



5.4.4 FLOOD

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 flood hazard in Burlington County.

2019 HMP UPDATE CHANGES

- 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 flood hazard is discussed. The flood hazard is now located in Section 5 of the plan update.
- New and updated figures from federal and state agencies are incorporated.
- Previous occurrences were updated with events that occurred between 2012 and 2018.
- A vulnerability assessment was conducted for the flood hazard and it now directly follows the hazard profile.

5.4.4.1 PROFILE

Hazard Description

Floods are one of the most common natural hazards in the United States. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states). Most communities in the U.S. have experienced some kind of flooding after spring rains, heavy thunderstorms, coastal storms, or winter snow thaws (George Washington University 2001). Floods are frequent and costly natural hazards in New Jersey in terms of human hardship and economic loss, particularly to communities that lie within flood-prone areas or floodplains of a major water source.

Many floods fall into three categories: riverine, coastal, and shallow (FEMA 2007). Other types of floods may include ice-jam floods, alluvial fan floods, dam failure floods, and floods associated with local drainage or high groundwater (as indicated in the previous flood definition). Flooding in Burlington County can be the result of heavy rainfall produced by hurricanes or thunderstorms; flash flooding; ice jams and severe winter storms. For the purpose of this HMP, and as deemed appropriate by the Burlington County Planning Committee, riverine/flash flooding, coastal flooding, and dam failure floods are the main flood types of concern for the county. These types of flood are further discussed below.

Riverine/Flash Floods

Riverine floods occur along a channel and include overbank and flash flooding. Channels are defined, ground features that carry water through and out of a watershed. They may be called rivers, creeks, streams, or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas (The Illinois Association for Floodplain and Stormwater Management 2006).

A flash flood is:

“a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters” (National Weather Service [NWS] 2009).



Additionally, riverine flooding can lead to stormwater and urban drainage flooding in Burlington County. Stormwater flooding described below is due to local drainage issues and high groundwater levels. Locally, heavy precipitation may produce flooding in areas other than delineated floodplains or along recognizable channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and surface runoff, water may accumulate and cause flooding problems. During winter and spring, frozen ground and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding issues of this nature generally occur in areas with flat gradients and generally increase with urbanization which speeds the accumulation of floodwaters because of impervious areas. Shallow street flooding can occur unless channels have been improved to account for increased flows (FEMA 1997).

High groundwater levels can be a concern and cause problems even where there is no surface flooding. Basements are susceptible to high groundwater levels. Seasonally high groundwater is common in many areas, while elsewhere high groundwater occurs only after long periods of above-average precipitation (FEMA 1997).

Urban drainage flooding is caused by increased water runoff due to urban development and drainage systems. Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent localized flooding on streets and other urban areas. They make use of a closed conveyance system that channels water away from an urban area to surrounding streams. This bypasses the natural processes of water filtration through the ground, containment, and evaporation of excess water. Since drainage systems reduce the amount of time the surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development in that area (FEMA 2007).

Coastal Flooding

Coastal flooding occurs along the coasts of oceans, bays, estuaries, coastal rivers, and large lakes. Coastal floods are the submersion of land areas along the ocean coast and other inland waters caused by seawater over and above normal tide action. They are a result of the storm surge where local sea levels rise often resulting in weakened or destroyed coastal structures. Hurricanes and tropical storms, severe storms, and Nor'easters cause most of the coastal flooding in Burlington County. Coastal flooding has many of the same problems identified for riverine flooding but also has additional problems such as beach erosion; loss or submergence of wetlands and other coastal ecosystems; saltwater intrusion; high water tables; loss of coastal recreation areas, beaches, protective sand dunes, parks, and open space; and loss of coastal structures. Coastal structures can include sea walls, piers, bulkheads, bridges, or buildings (FEMA 2011).

There are several forces that occur with coastal flooding:

- *Hydrostatic forces* against a structure are created by standing or slowly moving water. Flooding can cause vertical hydrostatic forces, or flotation. These types of forces are one of the main causes of flood damage.
- *Hydrodynamic forces* on buildings are created when coastal floodwaters move at high velocities. These high-velocity flows are capable of destroying solid walls and dislodging buildings with inadequate foundations. High-velocity flows can also move large quantities of sediment and debris that can cause additional damage. In coastal areas, high-velocity flows are typically associated with one or more of the following:
 - Storm surge and wave run-up flowing landward through breaks in sand dunes or across low-lying areas
 - Tsunamis
 - Outflow of floodwaters driven into bay or upland areas
 - Strong currents parallel to the shoreline, driven by waves produced from a storm
 - High-velocity flows



High-velocity flows can be created or exacerbated by the presence of manmade or natural obstructions along the shoreline and by weak points formed by roads and access paths that cross dunes, bridges or canals, channels, or drainage features.

- *Waves* can affect coastal buildings from breaking waves, wave run-up, wave reflection and deflection, and wave uplift. The most severe damage is caused by breaking waves. The force created by these types of waves breaking against a vertical surface is often at least 10 times higher than the force created by high winds during a coastal storm.
- *Flood-borne debris* produced by coastal flooding events and storms typically includes decks, steps, ramps, breakaway wall panels, portions of or entire houses, heating oil and propane tanks, cars, boats, decks and pilings from piers, fences, erosion control structures, and many other types of smaller objects. Debris from floods are capable of destroying unreinforced masonry walls, light wood-frame construction, and small-diameter posts and piles (FEMA 2011).

Dam Failure Flooding

A dam is an artificial barrier that can impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water (FEMA 2007). Dams are man-made structures built across a stream or river that impound water and reduce downstream flow (FEMA 2003). They are built for purposes of power production, agriculture, water supply, recreation, and flood protection. Dam failure is any malfunction or abnormality outside of the design that adversely affects a dam's primary function of impounding water (FEMA 2007). Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam (inadequate spillway capacity)
- Prolonged periods of rainfall and flooding
- Deliberate acts of sabotage (terrorism)
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate or negligent operation, maintenance, and upkeep
- Failure of upstream dams on the same waterway
- Earthquake (liquefaction/landslides) (FEMA 2013)

A break in a dam can produce extremely dangerous flood situations because of the high velocities and large volumes of water released by such a break. Sometimes dam breaks can occur with little to no warning. Breaching of dams often occurs within hours after the first visible sign of dam failure, leaving little or no time for evacuation (FEMA 2013).

Location

Burlington County and its jurisdictions experience many types of flooding. While none of the County's municipalities directly border the Atlantic Ocean or Great Bay, many waterways are influenced by the tides for at least some of their reaches. Flooding in Burlington County ranges from tidal and riverine flooding to shallow flooding which result from urban drainage issues (Burlington County HMP 2013). Please refer to Section 4 (County Profile) for detailed information regarding the river basins and the hydrography/hydrology of Burlington County.



The December 2017 Preliminary Flood Insurance Study (FIS) for Burlington County describes the principal flood problems for the county and municipalities. The information from the FIS is presented in Table 5.4.4-1.

