County.

2021 HMP Changes

- This is a new hazard of concern for Sussex County.

Profile

Hazard Description

An outbreak or an epidemic occurs when new cases of a certain disease, in a given population, substantially exceed what is expected. An epidemic may be restricted to one locale, or it may be global, at which point it is called a pandemic. Pandemic is defined as a disease occurring over a wide geographic area and affecting a high proportion of the population. A pandemic can cause sudden, pervasive illness in all age groups on a local or global scale. A pandemic is a novel virus to which humans have no natural immunity that spreads from person-to-person. A pandemic will cause both widespread and sustained effects and is likely to stress the resources of both the State and federal government (NJOEM 2019).

Of particular concern in Sussex 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). New Jersey 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. The three most common mosquito-borne diseases in New Jersey are: West Nile Virus (WNV), Eastern equine encephalitis (EEE) virus, and St. Louis encephalitis (SLE) virus. These diseases rely on mosquitos to spread. They become infected by feeding on birds carrying the virus; and then spread to humans and other animals when the mosquito bites them (New Jersey Department of Health 2013).

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 Babesiois. These types of diseases rely on ticks for transmission. Ticks become infected by micro-organisms when feeding on small infected mammals (mice and voles). Different tick-borne diseases are caused by different micro-organisms, and it is possible to be infected with more than one tick-borne disease at a time. Anyone who is bitten by an infected tick may get a tick-borne disease. People who spend a lot of time outdoors have a greater risk of becoming infected. 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).

For the purpose of this HMP update, the following arboviruses will be discussed in further detail: West Nile Virus, Eastern Equine Encephalitis virus, St. Louis Encephalitis virus, Lyme disease, and Ebola virus. Influenza will also be discussed due to several outbreaks in the past five years. In addition, due to the COVID-19 pandemic that emerged during the development of this plan update, a brief description is described in this section.

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).

Eastern Equine Encephalitis

Eastern Equine Encephalitis (EEE) is a virus disease of wild birds that is transmitted to horses and humans by mosquitoes. It is a rare but serious viral infection. EEE is most common in the eastern half of the U.S. and is spread by the bite of an infected mosquito. EEE can affect humans, horses, and some birds. The risk of getting this virus is highest from late July through early October (New Jersey Department of Health 2012a). New Jersey represents a major focus for the infection with some form of documented viral activity nearly every year. Horse cases are most common in the southern half of New Jersey because the acid water swamps that produce the major mosquito vectors are especially prevalent on the southern coastal plain (Crans 2013).

St. Louis Encephalitis

St. Louis Encephalitis (SLE) is a rare but serious viral infection. It 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 2019).

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. Anyone who is bitten by a tick carrying the bacteria can become infected (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. Densely populated areas will spread diseases quicker than less densely populated areas (NJOEM 2019).

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. Pandemic influenza is likely to affect more people than the seasonal flu, including young adults. 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 provided international outbreak investigation assistance (CDC 2010).

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).

