5.4.7 SEVERE WINTER WEATHER

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 severe winter weather hazard in Burlington County.

2019 HMP UPDATE CHANGES

- For the 2019 HMP update, the severe winter weather hazard groups together heavy snow, Nor'Easters, blizzards, freezing rain/sleet, and ice storms. The hazard profile has been significantly enhanced to include a detailed hazard description, location, extent, previous occurrences, probability of future occurrence, and potential change in climate and its impacts on the severe weather hazard is discussed.
- New and updated figures from federal and state agencies are incorporated.
- Previous occurrences were updated with events that occurred between 2013 and 2017.
- A vulnerability assessment was conducted for the severe winter weather hazard; it directly follows the hazard profile.

5.4.7.1 PROFILE

Hazard Description

A winter storm is a weather event in which the main types of precipitation are snow, sleet or freezing rain. They can be a combination of heavy snow, blowing snow, and/or dangerous wind chills. There are three basic components needed to make a winter storm. Below freezing temperatures (cold air) in the clouds and near the ground are necessary to make snow and ice. Lift, something to raise the moist air to form clouds and cause precipitation, is needed. Examples of this is warm air colliding with cold air and being forced to rise over the cold dome or air flowing up a mountainside. The last thing needed to make a winter storm is moisture to form clouds and precipitation. Air blowing across a body of water, such as a large lake or the ocean (National Severe Storms Laboratory 2018).

Some winter storms are large enough to immobilize an entire region while others may only affect a single community. Winter storms are typically accompanied by low temperatures, high winds, freezing rain or sleet, and heavy snowfall. The aftermath of a winter storm can have an impact on a community or region for days, weeks, or even months; potentially causing cold temperatures, flooding, storm surge, closed and/or blocked roadways, downed utility lines, and power outages. In Burlington County, winter storms include blizzards, snow storms, freezing rain/sleet, Nor'Easters and ice storms.

Blizzards

A blizzard is a severe storm condition characterized by low temperatures, strong winds, and heavy snow. The difference between a blizzard and a snowstorm is the strength of the wind. The general definition of a blizzard is a storm with considerable falling or blowing snow and winds in excess of 35 mph and visibilities of less than ¼ mile for at least three hours (NWS 2011).

Heavy Snow

According to the National Snow and Ice Data Center (NSIDC), snow is precipitation in the form of ice crystals. It originates in clouds when temperatures are below the freezing point (32°F), when water vapor in the atmosphere condenses directly into ice without going through the liquid stage. Once an ice crystal has formed, it absorbs and freezes additional water vapor from the surrounding air, growing into a snow crystals or snow

pallet, which then falls to the earth. Snow falls in different forms: snowflakes, snow pellets, or sleet. Snowflakes are clusters of ice crystals that form from a cloud. Snow pellets are opaque ice particles in the atmosphere. They form as ice crystals fall through super-cooled cloud droplets, which are below freezing but remain a liquid. The cloud droplets then freeze to the crystals. Sleet is made up of drops of rain that freeze into ice as they fall through colder air layers. They are usually smaller than 0.30 inches in diameter (NSIDC 2018).

Freezing Rain / Sleet

Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground or other hard surfaces. Heavy sleet is a relatively rare event defined as an accumulation of ice pellets covering the ground to a depth of a ½" or more. Freezing rain is rain that falls as a liquid but freezes into glaze upon contact with the ground (NWS 2018).

Nor'Easters

A Nor'Easter is a cyclonic storm that moves along the East Coast of North America. It is called a Nor'Easter because the damaging winds over coastal areas blow from a northeasterly direction. Nor'Easters can occur any time of the year, but are most frequent and strongest between September and April. These storms usually develop between Georgia and New Jersey within 100 miles of the coastline and typically move from southwest to northeast along the Atlantic Coast of the United States (NWS 2018).