Table 5.4.4-1. Principal Flood Problems in Burlington County

Flooding Source	Description of Flood Problems
All Sources	- Most flooding in Burlington County occurs during the summer and early fall months; however, floods have occurred at different times throughout the year. Portions of Burlington County experience tidal flooding from the Delaware River caused by extremely high tides, hurricane activity and tropical storms. - Township of Lumberton – flooding is primarily due to torrential rains during summer and autumn months. - Township of Mount Holly – flooding is primarily due to continental and ocean-bred storms resulting in both riverine and tidal flooding. Mount Holly is affected by tidal surge of the Delaware River. Tidal backwater from the Delaware River affects inland locations in Mount Holly - Township of Mount Laurel – all streams are flooding sources.
Assiscunk Creek	City of Burlington - Riverine and tidal flooding impact the City of Burlington and has caused heavy flooding damage in the area of U.S. Route 130, combined with the effects from the Delaware River.
Bass River	Township of Bass River – flooding occurs at Bass River near Allens Dock at U.S. Route 9; at East Branch Bass River near Stage Road; and the Merrygold Branch of Wading River at Hammonton Road. All these flooding problems are affected by tidal flooding from the Great Bay
Beaverdam Creek	Township of Southampton – primary flooding source due to torrential rains during summer and autumn months.
Delaware River	- Subject to flooding from intense rainfall runoff and is also subject to tidal - flooding caused by extremely high tides, hurricane activity, or tropical storms. The Delaware River causes flooding in the Borough of Palmyra, and the Cities of Bordentown and Burlington; the Township of Bordentown, Burlington, Cinnaminson, Delcane, Delran, Florence, Hainesport, Mansfield - Township of Cinnaminson – high tides on the Delaware River produce major flooding in Pompeston Creek’s lower reaches - Borough of Palmyra – flows through the tidal flatlands creating flooding.
East Branch	Township of Cinnaminson – East Branch is easily overflows its banks during storms of high intensity and short duration
Jacks Run	Borough of Riverton and Township of Cinnaminson – Jacks Run is easily overflows its banks during storms of high intensity and short duration. Urbanization in the vicinity of Jacks Run has decreased the ability of the watershed to absorb water, creating more surface water for a given frequency rainfall than existed in the past.
Laurel Run	Township of Delran – primary flooding source
Lake Flooding	Borough of Medford Lakes – lake flooding is the primary source of flooding in the Borough of Medford Lakes when lake levels are at their highest for summer recreational purposes and a downpour causes the lakes to overtop their banks.
Masons Creek	Township of Hainesport – flooding source impacted by high tides caused on the Delaware River due to passing hurricanes and other large storms
Mullica River	Township of Washington – the Mullica River is the primary cause of flooding in the Township, typically associated with hurricanes and tropical storms. Downstream of the Pleasant Mills Bridge, flooding on the River is tidally influenced. Tributaries to the River have also experienced flooding, like the Batsto River
Pennsauken Creek	Borough of Palmyra – flows through the tidal flatlands and confluences with the Delaware River, making it subject to tidal flooding.
Pennsauken Creek North Branch	Township of Maple Shade – primary flooding source due to heavy rains and local thunderstorms.
Pennsauken Creek South Branch	Township of Maple Shade – primary flooding source due to heavy rains and local thunderstorms.



Flooding Source	Description of Flood Problems
Pompeston Creek	Borough of Riverton – high tides on the Delaware River produce major flooding in Pompeston Creek’s lower reaches
Rancocas Creek	- Township of Delanco – Rancocas Creek, along with the Delaware River, is a primary flooding source. Tidal surge occurs along the Delaware River especially when hurricane tracks are close to the Delaware River. - Township of Delran – primary flooding source - Townships of Riverside, Westampton, and Willingboro - primary flooding source
Rancocas Creek North Branch	- Township of Eastampton – flooding occurs in the low-lying areas adjacent to Rancocas Creek North Branch during hurricanes and other large storms. - Township of Hainesport – flooding source impacted by high tides caused on the Delaware River due to passing hurricanes and other large storms. - Township of Medford – flooding is primarily due to torrential rains during summer and autumn month. - Township of Mount Holly – flooding is made more severe due to undersized culverts connecting the dredged stream to the former stream under the railroad embankment and from Buttonwood Run due to increasing development upstream in the Township of Eastampton. - Borough of Pemberton; Townships of Pemberton, Southampton – primary flooding source due to torrential rains during summer and autumn months.
Rancocas Creek South Branch	- Township of Hainesport – flooding source impacted by high tides caused on the Delaware River due to passing hurricanes and other large storms. - Township of Medford – flooding is primarily due to torrential rains during summer and autumn months.
Rancocas Creek Southwest Branch	Township of Medford – flooding is primarily due to torrential rains during summer and autumn months
Swede Run	Township of Delran – primary flooding source
Wading River West Branch	Township of Woodland – primary flooding source.
Within the extent of the Lower Delaware River Basin	Heavy rains, balmy temperatures, and rapid snowmelt can cause serious flooding in the Lower Delaware River Basin during the winter months. Flooding upstream and on the main stem of the Delaware River can severely affect flooding in the lower basin. Slow moving storms can cause flash flooding on the Lower Delaware River Basin.

Source: FEMA FIS 2017

The DVRPC conducted a series of Coastal Vulnerability Assessment reports for six municipalities in Burlington County along the Delaware River. While the reports focused on coastal flooding impacts combined with sea level rise, they also identified the following locations as prone to riverine flooding and flash flooding:

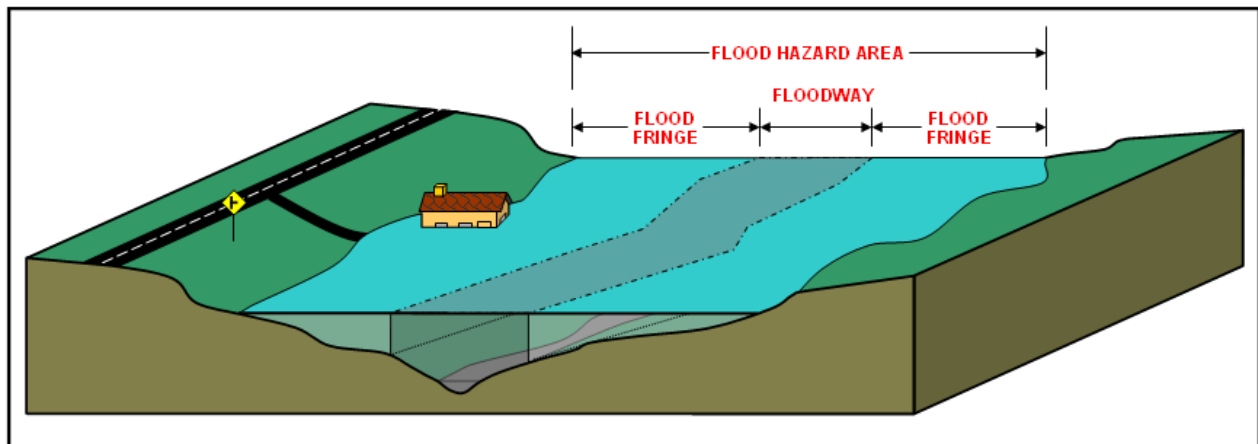
- Delran Township:
 - Flooding in upstream municipalities during storms exacerbates flooding in some of Delran’s neighborhoods, with roadway flooding in the Westover Drive neighborhood as one affected location. A culverted tributary of the Pompeston Creek has also historically created flooding on this road.
 - Flooding causes scour and erosion which threatens the integrity of Conrow Road, and an outdated culvert causes flooding at Bridgeboro Road and adjacent properties.
- City of Beverly
 - Riverine flooding poses a threat for the area along Railroad Avenue and Manor Road, which includes such critical municipal facilities as the Beverly Edgewater Park Emergency Squad building, the Beverly City Elementary School, and the American Legion building.
 - The area around Bridgeboro Road in Edgewater Park Township also floods; although it is outside Beverly’s borders, flooding at this location has the potential to block egress from the city along its Broad Street evacuation route.
- Bordentown Township:

- The area around Jumble Gut Run and near the Old Amboy Railroad. The Sylvan Glen neighborhood and the Old Amboy Railroad are vulnerable to high volumes and velocities of stormwater runoff pose a problem for these areas. In the Sylvan Glen neighborhood, stormwater volume in Jumble Gut Run causes bank erosion and slope destabilization, undermines utilities and stormwater infrastructure, and can cut off ingress and egress from the overtopping of NJ-206 and Orchard Road. In the Old Amboy neighborhood, poor drainage at a culvert leads to flooding of properties along the adjacent rail corridor during heavy rainfall events.
- Burlington Township
 - Riverine flooding impacts areas around Route 130, Jennifer Lane, Fountain Avenue, and Spring Hill Lane.
 - “Upstream-downstream” concerns were cited regarding the position of the Township in the watershed relative to other neighboring municipalities, which causes them to receive stormwater runoff from upstream municipalities.

Floodplains

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is not a flood that will occur once every 100 years, rather it is a flood that has a 1-percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. Due to this misleading term, FEMA has properly defined it as the 1-percent annual chance flood. This 1-percent annual chance flood is now the standard used by most federal and state agencies and by the NFIP (FEMA 1997).