Coronavirus

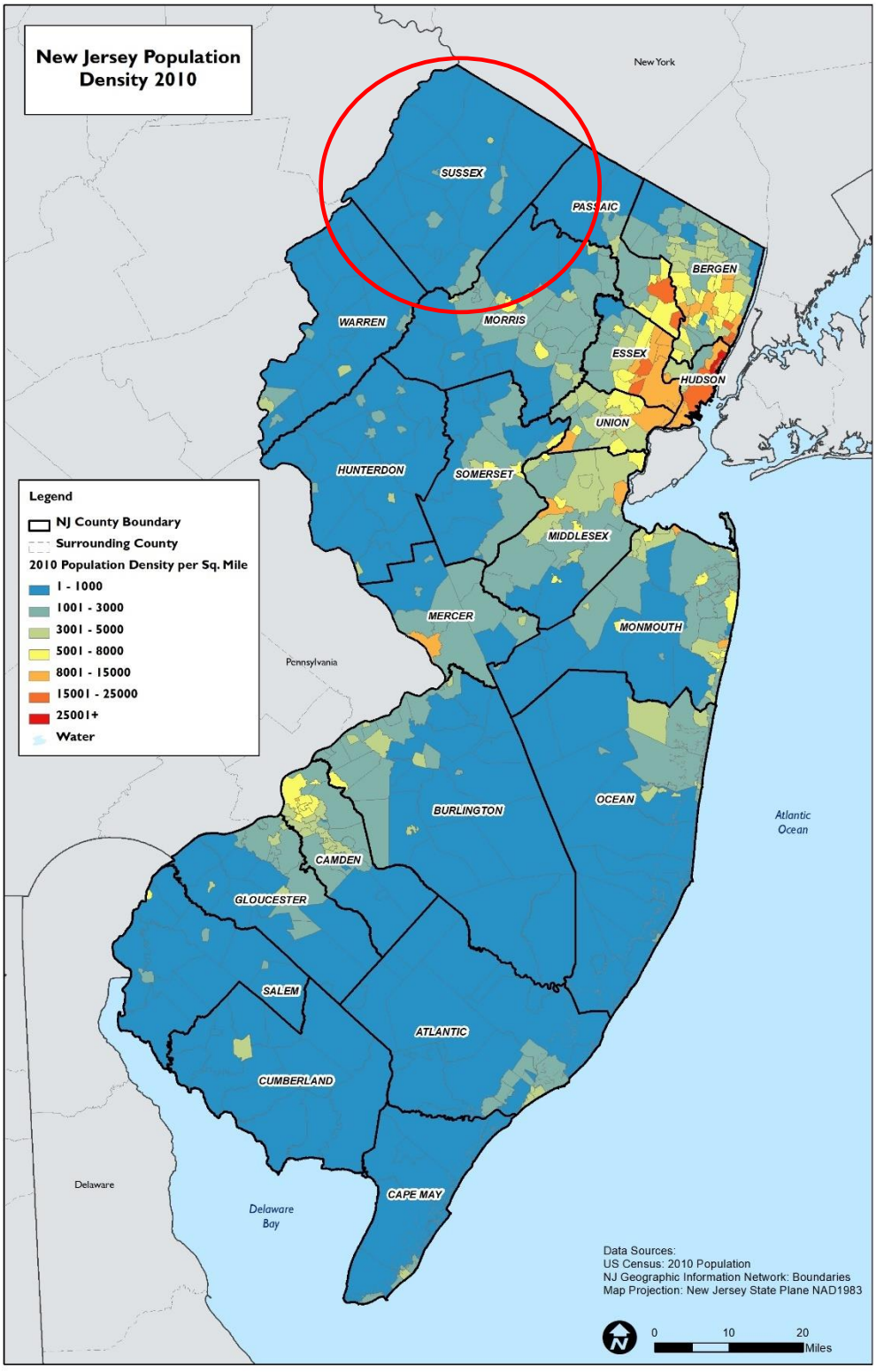
Coronavirus disease (COVID-19) is an infectious disease first identified in 2019. The virus rapidly spread into a global pandemic by spring of 2020. The elderly and those with underlying medical conductions such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness (WHO 2020). With the virus being relatively new, information regarding transmission and symptoms of the virus is emerging from the research. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Reported illnesses have ranged from mild symptoms to severe illness and death. Reported symptoms include trouble breathing, persistent pain or pressure in the chest, new confusion or inability to arouse, and bluish lips or face. Symptoms may appear 2-14 days after exposure to the virus (based on the incubation period of MERS-CoV viruses) (CDC 2020).

In an effort to slow the spread of the virus, the federal government and States have urged the public to avoid touching of the face, properly wash hands often, and use various social distancing measures. At the time of this plan update, there are no specific vaccines or treatments for COVID-19. However, there are many ongoing clinical trials evaluating potential treatments (WHO 2020).

Location

New Jersey's geographic and demographic characteristics make it particularly vulnerable to importation and spread of infectious diseases. All 21 counties in New Jersey have experienced the effects of a pandemic or disease outbreak. In terms of pandemic influenza, all counties may experience pandemic influenza outbreak caused by factors such as population density and the nature of public meeting areas. Densely populated areas will spread diseases quicker than less densely populated areas. Figure 4.3.2-1 shows population density throughout the State. Additionally, much of the State can experience other diseases such as WNV due to the abundance of water bodies throughout the State, which provide a breeding ground for infected mosquitos.

Figure 4.3.2-1. New Jersey Population Density (United States Census 2010)



Source: *United States Census 2010; New Jersey Geographic Information Network (NJGIN)*
Note: *Sussex County is circled in red.*

Extent

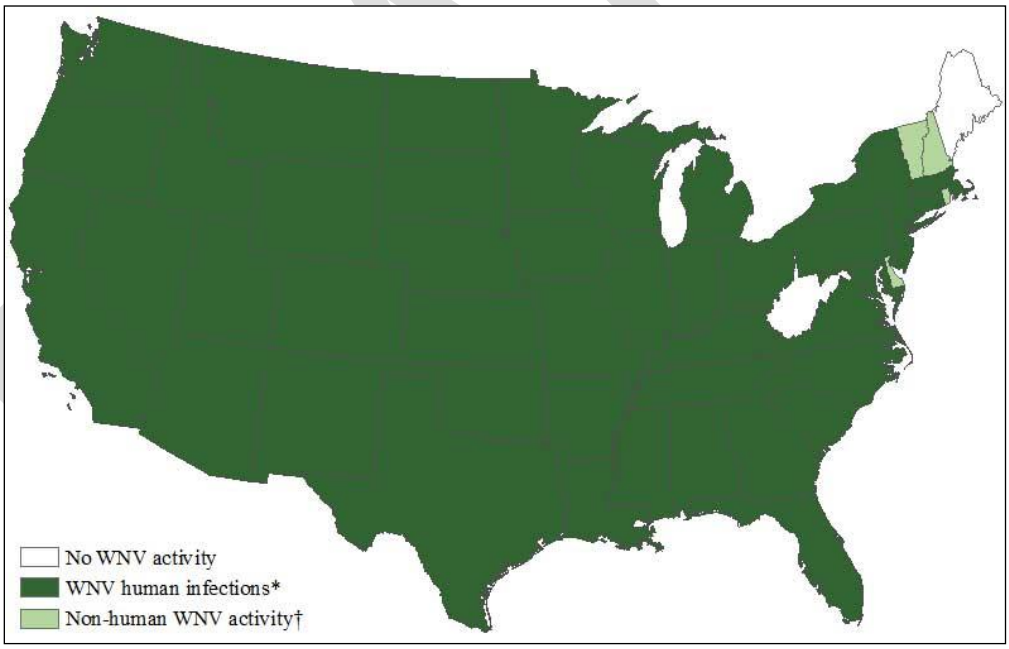
The exact size and extent of an infected population depends on how easily the illness is spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in more densely populated areas. The transmission rate of infectious diseases will depend on the mode of transmission of a given illness.