In order to be called a Nor'Easter, a storm must have the following conditions, as per the Northeast Regional Climate Center (NRCC):

- Must persist for at least a 12-hour period
- Have a closed circulation
- Be located within the quadrilateral bounded at 45°N by 65° and 70°W and at 30°N by 85°W and 75°W
- Show general movement from the south-southwest to the north-northeast
- Contain wind speeds greater than 23 miles per hour (mph)

Nor'Easters are a common winter occurrence in New Jersey. New Jersey may be impacted by 10 to 20 Nor'Easters each year, with approximately five to 10 of those having significant impact to the State. These storms repeatedly result in flooding, wave and erosion damage to structures, and erosion of natural resources, such as beaches, dunes, and coastal bluffs. The erosion of coastal features commonly results in greater potential for damage to shoreline development from future storms. While some of the most devastating effects of Nor'Easters are experienced in coastal areas (e.g. beach erosion, coastal flooding), the effects on inland areas, like Burlington County, may include heavy snow, strong winds and blizzards (Burlington County 2014).

Ice Storms

An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually accumulations of a ¼" or greater (NWS 2018).

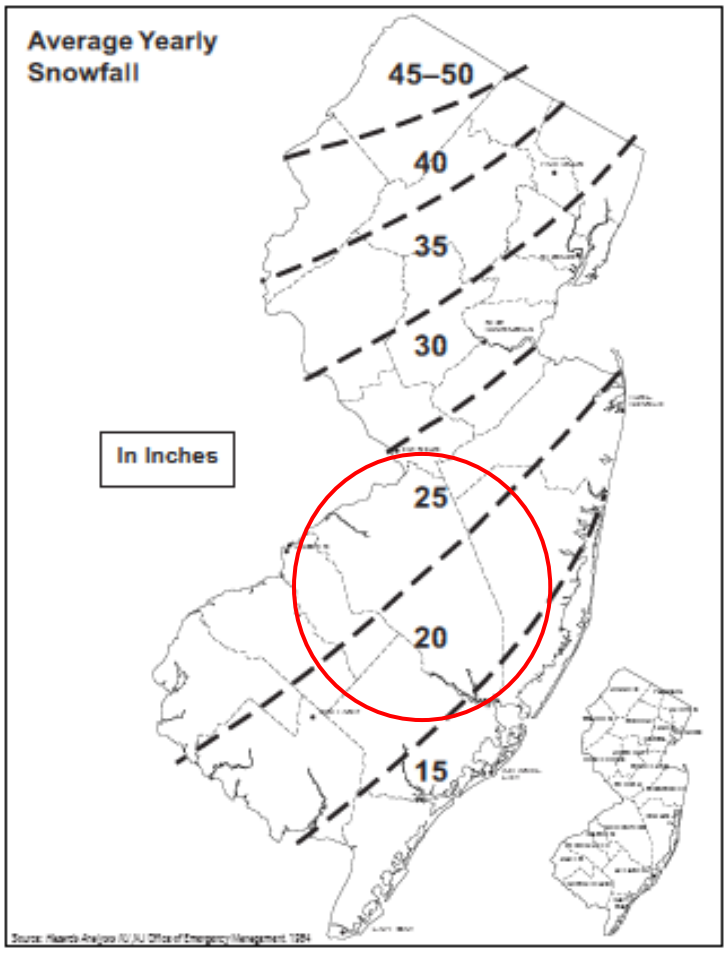
Location

The trajectory of the storm center—whether it passes close to the New Jersey coast or at a distance—largely determines both the intensity and the duration of the snowfall over the State. Winter storms tend to have the heaviest snowfall within a 150-mile wide swath to the northwest of what are generally southwest to northeast

moving storms. Depending on whether all or a portion of New Jersey falls within this swath, the trajectory determines which portion of the State (or all of the State) receives the heaviest amount of snow.

Severe winter weather events impact the entire county. Overall, normal seasonal snowfall in New Jersey ranges from 14.9 inches in Cape May County to over 40 inches in Sussex County (ONJSC 2018). For Burlington County, average annual snowfall ranges from a low of approximately 15 inches in the extreme southern portion of the county, to a high of roughly 25 inches in northwestern areas nearest the Delaware River (see Figure 5.4.7-1). This can vary greatly from one year to the next, particularly if several major extended-period storms impact the area (during which snowfall totals can approach or exceed annual averages) (Burlington County HMP, 2008).

Figure 5.4.7-1. Average Yearly Snowfall for New Jersey



Source: *NJOEM, 2012*
Note: *Red circle indicates approximate location of Burlington County*

Extent

The magnitude or severity of a severe winter storm depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and time of occurrence during the day (e.g., weekday versus weekend), and time of season.