Figure 5.4.4-1. The Floodplain

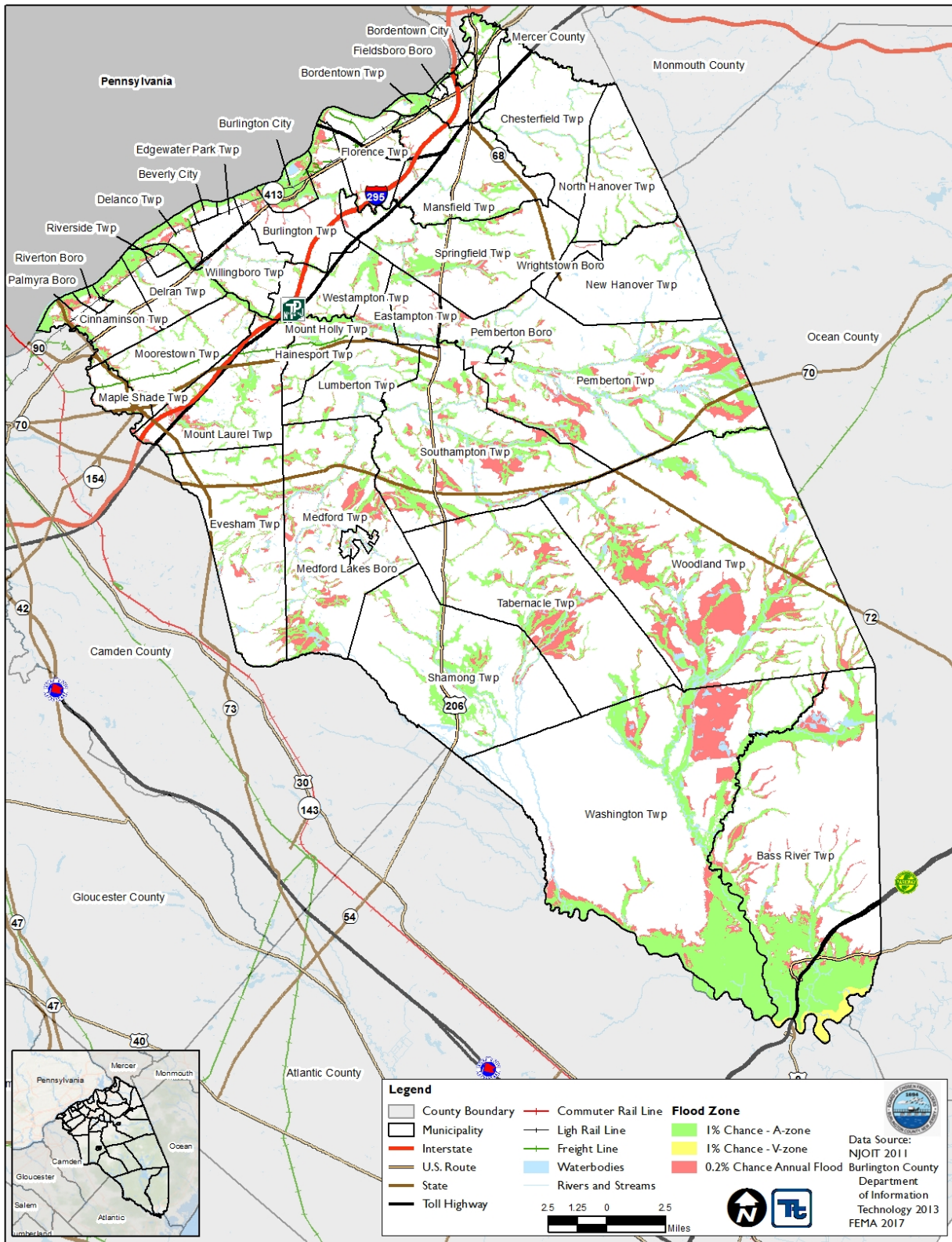


Source: NJDEP, Date Unknown

The 1-percent annual chance of flood hazard zones are widely dispersed in Burlington County, generally following riverine corridors as shown in Figure 5.4.4-2. A significant concentration of 1-percent annual chance flood hazard zones borders the Delaware and Mullica Rivers. There is a very small portion of the County located in the 1-percent annual chance V-zone (Bass River Township). V-zones include areas along coasts that are subject to flooding with additional hazards associated with storm-induced waves. Bass River Township experiences tidal flooding from the Great Bay. Other 1-percent annual chance flood hazard zones exist along various creeks throughout the interior of Burlington County. Refer to Table 5.4.4-2 to see the total land area each municipality has in the 1-percent and 0.2-percent annual chance flood hazard zones.



Figure 5.4.4-2. FEMA Flood Hazard Areas in Burlington County



Source: FEMA 2017
FEMA Federal Emergency Management Agency





Table 5.4.4-2. Total land area located in the 1- and 0.2-percent annual chance flood zones (acres)

Municipality	Total Area (acres)	1% Flood Event Hazard Area				0.2% Flood Event Hazard Area	
		A-Zone Area Exposed (acres)	% of Total	V-Zone Area Exposed (acres)	Area Exposed (acres)	Area Exposed (acres)	% of total
Bass River Township	50,168.0	13,629.0	27.2%	1,292.9	2.6%	16,004.2	31.9%
Beverly City	493.2	189.2	38.4%	0.0	0.0%	211.3	42.9%
Bordentown City	617.4	105.0	17.0%	0.0	0.0%	111.0	18.0%
Bordentown Township	5,764.9	1,327.7	23.0%	0.0	0.0%	1,383.6	24.0%
Burlington City	2,390.7	1,697.0	71.0%	0.0	0.0%	2,008.2	84.0%
Burlington Township	8,935.9	844.6	9.5%	0.0	0.0%	1,232.7	13.8%
Chesterfield Township	13,946.8	921.5	6.6%	0.0	0.0%	938.4	6.7%
Cinnaminson Township	5,132.8	1,005.2	19.6%	0.0	0.0%	1,213.0	23.6%
Delanco Township	2,156.7	906.8	42.0%	0.0	0.0%	1,135.5	52.7%
Delran Township	4,662.5	921.5	19.8%	0.0	0.0%	1,036.5	22.2%
Eastampton Township	3,745.5	552.4	14.7%	0.0	0.0%	595.6	15.9%
Edgewater Park Township	1,959.6	97.3	5.0%	0.0	0.0%	104.3	5.3%
Evesham Township	19,000.8	1,973.4	10.4%	0.0	0.0%	2,103.6	11.1%
Fieldsboro Borough	303.9	129.3	42.6%	0.0	0.0%	133.1	43.8%
Florence Township	6,507.0	576.1	8.9%	0.0	0.0%	616.4	9.5%
Hainesport Township	4,362.6	1,107.8	25.4%	0.0	0.0%	1,203.3	27.6%
Lumberton Township	8,335.7	1,419.3	17.0%	0.0	0.0%	1,457.4	17.5%
Mansfield Township	14,040.8	1,383.0	9.8%	0.0	0.0%	1,389.6	9.9%
Maple Shade Township	2,453.7	193.1	7.9%	0.0	0.0%	268.8	11.0%
Medford Lakes Borough	799.2	142.7	17.9%	0.0	0.0%	146.7	18.4%
Medford Township	25,531.6	3,774.2	14.8%	0.0	0.0%	4,137.9	16.2%
Moorestown Township	9,552.0	960.2	10.1%	0.0	0.0%	1,097.7	11.5%
Mount Holly Township	1,850.9	316.0	17.1%	0.0	0.0%	431.6	23.3%
Mount Laurel Township	14,048.0	1,659.5	11.8%	0.0	0.0%	2,147.6	15.3%
New Hanover Township	14,360.2	520.6	3.6%	0.0	0.0%	520.6	3.6%
North Hanover Township	10,945.7	855.4	7.8%	0.0	0.0%	855.8	7.8%
Palmyra Borough	1,532.7	638.1	41.6%	0.0	0.0%	881.2	57.5%
Pemberton Borough	395.4	82.8	20.9%	0.0	0.0%	92.3	23.4%
Pemberton Township	40,295.9	7,471.8	18.5%	0.0	0.0%	7,601.8	18.9%
Riverside Township	1,044.0	356.3	34.1%	0.0	0.0%	410.8	39.3%
Riverton Borough	609.5	236.1	38.7%	0.0	0.0%	303.4	49.8%
Shamong Township	28,910.4	4,157.6	14.4%	0.0	0.0%	4,239.1	14.7%
Southampton Township	28,027.8	5,259.6	18.8%	0.0	0.0%	5,346.7	19.1%
Springfield Township	18,725.8	2,269.0	12.1%	0.0	0.0%	2,385.8	12.7%
Tabernacle Township	31,717.9	3,769.4	11.9%	0.0	0.0%	3,781.0	11.9%
Washington Township	66,071.1	15,241.5	23.1%	4.9	<1%	16,695.9	25.3%
Westampton Township	7,106.0	1,050.3	14.8%	0.0	0.0%	1,108.4	15.6%
Willingboro Township	5,200.1	712.8	13.7%	0.0	0.0%	868.6	16.7%