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. The already weakened state of the ecosystem causes it to more easily be impacted to an infestation. The presence of disease-carrying mosquitoes and ticks has been reported throughout most of New Jersey and Sussex County.

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. As of January 2020, every state in the continental United States aside from Maine and West Virginia has WNV activity with Delaware, Rhode Island, Vermont, and New Hampshire only being impacted by non-human WNV activity. Figure 4.3.2-2 shows the activity of WNV by state.

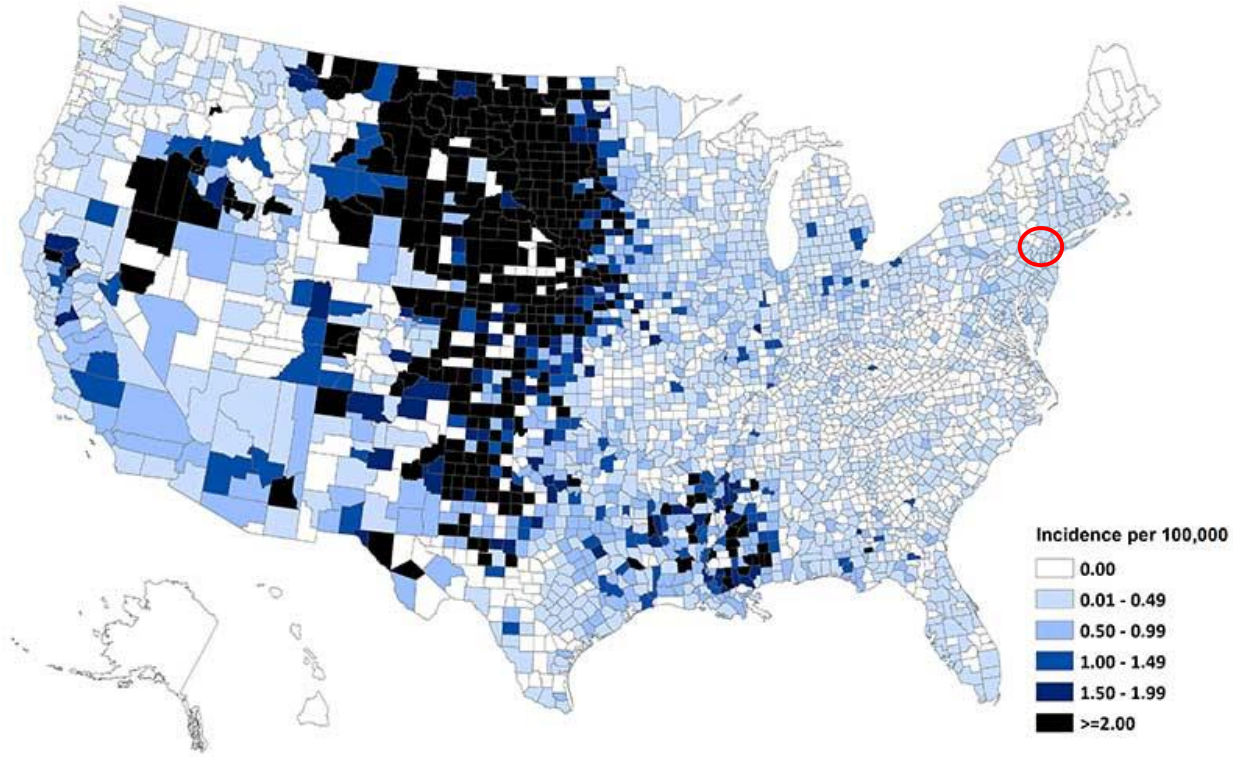
Figure 4.3.2-2. WNV Activity by State 2019



Source: CDC 2020

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 2019). Figure 4.3.2-3 illustrates WNV activity in the U.S. from 1999-2018.

Figure 4.3.2-3. Average Annual Incidence of West Nile Virus Neuroinvasive Disease Reported to CDC by County, 1999-2018



Source: *CDC 2019*
Note: *The circle indicates the approximate location of Sussex County.*

Eastern Equine Encephalitis

In the State of New Jersey, there has been five cases of EEE from 2010-2019 (CDC 2019.)

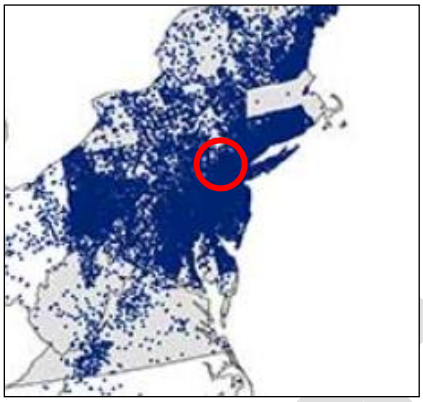
St. Louis Encephalitis

In the State of New Jersey, there have been no cases of St. Louis virus neuroinvasive disease from 2010-2019. However, nearby states have reported cases (CDC 2019).