The extent of a severe winter storm can be classified by meteorological measurements and by evaluating its societal impacts. NOAA's National Centers for Environmental Information (NCEI) is currently producing the

Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the United States. The RSI ranks snowstorm impacts on a scale from 1 to 5. It is based on the spatial extent of the storm, the amount of snowfall, and the interaction of the extent and snowfall totals with population (based on the 2000 Census) (NOAA-NCEI 2018). Table 5.4.7-1 presents the five RSI ranking categories.

Table 5.4.7-1. RSI Ranking Categories

Category	RSI Value	Description
1	1-3	Notable
2	3-6	Significant
3	6-10	Major
4	10-18	Crippling
5	18.0+	Extreme

Source: NOAA-NCEI 2018
RSI Regional Snowfall Index

The NWS operates a widespread network of observing systems such as geostationary satellites, Doppler radars, and automated surface observing systems that feed into the current state-of-the-art numerical computer models to provide a look into what will happen next, ranging from hours to days. The models are then analyzed by NWS meteorologists who then write and disseminate forecasts (NWS 2013).

The NWS uses winter weather watches, warnings and advisories to ensure that people know what to expect in the coming hours and days. A winter storm watch is issued by the National Weather Service when there is a potential for heavy snow or significant ice accumulations, usually at least 24 to 36 hours in advance. A watch is upgraded to a winter storm warning when a winter storm is producing or is forecast to produce heavy snow or significant ice accumulations. The criteria for a winter storm watch and winter storm warning can vary from place to place (NWS 2018). They are usually issued 12 to 24 hours before the event is expected to begin. Winter weather advisories are issued when a low-pressure system produces a combination of winter weather (snow, freezing rain, sleet, etc.) that present a hazard, but does not meet warning criteria. The NWS may also issue a blizzard warning when snow and strong winds combine and produce a blinding snow, deep drifts, and wind chill (NWS 2018).

Previous Occurrences and Losses

Many sources provided winter storm information regarding previous occurrences and losses associated with winter storm events throughout Burlington County. With so many sources reviewed for the purpose of this HMP update, loss and impact information for many events may 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 update.

Between 1954 and 2018, FEMA included the State of New Jersey in 10 winter-storm related major disaster (DR) or emergency (EM) declarations. These events were classified as one or a combination of the following incidents: severe winter storm, snowstorm, snow, severe winter coastal storm, high winds, flooding, blizzard, and ice conditions. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Burlington County was included in nine of these declarations. Since the 2014 HMP, the County has been included in FEMA disaster declarations for two additional declarations. Table 5.4.7-2 lists FEMA DR and EM declarations from January 2012 to May 2019 for this HMP Update.

Table 5.4.7-2. FEMA Declarations Since 2012 for Severe Winter Storm Events in Burlington County

FEMA Declaration Number	Date(s) of Event	Event Type	Counties Included
DR-4264	January 22-24, 2016	Severe Winter Storm and Snowstorm	Atlantic, Bergen, Burlington, Camden, Cape May, Cumberland, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Somerset, Union, and Warren
DR-4368	March 6-7, 2018	Severe Winter Storm and Snowstorm	Bergen, Burlington, Essex, Morris, Passaic, and Somerset

Source: FEMA 2018

Agriculture-related severe winter weather disasters are quite common. One-half to two-thirds of the counties in the U.S. have been designated as disaster areas in each of the past several years. The USDA Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2012 and 2018, New Jersey has been included in two USDA winter weather-related declarations. Burlington County was included in one of these declarations, to date.

- S3487 – June-November 2012 – disaster declared as a result of the combined effects of drought, high winds (derecho), hail, excessive heat, excessive rain, flash flooding, Hurricane Sandy, a snowstorm, and a Nor'Easter; over $62,000 in claims filed in Burlington County

For this 2019 HMP update, winter weather events were summarized from 2013 to 2018. For events prior to 2013, refer to Appendix G (Supplementary Data). Known winter storm events, including FEMA disaster declarations, which have impacted Burlington County are identified in Table 5.4.7-3. For detailed information on damages and impacts for each municipality, refer to Section 9 (Annexes). Please note that not all events that have occurred in Burlington County are included due to the extent of documentation and the fact that not all sources may have been identified or researched. Loss and impact information 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 update.