Municipality	Total Area (acres)	1% Flood Event Hazard Area				0.2% Flood Event Hazard Area	
		A-Zone Area Exposed (acres)	% of Total	V-Zone Area Exposed (acres)	Area Exposed (acres)	Area Exposed (acres)	% of total
Woodland Township	61,174.2	10,115.6	16.5%	0.0	0.0%	10,167.9	16.6%
Wrightstown Borough	1,328.0	5.2	0.4%	0.0	0.0%	5.2	<1%
Burlington County Total:	524,204.7	88,574.1	16.9%	1,297.8	<1%	96,372.6	18.4%

Source: FEMA 2017

Note: % = Percent;

The area presented includes the area of inland waterways

Natural and Beneficial Floodplain Areas

Although typically associated as a hazard area, floodplains also serve beneficial and natural functions (on ecological/environmental, social, and economic levels). Disruption of these natural systems can have long-term consequences on entire regions; however, this potential impact has only recently been noted. Some of the more well-known water-related functions for floodplains include:

- Natural flood and erosion control
 - Provide flood storage and conveyance
 - Reduce flood velocities
 - Reduce flood peaks
 - Reduce sedimentation
- Surface water quality maintenance
 - Filter nutrients and impurities from runoff
 - Process organic wastes
 - Moderate temperatures of water
- Groundwater recharge
 - Promote infiltration and aquifer recharge
 - Reduce frequency and duration of low surface flows (FEMA 2007)

Areas in the floodplain that typically provide these natural functions are wetlands, riparian areas, sensitive areas, and habitats for rare and endangered species. According to NJ DEP 2015 Land-Use Land-Cover data and 2017 NJDEP Landscape Project Data, the County has several floodplain areas that could serve natural and beneficial functions (Landscape Project contains the endangered species data). This information is summarized in the table below.

Table 5.4.4-3. Acreage of Wetlands by Municipality

Municipality	Total Area (acres)	Wetland Area (acres)	Percent of Total
Bass River Township	50,168.0	12,552.4	25.0%
Beverly City	493.2	10.0	2.0%
Bordentown City	617.4	57.5	9.3%
Bordentown Township	5,764.9	1,078.7	18.7%
Burlington City	2,390.7	97.6	4.1%
Burlington Township	8,935.9	1,016.8	11.4%
Chesterfield Township	13,946.8	3,387.9	24.3%



Municipality	Total Area (acres)	Wetland Area (acres)	Percent of Total
Cinnaminson Township	5,132.8	251.5	4.9%
Delanco Township	2,156.7	76.9	3.6%
Delran Township	4,662.5	313.9	6.7%
Eastampton Township	3,745.5	1,202.7	32.1%
Edgewater Park Township	1,959.6	4.6	0.2%
Evesham Township	19,000.8	5,465.3	28.8%
Fieldsboro Borough	303.9	51.5	17.0%
Florence Township	6,507.0	945.9	14.5%
Hainesport Township	4,362.6	550.1	12.6%
Lumberton Township	8,335.7	1,909.9	22.9%
Mansfield Township	14,040.8	3,535.1	25.2%
Maple Shade Township	2,453.7	112.1	4.6%
Medford Lakes Borough	799.2	4.6	0.6%
Medford Township	25,531.6	9,299.3	36.4%
Moorestown Township	9,552.0	903.9	9.5%
Mount Holly Township	1,850.9	134.2	7.2%
Mount Laurel Township	14,048.0	2,536.8	18.1%
New Hanover Township	14,360.2	3,894.4	27.1%
North Hanover Township	10,945.7	1,776.9	16.2%
Palmyra Borough	1,532.7	60.1	3.9%
Pemberton Borough	395.4	68.0	17.2%
Pemberton Township	40,295.9	14,274.8	35.4%
Riverside Township	1,044.0	41.9	4.0%
Riverton Borough	609.5	0.5	0.1%
Shamong Township	28,910.4	10,761.7	37.2%
Southampton Township	28,027.8	12,543.3	44.8%
Springfield Township	18,725.8	6,599.5	35.2%
Tabernacle Township	31,717.9	8,529.6	26.9%
Washington Township	66,071.1	24,946.4	37.8%
Westampton Township	7,106.0	1,464.5	20.6%
Willingboro Township	5,200.1	264.0	5.1%
Woodland Township	61,174.2	17,549.2	28.7%
Wrightstown Borough	1,328.0	244.4	18.4%
Burlington County Total:	524,204.7	148,518.6	28.3%

Source: NJDEP 2015



Table 5.4.4-4. Natural and Beneficial Land in Burlington County

Wetlands	Area (acres)	Forest	Area (acres)	Endangered Species	Area (acres)
Agricultural Wetlands (Modified)	5,370.3	Coniferous Brush/Shrubland	155.6	Special Concern	11,801.6
Atlantic White Cedar Wetlands	9,932.3	Coniferous Forest (>50% Crown Closure)	3,331.2	State Endangered	59,683.5
Coniferous Scrub/Shrub Wetlands	209.7	Coniferous Forest (10-50% Crown Closure)	1,244.7	State Threatened	3,966.0
Coniferous Wooded Wetlands	5,654.9	Deciduous Brush/Shrubland	251.8		
Deciduous Scrub/Shrub Wetlands	2,856.6	Deciduous Forest (>50% Crown Closure)	2,172.8		
Deciduous Wooded Wetlands	18,209.1	Deciduous Forest (10-50% Crown Closure)	833.8		
Disturbed Wetlands (Modified)	131.5	Mixed Deciduous/Coniferous Brush/Shrubland	184.7		
Former Agricultural Wetland (Becoming Shrubby, Not Built-Up)	123.2	Mixed Forest (>50% Coniferous With >50% Crown Closure)	861.4		
Freshwater Tidal Marshes	1,581.2	Mixed Forest (>50% Coniferous With 10-50% Crown Closure)	110.1		
Herbaceous Wetlands	2,160.0	Mixed Forest (>50% Deciduous With >50% Crown Closure)	556.1		
Managed Wetland in Built-Up Maintained Rec Area	87.6	Mixed Forest (>50% Deciduous With 10-50% Crown Closure)	104.6		
Managed Wetland in Maintained Lawn Greenspace	100.9	Old Field (< 25% Brush Covered)	293.6		
Mixed Scrub/Shrub Wetlands (Coniferous Dom.)	598.1	Phragmites Dominate Old Field	16.3		
Mixed Scrub/Shrub Wetlands (Deciduous Dom.)	917.1	Plantation	2.9		
Mixed Wooded Wetlands (Coniferous Dom.)	5,048.2				
Mixed Wooded Wetlands (Deciduous Dom.)	3,553.4				
Phragmites Dominate Coastal Wetlands	1,529.4				
Phragmites Dominate Interior Wetlands	160.5				
Phragmites Dominate Urban Area	0.3				
Saline Marsh (High Marsh)	263.1				
Saline Marsh (Low Marsh)	5,953.4				