Lyme Disease

Lyme disease is the most commonly reported vector borne illness in the U.S. Between 2014 and 2018, there were 1,404 confirmed cases of Lyme disease in Sussex County (NJ DOH 2020). Figure 4.3.2-4 shows the reported cases of Lyme disease in the northeast U.S. for 2018.

Figure 4.3.2-4. 2018 Reported Cases of Lyme Disease in the Northeast U.S.

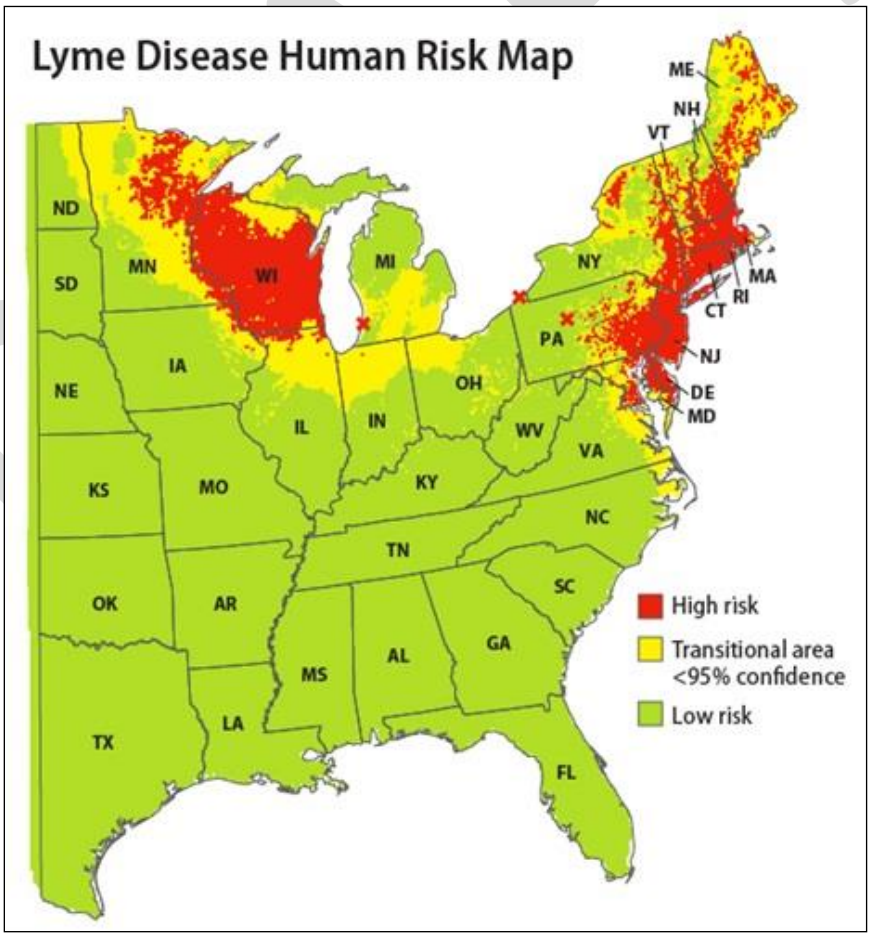


Source: *CDC 2019*

Note: *The red circle indicates the approximate location of Sussex County.*

Figure 4.3.2-5 shows the risk of Lyme disease in the northeastern U.S. The figure indicates that Sussex County is located in a high-risk area.

Figure 4.3.2-5. Lyme Disease Human Risk Map in the Northeast U.S.



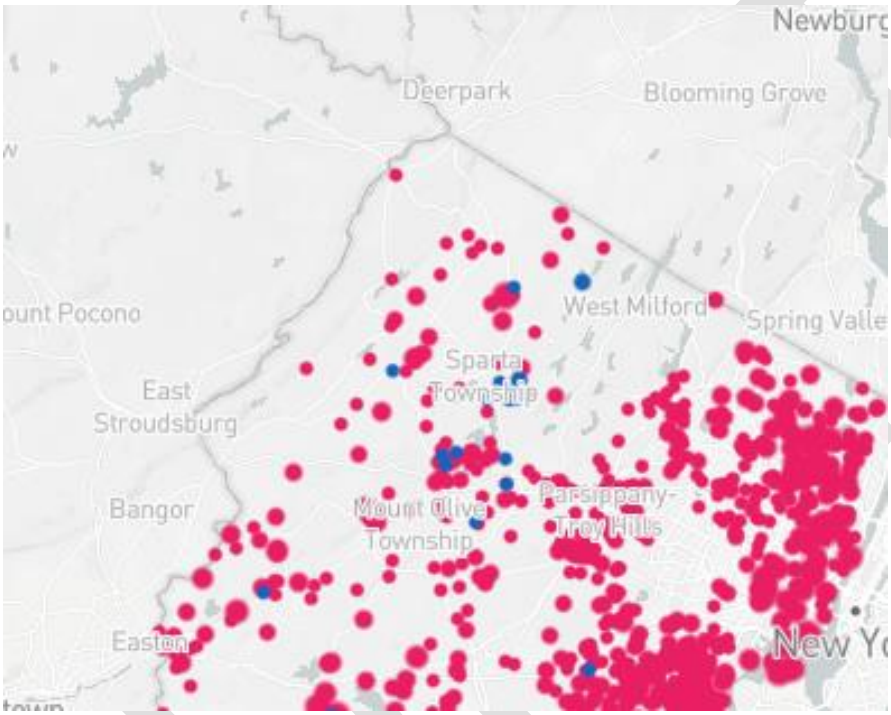
Source: *Yale School of Public Health, 2013*