Table 5.4.7-3. Severe Winter Weather Events in Burlington County, 2013 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
January 6, 2013	Winter Weather	N/A	N/A	A return southwest flow of relatively milder air caused a light accumulating snow (near an inch) to occur along and just to the east of the Interstate 95 corridor in the central third of New Jersey during the early morning of the 6th. Less snow fell elsewhere in the state. The combination of the snow itself and temperatures falling to or below the freezing mark once the snow began falling caused slippery travel to occur mainly on untreated less traveled roadways as well as bridges and overpasses. The snow fell between 2 a.m. EST and 6 a.m. EST on the 6th. Representative snowfall included 0.8 inches in Moorestown Township (Burlington County) and 0.7 inches in Tabernacle Township (Burlington County).
January 21, 2013	Winter Weather	N/A	N/A	Snow showers, which were briefly heavy, followed a cold frontal passage and caused quick accumulations of 1 to 3 inches in central and southern New Jersey. The heaviest snowfall occurred along and to the east of the Interstate 95 corridor. Snow began falling between 630 p.m. EST and 8 p.m. EST that evening and fell heavy at times between 730 p.m. EST and 9 p.m. EST when visibilities were around one-quarter of a mile. The steady snow ended by 10 p.m. EST that evening. Temperatures quickly fell below freezing after the snow started and untreated roads were hazardous, especially bridges and overpasses. Numerous accidents were reported between 8 p.m. EST and 1030 p.m. EST in central New Jersey. Accidents were reported from the local Philadelphia area northeast through Middlesex County. Representative snowfall included 1.4 inches in Westampton Township (Burlington County) and 1.2 inches in Maple Shade Township (Burlington County).
January 2-3, 2014	Heavy Snow	N/A	N/A	A winter storm dropped 5 to 9 inches of snow across most of New Jersey, except around 10 inches in northern Ocean County and in Monmouth County. This caused hazardous traveling conditions for the evening commute on the 2nd and the morning commute on the 3rd. Governor Chris Christie declared a state of emergency in New Jersey. New Jersey State Police reported about 250 storm related accidents and 900 calls from stranded motorists. In Burlington County, snowfall totals ranged from 7.2 inches in Tabernacle Township to 8.8 inches in Mount Laurel Township.
January 22-24, 2016	Severe Winter Storm and Snowstorm	DR-4264	Yes	Snow began falling during the Friday afternoon commute on January 22nd, then continued, heavy at times, Friday night into early Sunday morning. Wind gusts up to 60 MPH produced blizzard conditions as visibilities dropped to one-quarter mile or less in spots. At one point during the storm, up to 270,000 customers were without power. Outages were concentrated closer to the coast where the strongest winds occurred. On February 11, 2016, Governor Christie requested a major disaster declaration due to the storm. On March 14, 2016, President Obama declared that a major disaster existed in New Jersey for 17 counties, including Burlington County. In Burlington County, snowfall totals of 22.5 inches in Florence Township were recorded. The County

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				reported $4.7 million spent on snow removal with $279,000 spent in Evesham Township and $189,000 spent in Mount Laurel Township.
March 6-7, 2018	Severe Winter Storm and Snowstorm	DR-4368	Yes	Precipitation gradually overspread the region during the overnight hours of March 6th to the 7th. To the east of the NJ Turnpike/Interstate 95, precipitation began as rain or a mix of rain and snow. Further west, precipitation fell mainly as snow. The snow contained large amounts of liquid, making it heavy and wet. This resulted in downed trees, limbs, and wires, leading to numerous power outages across portions of New Jersey, especially where the heaviest snow was reported. There were numerous reports of lightning associated with the precipitation in New Jersey, mainly southeast of the Turnpike. This included thunderstorms with heavy rainfall closer to the coast, and thunder with heavy snowfall further inland. Governor Phil Murphy declared a state of emergency which went into effect at 8 PM Tuesday March 6th. Flights were cancelled at all the major airports due to the storm, and Amtrak cancelled at least some Wednesday service. Precipitation fell as, or mixed with, rain during much of the event, limiting snowfall amounts to under 6 inches in most locations. Less than one inch of snow fell in areas closer to the coast.