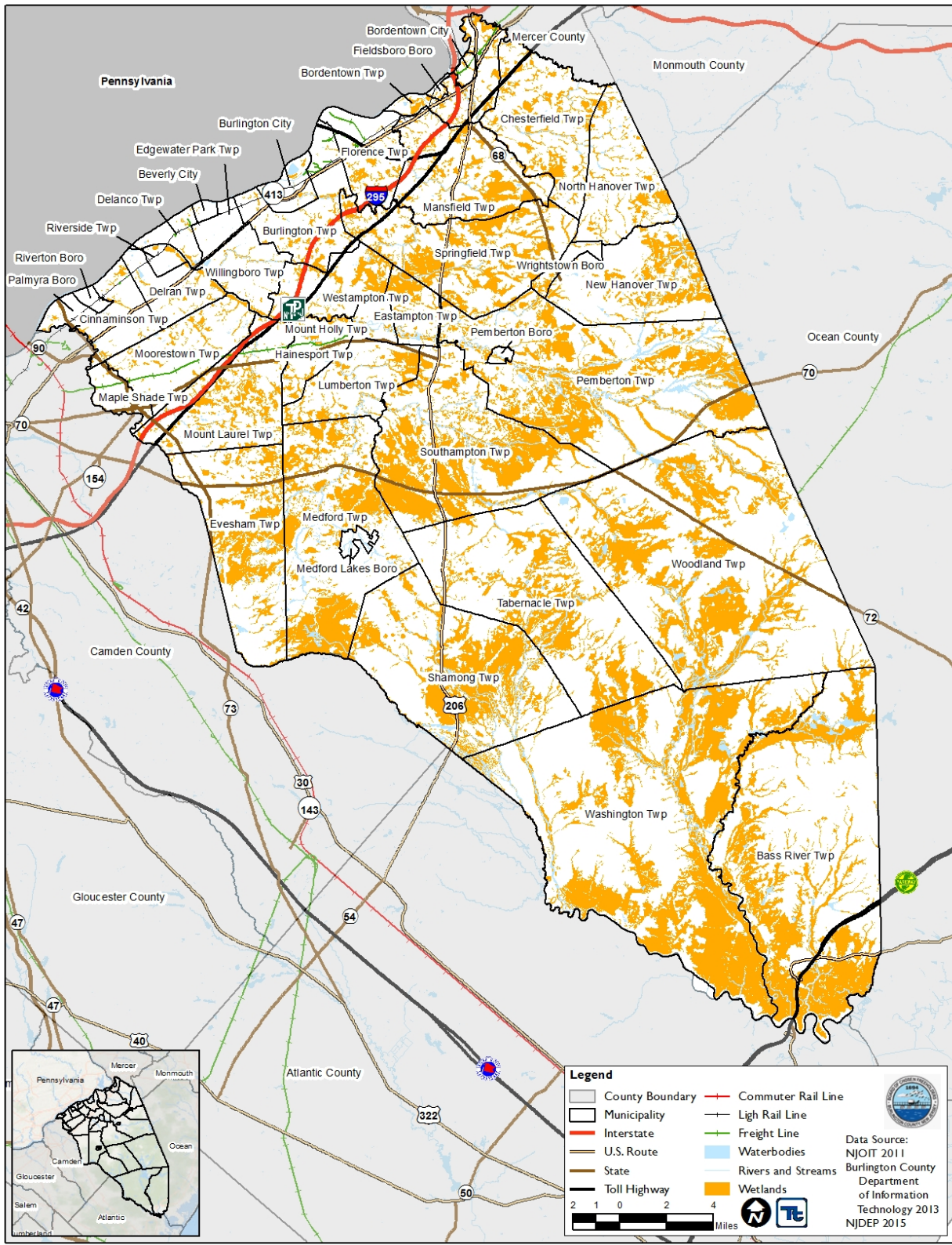
SECTION 5.4.4: RISK ASSESSMENT - FLOOD

Wetlands	Area (acres)	Forest	Area (acres)	Endangered Species	Area (acres)
Wetland Rights-Of-Way	162.3				

Note: An additional 8,154.2 acres of land didn't have a joinable ID number for the Landscape Project data. This could be a miscellaneous potential habitat for endangered species.



Figure 5.4.4-3. Wetlands in Burlington County



Source: NJDEP 2015





According to the Landscape Project data, Burlington County contains potential habitats for over 50 endangered species from multiple taxonomic classes, including Amphibia, Aves, Bivalvia, Insecta, Mammalia, Osteichthyes, and Reptilia. Habitats for about 48 of these species are located within the 1-percent annual chance floodplain. These species include, the Indiana bat, the bald eagle, the shortnose sturgeon and the bog turtle.

Extent

Once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- Minor Flooding - minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding - some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations (NWS 2011).

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. The size of rivers and streams in an area and infiltration rates are significant factors. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration rates decrease and any more water that accumulates must flow as runoff (Harris 2001).

Previous Occurrences and Losses

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

Between 1954 and 2018, FEMA declared that the State of New Jersey experienced 34 flood-related disasters (DR) or emergencies (EM) classified as flooding, or as flooding with one or a combination of the following disaster types: Severe Storms; Inland and Coastal Flooding; Mudslides; Coastal Storm; High Tides; Heavy Rain; High Winds; and Hurricane. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Burlington County was included in 12 of these flood-related declarations between 1954 and 2018, and two declarations since the 2014 Burlington County HMP. Table 5.4.4-5 lists FEMA DR declarations from January 1, 2012 to January 1, 2018 for this HMP update.

Table 5.4.4-5. FEMA Declarations since 2012 for Flood Events in Burlington County

FEMA Disaster Number	Date(s) of Incident	Incident Type / Title	Declared Counties
DR-4086, EM 3354	October 26 – November 8, 2012	Hurricane Sandy	Atlantic, Bergen, Burlington, Camden, Cape May, Cumberland, Essex, Gloucester, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Passaic, Salem, Somerset, Sussex, Union, and Warren
DR-4231	June 23, 2015	Severe Storm	Atlantic, Burlington, Camden, and Gloucester
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

Source: FEMA 2018



United States Department of Agriculture (USDA) crop losses provide another indicator of the severity of previous events. Additionally, crop losses can have a significant impact on the economy by reducing produce sales and purchases. Such impacts may have long-term consequences, particularly if crop yields are low the following years as well. Burlington County has experienced annual crop losses due to natural hazard events. The USDA records from 2012 to 2018 note that Burlington County had two USDA agricultural disasters (2013 and 2015) that were related to flood damages. (USDA 2018).

For this 2019 HMP update, flood events were summarized from January 1, 2012 to January 1, 2018. Known flood events, including FEMA disaster declarations, which have impacted Burlington County between 2012 and 2018 are identified in Table 5.4.4-6. For events prior to 2012, please refer to Appendix G (Supplementary Data). 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. Please see Section 9 for detailed information regarding impacts and losses to each municipality.



Table 5.4.4-6. Flood Events in Burlington County, 2012 to 2018

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
June 4, 2012	Coastal Flood	N/A	N/A	Spring tides associated with the full moon caused minor to moderate tidal flooding during the first few days of June. Moderate tidal flooding occurred along Raritan Bay, coastal New Jersey, and Delaware Bay during the overnight high tide cycle on June 4 th . Flooding occurred up and down the coast of New Jersey. In Burlington County, in the City of Burlington, the Delaware River was 10.1 feet above MLLW on the 4 th .
September 3-6, 2012	Flash Flood, Flood	N/A	N/A	Waves of thunderstorms brought heavy rain on the 3 rd and 4 th that produced flash flooding in southwestern Ocean County and southeastern Burlington County. Storm total estimates reached around 10 inches in southeastern Burlington County, more than half of which fell with the first wave of storms. The storms caused small stream and poor drainage flooding in sections of Bass River Township and Woodland Township. Rainfall totals included 5.19 inches in Woodland. Additional storms that fell after the 4 th led to flooding along County Routes 563 and 679. Route 563 was closed and barricaded at the Evans Bridge. The roadway was also closed between Greenbank-Chatsworth Road in Washington Township and Leektown Road in Bass River Township.
October 29-30, 2012	Hurricane Sandy	DR-4086, EM 3354	Yes	Post Tropical Storm Sandy was the costliest natural disaster by far in the state of New Jersey. Record breaking high tides and wave action combined with sustained winds as high as 60 to 70 mph with wind gusts as high as around 90 mph to batter the state. Statewide, Sandy caused an estimated \$29.4 billion in damage, destroyed or significantly damaged 30,000 homes and businesses, affected 42,000 additional structures and was responsible directly or indirectly for 38 deaths. A new temporary inlet formed in Mantaloking (Ocean County) where some homes were swept away. About 2.4 million households in the state lost power. It would take two weeks for power to be fully restored to homes and businesses that were inhabitable. In the Mount Holly warning and forecast area of New Jersey, Sandy was responsible for 24 deaths, 8 that are considered directly caused by the system: two drownings, five people killed by fallen trees and one person was blown over by the wind. Hardest hit were the coastal areas of Ocean and Monmouth Counties. Approximately 230,000 residents of the state have applied for assistance from FEMA. In Burlington County, heavy rain caused urban and poor drainage flooding and exacerbated the tidal flooding along the Delaware River and near the Atlantic Coast. Along the Delaware River, tidal flooding occurred in the Columbus Park development along Assiscunk Creek in the City of Burlington. In Mount Laurel Township, Union Mill Road was closed because Parkers Creek flooded. The North Branch of the Rancocas Creek at Pemberton was above its 2.5-foot flood stage from 4:30 p.m. on the 30 th through 6 p.m. on the 31 st . It crested at 2.58 feet at 1:30 a.m. on the 31 st . The highest crest in the County was 8.67 feet MLLW at the City of Burlington. Rainfall totals in Burlington County included 4.10 inches in Medford Township, 3.51 inches in Chatsworth, 3.15 inches in Medford Lakes, 2.92 inches in Mount Laurel Township, 2.82 inches in Morrestown Township and 2.42 inches in Westampton Township. Peak wind gusts in the County ranged from 56 mph in Woodland Township to 70 mph in Florence Township.



Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				The most widespread damage in Burlington County was reported in Bass River Township, mainly due to tidal and flood-related damages. In Mount Holly Township, a resident was trapped inside their home after a tree landed on the house. Seven roadways in Medford Township were closed due to downed trees. Overall, the County reported approximately \$5 million in property damage from Hurricane Sandy.
December 21, 2012	Coastal Flood	N/A	N/A	Strong wind gusts ranging from 46 mph to 64 mph across New Jersey downed trees and power lines. The winds also allowed water to pile up along the New Jersey shore and into the Delaware Bay, producing minor to moderate coastal flooding. Moderate to heavy rain also fell across the state, with storm totals ranging between one and three inches. This rain also resulted in some minor flooding of smaller streams and creeks in southern New Jersey. In Burlington County, homes were evacuated in the City of Burlington due to tidal flooding. The high tide in the City reached 11.13 feet above MLLW. Wind gusts in the County ranged from 52 mph at McGuire Air Force Base to 62 mph at the City of Burlington.
December 27, 2012	Flood	N/A	N/A	Heavy rain caused poor drainage flooding as well as stream and river flooding in the central portion of New Jersey, including Burlington County. Rainfall totals ranged from one to three inches, flooding many roadways. The North Branch of the Rancocas Creek at Pemberton Township was above its 2.5-foot flood stage from 8:45 p.m. on the 27th through 9:45 a.m. on the 29th. It crested at 2.56 feet at 9:45 a.m. on the 28th. The McDonald's Branch in Woodland Township was above its 1.7-foot flood stage from 3:45 p.m. through 9:44 p.m. on the 27th. It crested at 1.71 feet at 4 p.m.. Event precipitation totals included 2.98 inches in Oswego Lake, 2.21 inches in Tabernacle Township, 2.20 inches in Pemberton Township, 2.00 inches in Southampton Township, 1.97 inches in Lumberton Township, 1.85 inches at the McGuire Air Force Base, 1.73 inches in Mount Laurel Township, and 1.59 inches in Westampton Township.
March 7, 2013	Coastal Flood	N/A	N/A	An intense Nor'Easter brought strong to high winds across central and southern New Jersey, as well as minor to moderate tidal flooding along the Raritan Bay, lower Delaware Bay and along the Atlantic Ocean. In Burlington County, tidal flooding was reported in Washington Township. Wind gusts in the county ranged from 49 mph in Coyle Field to 51 mph at McGuire Air Force Base. Approximately \$10,000 in property damage.
June 18, 2013	Flash Flood	N/A	N/A	Thunderstorms with heavy rain caused flash flooding along the Southampton and Pemberton Township borders. The flooding also affected New Jersey State Routes 70 and 72. Event precipitation totals included 3.07 inches in Tabernacle Township, 2.15 inches in Pemberton Township and 1.98 inches in Oswego Lake.
June 30, 2013	Flash Flood	N/A	N/A	Thunderstorms with very heavy rain caused flash flooding along roadways and smaller creeks in the southern part of Evesham Township. Event precipitation totals included 2.10 inches in nearby Medford Lakes Borough and 1.80 inches in Medford Township.
July 13, 2013	Flood	N/A	N/A	Slow moving showers and thunderstorms caused heavy rain to fall across extreme northwest Burlington County during the evening. Roadway flooding was reported in Florence Township and Roebling. Event totals included 1.65 inches in Florence Township. Doppler Radar storm total estimates reached 1 to 2 inches in the northwestern part of the county
July 22-23, 2013	Flash Flood, Flood	N/A	N/A	Heavy rain fell through the night of the 22nd and caused poor drainage and small stream flash flooding to occur during the early morning of the 23 rd in Burlington County. Several roads



Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				reported flooding through the Mount Holly Township/Westampton Township/Mount Laurel Township area. In Mount Holly Township, two homes were damaged by flooding on Cherry Street as the Buttonwood Run flooded. Part of the foundation of one home was washed away and was uninhabitable. The other home was severely damaged but was unoccupied. The intersection of Rancocas Road and the Mount Holly By-Pass (County Route 541) was flooded and closed. The basement of the First Presbyterian Church also flooded. In Mount Laurel, flash flooding along Parkers Creek shut down Hartford and Union Mill Rods. The runoff from all of the rain caused the Rancocas Creek to exceed its flood stage. Flooding closed Mill and King Streets as well as Rancocas-Mount Holly Road along the creek. The North Branch of the Rancocas Creek at Iron Works Park was above its 11.7-foot flood stage from 9:22 a.m. through 145 p.m. on the 23rd. It crested at 11.74 feet at 11:15 a.m. Event precipitation totals included 6.71 inches in Eastampton Township, 6.25 inches at the Mount Holly WFO, 4.00 inches in Florence Township, 3.43 inches in Hainesport Township, and 3.36 inches in Mount Laurel Township. Springside reported \$100,000 in property damages.
July 28, 2013	Flash Flood, Flood	N/A	N/A	Thunderstorms with torrential downpours caused small stream and poor drainage flash flooding in western Burlington County. The Southwest Branch of the Rancocas Creek flooded sections of the Golden Pheasant Golf Course in Lumberton. In Southampton, several apartment buildings flooded at the Sherwood Village Complex. Event precipitation totals included 2.91 inches in Mount Laurel Township, 2.76 inches in Mount Holly Township, 2.37 inches in Cinnaminson Township, 2.32 inches in Westampton Township, 2.08 inches in Palmyra Borough, and 2.05 inches in Moorestown Township. Riverton Borough reported \$10,000 in property damages. The South Branch of the Pennsauken Creek near Mill Road on New Jersey State Route 38 in Cherry Hill was above its 9-foot flood stage from 10:22 p.m. on the 28th through 6:39 a.m. on the 29th. It crested at 10.03 feet at 3 a.m. on the 29th.
August 13, 2013	Flash Flood	N/A	N/A	Thunderstorms with torrential downpours caused flash flooding of roadways and creeks, especially across the central third of Burlington County. In Evesham Township, a school bus became stuck in flood waters on Erindale Drive. Thirty-one children were rescued. Also, within the township, a motorist was rescued from flood waters on New Jersey State Route 70 near Cropwell Road. Flooded and closed roadways also included Marlton Parkway in Evesham Township and Hartford Road in Medford Township. The flooding also affected the primary election as voting booths had to be moved after flooding occurred at some polling places. Event precipitation totals included 2.64 inches in Medford Township, 2.53 inches in Southampton Township, 2.35 inches in Pemberton Township and 2.30 inches in Tabernacle Township.
March 30- April 1, 2014	Flood	N/A	N/A	The runoff from waves of heavy precipitation caused minor flooding along the North Branch Rancocas from the late evening of the 30th through the late evening of April 1st. The North Branch Rancocas at Pemberton Township was above its 2.5 foot flood stage from 10:45 p.m. on the 30th through 10:30 p.m. on April 1st, and it crested at 2.65 feet at 530 p.m. on the 31st. Event precipitation totals included 3.08 inches in Moorestown Township, 3.06 inches in Riverton, 2.96 inches in Mount Laurel Township, 2.85 inches in Tabernacle Township, 2.81 inches in Medford Lakes, 2.73 inches in Burlington Township, and 2.70 inches at WFO Mount Holly.
April 30-May 1, 2014	Coastal Flood, Flood	N/A	N/A	Very heavy rain caused considerable poor drainage and creek flooding in the northern two-thirds of Burlington County. Event precipitation totals included 6.32 inches in Riverton Borough, 5.44



Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				inches in Medford Township, 5.28 inches in Crosswicks, 5.23 inches in Moorestown Township, 5.14 inches in Mount Laurel Township, and 4.96 inches at the Mount Holly WFO. This event led to many creeks and rivers in the county reaching and exceeding flood stages. Overall, the County had approximately \$500,000 in property damage from this event. Municipalities along the branches of the Rancocas Creek were hardest hit by the flooding, in particular Lumberton Township and Mount Holly Township. County Route 541 through Lumberton was closed through the morning of May 2nd because of flooding along the South Branch of the Rancocas Creek. Residents from 30 homes in Lumberton Township were evacuated. Four to five homes in Lumberton Township suffered damage onto the first floor. Most of the other home damage in the township involved flooded basements or damaged vehicles. Along the North Branch of the Rancocas Creek, the Mount Holly Municipal Building was flooded, and the Township's Buttonwood Dam was badly damaged. Floodwaters along the creek were lapping at homes in Eastampton Township. Residents from several homes in Medford Township near the Southwest Branch of the Rancocas Creek were also evacuated. All families in the county displaced by flooding were able to return to their homes. Major roadways that were flooded and closed included New Jersey State Route 73 in Maple Shade Township and New Jersey State Route 70 in Medford Township. Major roadway partial closures included New Jersey State Route 38 in Moorestown and Mount Laurel Townships, New Jersey State Route 73 in Palmyra Township, U.S. Route 130 in Burlington Township and U.S. Route 206 in Bordentown Township.
July 14, 2014	Flash Flood	N/A	N/A	Thunderstorms with torrential downpours caused the closure of Interstate 295 in Bordentown Township near Blacks Creek and the evacuation of residents along Ellisdale Road near the Crosswicks Creek in Chesterfield Township. Doppler Radar storm total estimates reached between 2.5 and 3.0 inches in the area. Event precipitation totals included 2.62 inches in Burlington Township.
January 18, 2015	Flood	N/A	N/A	Heavy rain caused flooding along Parkers Creek and closed both Union Mill and Hartford Roads in the vicinity of the creek in Mount Laurel Township. Event precipitation totals included 1.99 inches in Mount Laurel Township, 1.96 inches in Medford Township, and 1.95 inches in Moorestown Township.
June 27, 2015	Flash Flood	N/A	N/A	Thunderstorms with very heavy rain caused flash flooding of smaller streams as well as poor drainage flooding in southeastern Burlington County. Event precipitation totals included 4.46 inches in Chatsworth, 3.39 inches in Oswego Lake, 2.53 inches in Shamong Township and 2.23 inches in Westampton Township.
August 1-3, 2017	Flash Flood, Flood	N/A	N/A	A hot and humid airmass with weak boundaries led to slow moving strong to severe thunderstorms with damaging winds, hail and flooding. Over 2,000 people lost power. In Palmyra, several roads were flooded and impassable. In Willing Borough several apartments flooded on Brittany Court. In Burlington Township, water entering a house on Cornell Road due to a nearby creek overflowing its banks. In Ramblewood, Locust Street closed between Kenilworth and the railroad due to flooding. In Roebling, Route 130 north near Kinkira Road was impassable. In Columbus, the Exit 52 ramp on Interstate 295 was closed. In Florence, all lanes on US-130 north of CR656 were closed due to flooding. In Stevens, US-130 was closed at Neck Road due to flooding. In Burlington, the save-a-lot and Roger Wilco stores on Rt 130 were flooded.



Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
September 19, 2017	Coastal Flood	N/A	N/A	Moderate coastal flooding affected southeastern Burlington County with the evening high tide on Tuesday, September 19. Widespread roadway flooding was reported in the communities along tidal waters and many roads were closed.
March 3-4, 2018	Coastal Flooding	N/A	N/A	Minor coastal flooding over multiple tide cycles occurred along the New Jersey coast March 2nd through 4th. In Burlington County, moderate coastal flooding with some road closures along tidal waterways were reported in southeastern portions of the county.
July 11, 2018	Heavy Rain and Flash Flood	N/A	N/A	Torrential rain fell across parts of southeastern Pennsylvania and central and southern new Jersey. Rainfall totals of up to six inches was reported. In Burlington County, water rescues were conducted along and around Willow Bend Drive in Delran Township. At least five persons were rescued from vehicles that were stranded in flood waters. Rancocas Road was closed near the Mount Holly Bypass in Mount Holly and Westampton Township. Significant flooding occurred along the Leavitt Parkway in Willingboro. Several vehicles were trapped in flood waters around John F Kennedy Way. The Leavitt Parkway was closed in both directions at Echo Lane due to the development of a sink hole.
August 31, 2018	Flash Flood	N/A	N/A	Heavy rain produced flash flooding in parts of Burlington County on the morning of August 31. Rainfall totals of 2.5 to 5.5 inches fell in a short amount of time. Heavy rain produced flash flooding on Route 530 just east of Route 206 in Southampton Township.

Source: NOAA-NCEI 2018; CRREL 2018
 CRREL Cold Regions Research and Engineering Laboratory
 DR Major Disaster Declaration (FEMA)
 EM Emergency Declaration (FEMA)
 FEMA Federal Emergency Management Agency
 MLLW Mean Lower Low Water
 Mph Miles per hour
 NOAA National Oceanic and Atmospheric Administration
 NCEI National Centers for Environmental Information
 N/A Not Applicable
 WFO Weather Forecast Office



Table 5.4.4-7. Flood Events 1950-2018

Hazard Type	Number of Occurrences Between 1950 and 2018	Total Fatalities	Total Injuries	Total Property Damage (\$)	Total Crop Damage (\$)
Coastal Flood	40	0	0	\$5.36 million	\$0
Flood	43	0	0	\$59.005 million	\$1,000
Flash Flood	45	0	0	\$57.110 million	\$0
Ice Jam	0	0	0	\$0	\$0
TOTAL	128	0	0	\$121.475 million	\$1,000

Source: NOAA-NCEI 2018; CRREL 2018

Probability of Future Occurrences

Based on the historic and more recent flood events in Burlington County, it is clear that the county has a high probability of flooding for the future. The fact that the elements required for flooding exist and that major flooding has occurred throughout the county in the past suggests that many people and properties are at risk from the flood hazard in the future. It is estimated that Burlington County will continue to experience direct and indirect impacts of flooding events annually that may induce secondary hazards such as coastal erosion, storm surge in coastal areas, infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

As defined by FEMA, geographic areas within the 1-percent annual chance flood area in Burlington County are estimated to have a one-percent chance of flooding in any given year. A structure located within a 1-percent annual chance flood area has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage. Geographic areas in Burlington County located within the 0.2-percent annual chance flood area boundary are estimated to have a 0.2-percent chance of being flooded in any given year (FEMA 2007).

According to the NOAA National Climate Data Center (NCDC) and the CRREL database, Burlington County experienced 128 flood events between 1950 and 2018, including 40 coastal floods, 43 floods, 45 flash floods, and no ice jams. The table below shows these statistics, as well as the annual average number of events and the percent chance of these individual flood hazards occurring in Burlington County in future years (NOAA NCDC 2018).

Table 5.4.4-8. Probability of Future Occurrences of Flood Events

Hazard Type	Number of Occurrences Between 1950 and 2015	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in any given year	Percent chance of occurrence in any given year
Coastal Flood	40	0.59	1.73	0.58	57.97
Flood	43	0.63	1.60	0.62	62.32
Flash Flood	45	15.00	0.09	11.25	1125.00
Ice Jams	0	0.00	0	0	0

Source: NOAA-NCDC 2018; CRREL 2018

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 flood in the county is considered ‘frequent’ (likely to occur within 25 years, as presented in Table 5.3-3).

Climate Change Impacts

The climate of New Jersey is already changing and will continue to change over the course of this century. Since 1900, temperatures in the northeastern U.S. have increased an average of 1.5°F. The majority of this warming has occurred since 1970. From 1970 to 2010, average temperatures in New Jersey have increased 1.2°F (ONJSC 2013). In terms of winter temperatures, the northeastern U.S. has seen an increase in the average temperature by 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, and by 2080 projections show an increase of 4°F to 7.5°F (Sustainable Jersey Climate Change Adaptation Task Force 2015).

In addition to the effect of increased temperatures, precipitation is expected to increase over the next several decades. Average annual precipitation is projected to increase in the region by 0-10 percent by the 2020s and 5-10 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] 2013). Although precipitation is expected to increase, extreme precipitation is the most likely concern for New Jersey. Extreme precipitation has the potential to cause significant flooding and, in the winter, produce heavy snowfall. While exact projections are not available, it is estimated that the New York City region will see an increase of 10% to 25% of the frequency of intense precipitation events (Sustainable Jersey Climate Change Adaptation Task Force 2013). Both northern and southern New Jersey have become wetter over the past century. New Jersey’s Statewide precipitation average for the last 30 years (1987-2017) was 1.05” greater than the average for the period of record (1895-2017) (Office of New Jersey State Climatologist).

With this increase in frequency of precipitation, New Jersey and Burlington County may experience more flooding events. More intense, frequent flooding could lead to significant habitat loss for wildlife. Salt marshes and estuaries that serve as critical feeding grounds for birds and waterfowl, and as nursery habitats for commercial fish, could be lost. Climate change may also increase the rate of sea level rise which will lead to more frequent and extensive coastal flooding.