Note (1): *Sussex County is in a high risk or transitional area.*

The CDC Division of Vector Borne Diseases (DVBD) indicated in 2018 that New Jersey was the state with the second-highest number of confirmed Lyme disease cases, totaling approximately 4,000 cases. For total number of cases between 2007 and 2017, New Jersey ranked third highest for the number of confirmed Lyme disease cases, totaling approximately 32,731 (12.4% of the total reported cases in the U.S.) New Jersey is also considered a High Incidence State for Lyme Disease, with the average incidence of at least 10 confirmed cases per 100,000 persons for three reporting years (CDC 2018).

Figure 4.3.2-6 below shows reports of arbovirus in Sussex County between January 2003 and October 2020. The red dots are for locations of mosquitos with West Nile Virus, whereas blue dots show the location of mosquitos carrying Eastern Equine Encephalitis.

Figure 4.3.2-6. Arbovirus Reports in Sussex County



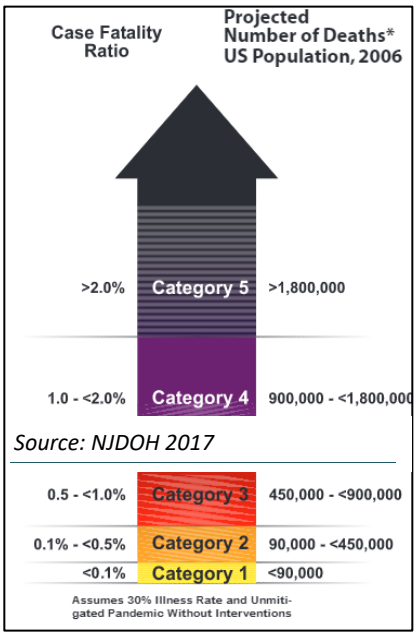
Source: VectorSurv Maps 2020

Influenza, Ebola and Coronavirus

The severity of a pandemic or infectious disease threat in New Jersey will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. Pandemics around the nation have the potential to affect New Jersey's populated areas.

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

Figure 4.3.2-7. Pandemic PSI



Source: NJDOH 2017

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, 2017). Figure 4.3.2-7 illustrates the five categories of the Pandemic Severity Index (PSI).

In 1999, the WHO Secretariat published guidance for pandemic influenza and defined the six phases of a pandemic. Updated guidance was published in 2005 to redefine these phases. This schema is designed to provide guidance to the international community and to national governments on preparedness and response for pandemic threats and pandemic disease. Compared with the 1999 phases, the new definitions place more emphasis on pre-pandemic phases when pandemic threats may exist in animals or when new influenza virus subtypes infect people but do not spread efficiently. Because recognizing that distinctions between the two interpandemic phases and the three pandemic alert phases may be unclear, the WHO Secretariat proposes that classifications be determined by assessing risk based on a range of scientific and epidemiological data (WHO 2009). The WHO pandemic phases are outlined in Table 4.3.2-1.

Table 4.3.2-1. WHO Global Pandemic Phases

Phase	Description
Preparedness	
Phase 1	No viruses circulating among animals have been reported to cause infections in humans.
Phase 2	An animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans, and is therefore considered a potential pandemic threat.
Phase 3	An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, for example, when there is close contact between an infected person and an unprotected caregiver. However, limited transmission under such restricted circumstances does not indicate that the virus has gained the level of transmissibility among humans necessary to cause a pandemic.
Response and Mitigation Efforts	
Phase 4	Human infection(s) are reported with a new subtype, but no human-to-human spread or at most rare instances of spread to a close contact.
Phase 5	Characterized by human-to-human spread of the virus into at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.
Phase 6	The pandemic phase, is characterized by community level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way.

Source: WHO 2009

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 4.3.2-2 compares the federal and New Jersey pandemic influenza phases and situations.