Source: NOAA-NCEI 2018, FEMA 2018
DR Major Disaster Declaration (FEMA)
EM Emergency Disaster Declaration (FEMA)
FEMA Federal Emergency Management Agency
Mph miles per hour
NOAA National Oceanic and Atmospheric Administration
NCEI National Center for Environmental Information

Probability of Future Occurrences

Severe winter weather is a common occurrence each winter season in New Jersey. The majority of the State will receive at least one measurable snow event during the winter months. The months of January, February, March, April, October, November and December are typically when a vast majority of New Jersey has been observed to receive measurable snow. Generally, counties in the northern region experience more snow events than those in the southern region. It is estimated that Burlington County will continue to experience the direct and indirect impacts of severe winter weather events annually that many induce secondary hazards such as: structural damage (snow and ice load), wind damage, impact to life safety, disruption of traffic, loss of productivity, economic impact, loss of ability to evacuate, taxing first-responder capabilities, service disruption (power, water, etc.), and communication disruption.

According to the NOAA-NCEI storm events database, between 1950 and 2018, Burlington County has been impacted by 289 winter weather-related events (blizzard, heavy snow, ice storm, winter storm and winter weather). These events resulted in $6.1 million in property damage. The table below shows the probability of future occurrences for each type of severe winter weather event to occur in Burlington County. Based on data from NOAA-NCEI, Burlington County can expect an average of 4 winter storm-related events each year.

Table 5.4.7-4. Probability of Future Occurrence of Severe Winter Weather Events

Hazard Type	Number of Occurrences Between 1950 and 2018	Annual Number of Events (average)	Recurrence Interval* (in years)	Probability of Event Occurring in Any Given Year	Percent Chance of Occurring in Any Given Year
Blizzard	4	0.06	17.25	0.06	5.8%
Heavy Snow	51	0.75	1.35	0.74	73.9%
Ice Storm	1	0.01	69.0	0.01	1.5%
Winter Storm	51	0.75	1.35	0.74	73.9%
Winter Weather	182	2.68	0.38	2.64	100%

Source: NOAA-NCEI 2018
**Estimate of the likelihood of an event to occur*

In Section 5.3, the identified hazards of concern for Burlington 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 severe winter weather in the county is considered 'frequent' (likely to occur within 25 years, as presented in Table 5.3-3).

Climate Change Impacts

In the State of New Jersey, 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) has been observed. 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).

In terms of snowfall and ice storms, there is a lack of quantitative data to predict how future climate change will affect this hazard. It is likely that the number of winter weather events may decrease, and the winter weather season may shorten; however, it is also possible that the intensity of winter storms may increase. The exact

effect on winter weather is still highly uncertain (Sustainable Jersey Climate Change Adaptation Task Force 2013).

Due to the increase in temperature, snow cover and sea ice extent are predicted to likely decrease over the next century and the snow season length is very likely to decrease over North America. However, warming of the lower atmosphere could potentially lead to more ice storms by allowing snow to more frequently melt as it falls and then refreeze near or at surface (NPCC 2010).

5.4.7.2 VULNERABILITY ASSESSMENT

All of Burlington County is exposed to the severe winter storm hazard; therefore, all assets in the County (population, structures, critical facilities, and lifelines), as described in the County Profile (Section 4), are potentially vulnerable to a severe winter storm event. The following summarizes the estimated potential impacts of severe winter storm events on the County. Refer to Section 5.1 for additional details on the methodology used to assess severe winter storm risk.

Impact on Life, Health and Safety

According to the NOAA National Severe Storms Laboratory (NSSL); every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow and extreme cold temperatures and dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. People can die in traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold. Heavy accumulations of ice can bring down trees and power lines, disabling electric power and communications for days or weeks. Heavy snow can immobilize a region and paralyze a city, shutting down all air and rail transportation and disrupting medical and emergency services. Storms near the coast can cause coastal flooding and beach erosion as well as sink ships at sea. The economic impact of winter weather each year is huge, with costs for snow removal, damage and loss of business in the millions (NSSL, 2018).

Heavy snow can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches. The cost of snow removal, repairing damages, and loss of business can have large economic impacts on cities and towns (NSSL, 2006).

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NSSL, 2006).

For the purposes of this HMP, the entire population of Burlington County (450,236 people) is exposed to severe winter storm events (U.S. Census, 2016). Snow accumulation and frozen/slippery road surfaces increase the frequency and impact of traffic accidents for the general population, resulting in personal injuries. Refer to Section 4 (County Profile) for population statistics for each participating municipality.

The elderly are considered most susceptible to this hazard due to their increased risk of injuries and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice. In addition, severe winter storm events can reduce the ability of these populations to access emergency services. Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply).

Impact on General Building Stock

The entire general building stock inventory is exposed and vulnerable to the severe winter storm hazard; however, properties in poor condition or in particularly vulnerable locations may be at risk to the most damage. In general, structural impacts include damage to roofs and building frames, rather than building content. Table 5.4.7-5 presents the total exposure value (structure only) for the general building stock for each participating municipality.

Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, the percent damage to structures that could result from severe winter storm conditions is considered. This allows planners and emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Table 5.4.7-5 below summarizes the estimated loss to structures as a result of 1-, 5- and 10-percent loss. Given professional knowledge and the currently available information, the potential loss for this hazard is many times considered to be overestimated because of varying factors (building structure type, age, load distribution, building codes in place, etc.). Therefore, the following information should be used as estimates only for planning purposes with the knowledge that the associated losses for severe winter storm events vary greatly.

Table 5.4.7-5. General Building Stock Exposure and Estimated Losses from Severe Winter Storm Events

Municipality	Total (All Occupancies)	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Bass River Township	$592,479,667	$5,924,797	$29,623,983	$59,247,967
Beverly City	$307,500,140	$3,075,001	$15,375,007	$30,750,014
Bordentown City	$744,949,381	$7,449,494	$37,247,469	$74,494,938
Bordentown Township	$1,674,099,210	$16,740,992	$83,704,961	$167,409,921
Burlington City	$1,962,644,603	$19,626,446	$98,132,230	$196,264,460
Burlington Township	$5,000,155,300	$50,001,553	$250,007,765	$500,015,530
Chesterfield Township	$1,400,485,206	$14,004,852	$70,024,260	$140,048,521
Cinnaminson Township	$3,443,136,617	$34,431,366	$172,156,831	$344,313,662
Delanco Township	$918,559,858	$9,185,599	$45,927,993	$91,855,986
Delran Township	$3,217,120,782	$32,171,208	$160,856,039	$321,712,078
Eastampton Township	$1,060,270,313	$10,602,703	$53,013,516	$106,027,031
Edgewater Park Township	$1,457,974,255	$14,579,743	$72,898,713	$145,797,426
Evesham Township	$9,168,653,192	$91,686,532	$458,432,660	$916,865,319
Fieldsboro Borough	$84,982,564	$849,826	$4,249,128	$8,498,256
Florence Township	$1,673,982,403	$16,739,824	$83,699,120	$167,398,240
Hainesport Township	$2,080,207,178	$20,802,072	$104,010,359	$208,020,718
Lumberton Township	$3,424,896,916	$34,248,969	$171,244,846	$342,489,692
Mansfield Township	$2,285,414,884	$22,854,149	$114,270,744	$228,541,488
Maple Shade Township	$2,679,790,126	$26,797,901	$133,989,506	$267,979,013
Medford Lakes Borough	$837,422,542	$8,374,225	$41,871,127	$83,742,254
Medford Township	$7,999,936,346	$79,999,363	$399,996,817	$799,993,635
Moorestown Township	$6,109,599,449	$61,095,994	$305,479,972	$610,959,945
Mount Holly Township	$2,150,068,863	$21,500,689	$107,503,443	$215,006,886
Mount Laurel Township	$9,343,991,534	$93,439,915	$467,199,577	$934,399,153
New Hanover Township	$1,546,232,618	$15,462,326	$77,311,631	$154,623,262

Table 5.4.7-**5**. General Building Stock Exposure and Estimated Losses from Severe Winter Storm Events