Table 4.3.2-2. Federal and New Jersey Pandemic Phases and Situations

Federal Pandemic Influenza Stage		New Jersey Situations	
0	New domestic outbreak in at-risk country (WHO Phase 1, 2, or 3)	1	Novel (new) influenza virus in birds or other animals outside the U.S.
		2	Novel (new) influenza virus in birds or other animals in the U.S./NJ
1	Suspected human outbreak overseas (WHO Phase 3)	3	Human case of novel (new) influenza virus outside of the U.S.
2	Confirmed human outbreak overseas (WHO Phase 4 or 5)	4	Human-to-human spread of novel (new) influenza outside the U.S. (no widespread human transmission)
		5	Clusters of human cases outside the U.S.
3	Widespread human outbreak in multiple locations overseas (WHO Phase 6)		
4	First human case in North America (WHO Phase 6)	6	Human case of novel (new) influenza virus (no human spread) in the U.S./NJ
5	Spread in the U.S. (WHO Phase 6)	7	First case of human-to-human spread of novel (new) influenza in the U.S./NJ
		8	Clusters of cases of human spread in the U.S./NJ
		9	Widespread cases of human-to-human spread of novel (new) influenza outside the U.S./NJ
6	Recovery and preparation for subsequent waves (WHO Phase 5 or 6)	10	Reduced spread of influenza or end of pandemic

Source: NJOEM 2019

NJ New Jersey

U.S. United States

WHO World Health Organization

Previous Occurrences and Losses

FEMA Major Disasters and Emergency Declarations

Between 1954 and 2020, Sussex County was included in two emergency declarations and one disaster declaration related to disease outbreak.

Table 4.3.2-3. Disease-Related Disaster (DR) and Emergency (EM) Declarations 1954-2020

Declaration	Event Date	Declaration Date	Event Description
EM-3156	May 30-November 1,2000	November 1, 2000	West Nile Virus
DR-4488 / EM-3451	January 20,2000 to present	March 25, 2020 and March 13, 2020	New Jersey COVID-19 Pandemic

Source: FEMA 2020

Disease Outbreak Events

Disease outbreak events that have impacted Sussex County between 2015 and 2020 are listed in Table 4.3.2-3. Please see Section 9 (Jurisdictional Annexes) for detailed information regarding impacts and losses to each municipality.

Table 4.3.2-3. Previous Occurrences of Disease Outbreak Events, 2014-2020

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Sussex County Designated?	Description
2014	Influenza	N/A	N/A	In 2014, 65 cases of nfluenza were reported in Sussex County.
2014	Lyme Disease	N/A	N/A	In 2014, 258 cases of Lyme disease were reported in Sussex County.
2015	Influenza	N/A	N/A	In 2015, 43 cases of influenza were reported in Sussex County.
2015	Lyme Disease	N/A	N/A	In 2015, 309 cases of Lyme disease were reported in Sussex County.
2016	Influenza	N/A	N/A	In 2016, 54 cases of influenza were reported in Sussex County.
2016	Lyme Disease	N/A	N/A	In 2016, 260 cases of Lyme disease were reported in Sussex County.
2017	Influenza	N/A	N/A	In 2017, 151 cases of influenza were reported in Sussex County.
2017	Lyme Disease	N/A	N/A	In 2017, 331 cases of Lyme disease were reported in Sussex County.
2017	West Nile Virus	N/A	N/A	In 2017, one case of West Nile Virus was reported in Sussex County.
2017	Zika Virus	N/A	N/A	In 2017, one case of Zika virus was reported in Sussex County
2018	Influenza	N/A	N/A	In 2018, 306 cases of influenza were reported in Sussex County.
2018	Lyme Disease	N/A	N/A	In 2018, 246 cases of Lyme disease were reported in Sussex County.
2019	Influenza	N/A	N/A	In 2019, 251 cases of influenza were reported in Sussex County.
2019	Lyme Disease	N/A	N/A	In 2019, 246 cases of Lyme disease were reported in Sussex County.
2020	Coronavirus	DR-4488 / EM-3451	Yes	In early spring of 2020, the coronavirus pandemic began. High numbers of hospitalizations and deaths prompted masking and social distancing requirements and the closure of schools and non-essential businesses. At the time of this plan update, the pandemic continues as do many social distancing and masking requirements. By October 19, 2020, Sussex County had recorded 1,652 cases and 197 deaths.

Source: FEMA 2020; NJDOH 2021

Note: Not all events that have occurred in Sussex County are included due to the extent of documentation and the fact that not all sources have been identified or researched.

Reportable disease statistics in NJ were only available up to 2018 at the writing of this plan update.

Probability of Future Occurrences

It is difficult to predict when the next disease outbreak will occur and how severe it will be because viruses are always changing. The Department of Health and Human Services and others are developing supplies of vaccines and medicines. In addition, the United States has been working with the WHO and other countries to strengthen detection of disease and response to outbreaks. Preparedness efforts are ongoing at the national, State, and

local level (NJOEM 2019). The Sussex County Division of Health is leading the effort in coordination with Sussex County DEM and other departments on the COVID-19 response.

In Sussex County, the probability for a future disease outbreak event is dependent on several factors. One factor that influences the spread of disease is population density. Populations that live close to one another are more likely to spread diseases. All of the critical components necessary to sustain the threat of mosquito-borne disease in Sussex County have been clearly documented. Instances of the WNV have been generally decreasing because of aggressive planning and eradication efforts, but some scientists suggest that as global temperatures rise and extreme weather conditions emerge from climate change, the range of the virus in the United States will grow (Epstein 2001). While instances of Zika have decreased since the outbreak in 2016, there is still the possibility of an outbreak occurring in the future. Therefore, based on all available information and available data regarding mosquito populations, it is anticipated that mosquito-borne diseases will continue to be a threat to Sussex County.

Disease-carrying ticks will continue to inhabit the northeast, including Sussex 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 Sussex County.

In Section 4.4, the identified hazards of concern for Sussex 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 Partnership, the probability of occurrence for disease outbreak in the County is considered ‘frequent’ (100 percent annual probability; a hazard event may occur multiple times per year, as presented in Table 4.4-1). The ranking of the disease outbreak hazard for individual municipalities is presented in the jurisdictional annexes (Section 9).

Climate Change Impacts

The relationship between climate change and increase in infectious diseases is difficult to predict with certainty, although there are scientific linkages between the two. Increased rainfall and heavy rainfalls increase the chances of standing water where mosquitos breed. As warm habitats that host insects such as mosquitoes increase, this may lead to an increase in individuals exposed to potential virus threats (The Washington Post, 2017). The notion that rising temperatures will increase the number of mosquitoes that can transmit diseases such as WNV and Zika 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 (NJOEM 2019). Increased rainstorms contribute to flooding and poor drainage in Sussex County. As flooding events increase in the County owing to climate change, water-borne and vector-borne diseases (particularly those associated with mosquitos) may similarly increase owing to the prevalence of standing water over long periods (World Health Organization).

Providing projections of future climate change for a specific region is challenging. Shorter term projections are more closely tied to existing trends making longer term projections even more challenging. The further out a prediction reaches the more subject to changing dynamics it becomes.

Climate change includes changes in temperature, precipitation, or wind patterns, which occur over several decades or longer. Due to the increase in greenhouse gas concentrations since the end of the 1890s, New Jersey has experienced a 3.5° F (1.9° C) increase in the State's average temperature (Office of the New Jersey State Climatologist 2020), which is faster than the rest of the Northeast region (2° F [1.1° C]) (Melillo et al. 2014) and the world (1.5° F [0.8° C]) (IPCC 2014). This warming trend is expected to continue. By 2050, temperatures in New Jersey are expected to increase by 4.1 to 5.7° F (2.3° C to 3.2° C) (Horton et al. 2015). Thus, New Jersey can expect to experience an average annual temperature that is warmer than any to date (low emissions scenario) and future temperatures could be as much as 10° F (5.6° C) warmer (high emissions scenario) (Runkle et al. 2017). New Jersey can also expect that by the middle of the 21st century, 70% of summers will be hotter than the warmest summer experienced to date (Runkle et al. 2017). The increase in temperatures is expected to be felt more during the winter months (December, January, and February), resulting in less intense cold waves, fewer sub-freezing days, and less snow accumulation.

As temperatures increase, Earth's atmosphere can hold more water vapor which leads to a greater potential for precipitation. Currently, New Jersey receives an average of 46 inches of precipitation each year (Office of the New Jersey State Climatologist 2020). Since the end of the twentieth century, New Jersey has experienced slight increases in the amount of precipitation it receives each year, and over the last 10 years there has been a 7.9% increase. By 2050, annual precipitation in New Jersey could increase by 4% to 11% (Horton et al. 2015). By the end of this century, heavy precipitation events are projected to occur two to five times more often (Walsh et al. 2014) and with more intensity (Huang et al. 2017) than in the last century. New Jersey will experience more intense rain events, less snow, and more rainfalls (Fan et al. 2014, Demaria et al. 2016, Runkle et al. 2017). Also, small decreases in the amount of precipitation may occur in the summer months, resulting in greater potential for more frequent and prolonged droughts (Trenberth 2011). New Jersey could also experience an increase in the number of flood events (Broccoli et al. 2020).

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard. The following discusses Sussex County's vulnerability, in a qualitative nature, to the disease outbreak hazard.

Impact on Life, Health and Safety

The entire population of Sussex County is vulnerable to the disease outbreak hazard. 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.

Maintaining certain key functions is important to preserve life and decrease societal disruption during pandemics. Heat, clean water, waste disposal, and corpse management all contribute to public health. Ensuring functional transportation systems also protects health by making it possible for people to access medical care and by transporting food and other essential goods. Critical infrastructure groups have a responsibility to maintain public health, provide public safety, transport medical supplies and food, implement a pandemic response, and maintaining societal functions. If these workers were absent due to pandemic outbreak, these systems will fail (CISA 2020).

Healthcare providers and first responders have an increased risk of exposure due to their frequent contact with infected populations. Areas with a higher population density also have an increased risk of exposure or

transmission of disease due to their proximity to potentially infected people. Further, the elderly and immunocompromised individuals may have increased vulnerability to becoming infected or experience exacerbated impacts depending upon the disease. Refer to Section 3 (County Profile) for summary of the vulnerable populations in Sussex County.

Most recently with COVID-19, the Centers for Disease Control and Prevention (CDC) has indicated that persons over 65 years and older, persons living in a nursing home or long-term care facility, and persons with underlying medical conditions such as diabetes, severe obesity, serious heart conditions, etc. are at a higher risk of getting severely ill (CDC 2020). Population data from the 2018 5-year American Community Survey indicates that 22,889 persons over 65 years old in Sussex County would be considered at risk for getting severely ill from the COVID-19 virus. While the statistics of this virus are subject to change during the publication of this HMP, the New Jersey Covid-19 dashboard shows that Sussex County is within the lower quarter of the impacted Counties. Overall, persons over 65 make up approximately 16.3-percent of positive COVID-19 cases in the entire State (NJ DOH 2020).