Municipality	Total (All Occupancies)	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
North Hanover Township	$1,729,559,019	$17,295,590	$86,477,951	$172,955,902
Palmyra Borough	$1,106,819,144	$11,068,191	$55,340,957	$110,681,914
Pemberton Borough	$207,432,867	$2,074,329	$10,371,643	$20,743,287
Pemberton Township	$5,772,021,833	$57,720,218	$288,601,092	$577,202,183
Riverside Township	$1,276,520,301	$12,765,203	$63,826,015	$127,652,030
Riverton Borough	$585,858,006	$5,858,580	$29,292,900	$58,585,801
Shamong Township	$1,696,218,832	$16,962,188	$84,810,942	$169,621,883
Southampton Township	$3,975,061,802	$39,750,618	$198,753,090	$397,506,180
Springfield Township	$2,223,461,090	$22,234,611	$111,173,055	$222,346,109
Tabernacle Township	$2,175,794,267	$21,757,943	$108,789,713	$217,579,427
Washington Township	$357,333,022	$3,573,330	$17,866,651	$35,733,302
Westampton Township	$2,487,347,035	$24,873,470	$124,367,352	$248,734,704
Willingboro Township	$5,281,247,833	$52,812,478	$264,062,392	$528,124,783
Woodland Township	$888,068,601	$8,880,686	$44,403,430	$88,806,860
Wrightstown Borough	$223,368,035	$2,233,680	$11,168,402	$22,336,804
Burlington County	**$101,150,665,635**	**$1,011,506,656**	**$5,057,533,282**	**$10,115,066,564**

Source: Burlington County

A specific area that is vulnerable to the severe winter storm hazard is the floodplain. Severe winter storms can cause flooding through blockage of streams or through snow melt. At-risk residential infrastructures are presented in the flood hazard profile (Section 5.4.4). Generally, losses resulting from flooding associated with severe winter storms should be less than that associated with a 100-year flood. In addition, coastal areas are at high risk during winter storm events that involve high winds. Please refer to the Severe Storm (Section 5.4.6) profile for losses resulting from wind.

Impact on Critical Facilities

Full functionality of critical facilities such as police, fire and medical facilities is essential for response during and after a severe winter storm event. These critical facility structures are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Because power interruption can occur, backup power is recommended. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires the clearing roadways and alerting citizens to dangerous conditions; following the winter season, resources for road maintenance and repair are required.

Impact on Economy

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain local financial resources. Another impact on the economy includes impacts on commuting into, or out of, the area for work or school. Heavy snow can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow and ice can collapse buildings and knock down trees and power lines. The loss of power and closure of roads can also prevent the commuter population traveling to work within and outside of the county. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches. The cost

of snow removal, repairing damages, and loss of business can have large economic impacts on cities and towns (NSSL, 2006).

Future Growth and Development

As discussed in Sections 4 and 9, areas targeted for future growth and development have been identified across Burlington County. Any areas of growth could be potentially impacted by the severe winter storm hazard because the entire planning area is exposed and vulnerable. Please refer to the specific areas of development indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Effect of Climate Change on Vulnerability

Both northern and southern New Jersey have become wetter over the past century. Northern New Jersey's 1971-2000 precipitation average was over five inches (12-percent) greater than the average from 1895-1970. Southern New Jersey became two inches (5-percent) wetter late in the 20th century (Office of New Jersey State Climatologist). Average annual precipitation is projected to increase in the region by 5-percent by the 2020s and up to 10-percent by the 2050s. Most of the additional precipitation is expected to come during the winter months (New York City Panel on Climate Change [NPCC] 2009).

In terms of snowfall and ice storms in New Jersey, there is a lack of quantitative data to predict how future climate change will affect this hazard. It is likely that the number of winter weather events may decrease, and the winter weather season may shorten; however, it is also possible that the intensity of winter storms may increase. The exact effect on winter weather is still highly uncertain (Sustainable Jersey Climate Change Adaptation Task Force 2013). An increase in the frequency and severity of severe winter storms may result in an increase of snow loads on the County's building stock and infrastructure, putting each building at risk for structural damage. More frequent and severe events will also result in increased resources being spent to prepare for and clean-up after an event. However, as winter temperatures continue to rise, the increase in precipitation is likely to occur during the winter months as rain. Increased rain on snowpack or frozen or saturated soils may lead to increased flooding and related impacts on the County's assets. Future enhancements in climate modeling will provide an improved understanding of how the climate will change and impact the Northeast.

Change of Vulnerability Since the 2014 HMP

The entire county continues to be vulnerable to the severe winter weather hazard. The 2019 HMP update used the same methodology as the original plan, while providing updated damage estimates using an updated custom building stock based on Burlington County and MODIV tax assessment data. The updated vulnerability assessment provides a more current assessment for the county.