Impact on General Building Stock

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

Impact on Critical Facilities and Lifelines

While the actual structures of County and municipal buildings, critical facilities, and infrastructure will not be impacted by a pandemic or disease outbreak, the effect of absenteeism on workers will impact local government services. The most significant impact on critical facilities would be the increase in hospitalization and emergency room visits that would take place as a result of the outbreak. This would create a greater demand on these critical facilities, their staff, and resources.

Mortuary services could be substantially impacted due to the anticipated increased numbers of deaths. The timely, safe, and respectful disposition of the deceased is an essential component of an effective response. Pandemic influenza may quickly rise to the level of a catastrophic incident that results in mass fatalities, which will place extraordinary demands (including religious, cultural, and emotional burdens) on local jurisdictions and the families of the victims (Homeland Security Council 2006).

The healthcare system will be severely taxed, if not overwhelmed, from the large number of illnesses and complications from influenza requiring hospitalization and critical care. Ventilators will be the most critical shortage if a pandemic were to occur (Homeland Security Council 2006). The 2020 coronavirus pandemic has led to overwhelmed hospitals in numerous hotspots.

Impact on Economy

Costs associated with the activities and programs implemented to conduct surveillance and address disease outbreaks have not been quantified for this plan update. However, numerous activities and programs have been implemented by the County and State to address this hazard. Such resources include the COVID-19 Housing Assistance Program to help residents pay for housing costs and the Executive Order, Extending Utility Shutoff Moratorium to prohibit cable and telecommunication providers from disconnecting internet services (Sussex County 2021). Further, there has been secondary economic impact of closing non-essential facilities to reduce the spread of the virus. The final costs of this virus are still to be determined.

Most recently, the Health Department has played an active role in maintaining and controlling COVID-19 protocols across the County. This activity requires additional costs from the State and County to manage COVID-19 in communities. In April 2020, the Sussex County Board of Chosen Freeholders approved a $117.4-

million County budget, which reallocated existing budget from other accounts to the Office of Emergency Management and the Office of Public Health Nursing. The updated budget also moved funding to the mosquito control unit of the Health Department in order to fund aerial spraying and the use of larvacides (New Jersey Harold 2020).

Impact on Environment

Disease outbreaks may have an impact on the environment if the outbreaks are caused by invasive species. Invasive species tend to be competitive with native species and their habitat. One study has shown that invasive mosquitos such as the Asian tiger mosquito, a common invasive mosquito found in New Jersey, have "desiccation-resistant eggs," which means that they have enhanced survival in inhospitable environments (Juliano and Lounibos 2005). This species is considered a competitive predator and will prey on other species of mosquitos and a range of insects disrupting the natural food chain. Invasive species of mosquitos can be the major transmitters of disease like Zika, dengue, and yellow fever (Placer Mosquito and Vector Control District 2019).

Secondary impacts from mitigating disease outbreaks could also have an impact on the environment. Pesticides used to control disease carrying insects like mosquitos have been reviewed by the EPA and department of health. If these sprays are applied in large concentrations, they could potentially leach into waterways and harm nearby terrestrial species. However, there is a law in New Jersey's Pesticide Regulations that states "no person shall distribute, sell, offer for sale, purchase, or use any pesticide which has been suspended or canceled by the EPA, except as provided for in the suspension of cancellation order" (New Jersey nd).

Further Changes that May Impact Vulnerability

Understanding future changes that may impact vulnerability in the county can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The county considered the following factors that may affect hazard vulnerability:

- Potential or projected development.
- Projected changes in population.
- Other identified conditions as relevant and appropriate, including the impacts of climate change.

Projected Development

Any areas of growth could be potentially impacted by the disease outbreak hazard because the entire planning area is exposed. As population counts change in the County, there may be at increased risk to certain diseases. Higher concentrations of persons traveling via public transportation may become more vulnerable to the exchange of disease through airborne transmission.

Projected Changes in Population

Changes in population density may influence the number of persons exposed to disease outbreaks. Higher density jurisdictions are not only at risk of greater exposure to disease outbreak, density may also reduce available basic services provided by critical facilities such as hospitals and emergency facilities for persons that are not affected by a disease. Further, as the population ages there may be increased risk to this demographic. Older adults and people who have severe underlying medical conditions like heart or lung disease or diabetes seem to be at higher risk for developing more serious complications from certain diseases, such as COVID-19.

Climate Change

As discussed earlier in this section, the relationship between climate change and increase in infectious diseases is difficult to predict with certainty, however there may be linkages between the two. Changes in the environment may create a more livable habitat for vectors carrying disease as suggested by the Centers for Disease Control and Prevention (CDC n.d.). Localized changes in climate and human interaction may also be a factor in the spread of disease.

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 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. As climate change accelerates it is likely to work synergistically with many of these factors, especially in populations increasingly subject to massive migration and malnutrition (Harmon 2010).

Vulnerability Change Since the 2016 HMP

Overall, the County continues to remain vulnerable to the disease outbreak hazard. Any changes or perceived increase in vulnerability may be attributed to changes in population numbers and density or the emergence of new diseases.