5.4.4.2 VULNERABILITY ASSESSMENT

To assess Burlington County’s risk to the flood hazard, a spatial analysis was conducted using the best available spatially-delineated flood hazard areas. The 1- and 0.2-percent annual chance flood events were examined to determine the assets located in the hazard areas and to estimate potential loss using the FEMA HAZUS-MHv4.0 model. These results are summarized below. Refer to Section 5.1 for additional details on the methodology used to assess flood risk.

Impact on Life, Health and Safety

The impact of flooding on life, health and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not strictly measurable. Using the 2010 U.S. Census blocks, there are an estimated 28,446 people are exposed to the one-percent annual chance event and 39,268 people are exposed to the



0.2-percent annual chance flood event. These residents may be displaced by the flooding of their homes, requiring them to seek temporary shelter with friends and family or in emergency shelters. Burlington City has the greatest total number and proportion of its population located in the floodplain; 7,585 (approximately 76.5-percent) and 8,534 (approximately 86.0-percent) for the 1-percent chance event and 0.2-percent chance event, respectively. For this project, the potential population exposed is used as a guide for planning purposes.

Table 5.4.4-9. Estimated Population Exposed to the Flood Hazard

Municipality	Total Population	1-Percent Chance Event		0.2-Percent Chance Event	
		Population in Hazard Area	Percent of Total Population	Population in Hazard Area	Percent of Total Population
Bass River Township	1,443	647	44.8%	822	57.0%
Beverly City	2,577	233	9.0%	373	14.5%
Bordentown City	3,924	76	1.9%	76	1.9%
Bordentown Township	11,367	701	6.2%	792	7.0%
Burlington City	9,920	7,585	76.5%	8,534	86.0%
Burlington Township	22,594	653	2.9%	1,143	5.1%
Chesterfield Township	7,699	22	<1%	22	<1%
Cinnaminson Township	15,569	1,047	6.7%	1,554	10.0%
Delanco Township	4,283	136	3.2%	1,018	23.8%
Delran Township	16,896	656	3.9%	928	5.5%
Eastampton Township	6,069	36	<1%	64	1.1%
Edgewater Park Township	8,881	0	0.0%	0	0.0%
Evesham Township	45,538	2,052	4.5%	2,142	4.7%
Fieldsboro Borough	540	22	4.1%	22	4.1%
Florence Township	12,109	88	<1%	88	<1%
Hainesport Township	6,110	170	2.8%	170	2.8%
Lumberton Township	12,559	754	6.0%	800	6.4%
Mansfield Township	8,544	184	2.2%	184	2.2%
Maple Shade Township	19,131	547	2.9%	1,194	6.2%
Medford Lakes Borough	4,146	425	10.3%	425	10.3%
Medford Township	23,033	1,448	6.3%	1,856	8.1%
Moorestown Township	20,726	246	1.2%	326	1.6%
Mount Holly Township	9,536	1,243	13.0%	2,206	23.1%
Mount Laurel Township	41,864	920	2.2%	2,466	5.9%
New Hanover Township	7,385	7	<1%	7	<1%
North Hanover Township	7,678	327	4.3%	327	4.3%
Palmyra Borough	7,398	748	10.1%	3,048	41.2%
Pemberton Borough	1,409	0	0.0%	40	2.8%
Pemberton Township	27,912	1,338	4.8%	1,413	5.1%
Riverside Township	8,079	530	6.6%	937	11.6%
Riverton Borough	2,779	175	6.3%	571	20.5%
Shamong Township	6,490	946	14.6%	946	14.6%
Southampton Township	10,464	1,364	13.0%	1,523	14.6%
Springfield Township	3,414	230	6.7%	260	7.6%
Tabernacle Township	6,949	157	2.3%	157	2.3%
Washington Township	687	429	62.4%	429	62.4%



Table 5.4.4-9. Estimated Population Exposed to the Flood Hazard

Municipality	Total Population	1-Percent Chance Event		0.2-Percent Chance Event	
		Population in Hazard Area	Percent of Total Population	Population in Hazard Area	Percent of Total Population
Westampton Township	8,813	1,262	14.3%	1,276	14.5%
Willingboro Township	31,629	1,039	3.3%	1,126	3.6%
Woodland Township	1,788	3	<1%	3	<1%
Wrightstown Borough	802	0	0.0%	0	0.0%
Burlington County	448,734	28,446	6.3%	39,268	8.8%

Sources: U.S. Census 2010; FEMA, 2017

The FEMA DFIRM boundaries were overlaid on the U.S. Census block; the blocks with their centroids within the hazard areas were totaled for each municipality.

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over age 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on net economic impacts on their families. The population over age 65 is also more vulnerable because they are more likely to seek or need medical attention that may not be available due to isolation during a flood event, and they may have more difficulty evacuating. Within the 1-percent annual chance event, there are approximately 3,871 people over the age of 65 and 3,364 people considered low income populations. These populations are all located within the 1-percent annual chance flood A-zones; no elderly or low-income populations are located within the 1-percent annual chance flood V-zones. As for the 0.2-percent chance event, there are approximately 6,836 people over the age 65 and 5,248 people considered low income populations.

Using 2010 U.S. Census data, HAZUS-MH 4.0 estimates the potential sheltering needs as a result of a 1-percent annual chance flood event. For the 1-percent flood event, HAZUS-MH 4.0 estimates 23,057 households will be displaced, and 15,599 people will seek short-term sheltering. These statistics, by municipality, are presented in Table 5.4.4-10. The estimated displaced population and number of persons seeking short-term sheltering differs from the number of persons exposed to the 1-percent annual chance flood, because the displaced population numbers take into consideration that not all residents will be significantly impacted enough to be displaced or to require short-term sheltering during a flood event.

Table 5.4.4-10. Estimated Population Displaced or Seeking Short-Term Shelter from the 1-percent Annual Chance Flood Event

Municipality	U.S. Census 2010 Population	1-percent Annual Chance Event	
		Displaced Households	Persons Seeking Short-Term Sheltering
Bass River Township	1,443	432	293
Beverly City	2,577	76	33
Bordentown City	3,924	65	16
Bordentown Township	11,367	180	77
Burlington City	9,920	7,485	6,908
Burlington Township	22,594	280	126
Chesterfield Township	7,699	122	3
Cinnaminson Township	15,569	1,109	707
Delanco Township	4,283	321	194



Table 5.4.4-10. Estimated Population Displaced or Seeking Short-Term Shelter from the 1-percent Annual Chance Flood Event

Municipality	U.S. Census 2010 Population	1-percent Annual Chance Event	
		Displaced Households	Persons Seeking Short-Term Sheltering
Delran Township	16,896	676	490
Eastampton Township	6,069	145	111
Edgewater Park Township	8,881	2	0
Evesham Township	45,538	1,327	732
Fieldsboro Borough	540	9	0
Florence Township	12,109	59	6
Hainesport Township	6,110	305	191
Lumberton Township	12,559	385	198
Mansfield Township	8,544	112	37
Maple Shade Township	19,131	407	291
Medford Lakes Borough	4,146	209	46
Medford Township	23,033	1,074	578
Moorestown Township	20,726	684	327
Mount Holly Township	9,536	670	458
Mount Laurel Township	41,864	1,425	896
New Hanover Township	7,385	16	0
North Hanover Township	7,678	77	10
Palmyra Borough	7,398	1,092	847
Pemberton Borough	1,409	6	0
Pemberton Township	27,912	1,070	340
Riverside Township	8,079	478	324
Riverton Borough	2,779	129	61
Shamong Township	6,490	193	59
Southampton Township	10,464	527	173
Springfield Township	3,414	136	34
Tabernacle Township	6,949	107	14
Washington Township	687	218	156
Westampton Township	8,813	432	274
Willingboro Township	31,629	954	576
Woodland Township	1,788	63	13
Wrightstown Borough	802	0	0
Burlington County	448,734	23,057	15,599

Source: HAZUS-MH 4.0



Total numbers of injuries and casualties resulting from typical riverine flooding are generally limited based on advance weather forecasting, blockades, and warnings. Injuries and deaths generally are not anticipated if proper warning and precautions occur. In contrast, warning time for flash flooding is limited. These events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard.

Cascading impacts may also include exposure to pathogens such as mold. After flood events, excess moisture and standing water contribute to the growth of mold in buildings. Mold may present a health risk to building occupants, especially those with already compromised immune systems such as infants, children, the elderly and pregnant women. The degree of impact will vary and is not strictly measurable. Molds can grow in as short a period as 24-48 hours in wet and damaged areas of buildings that have not been properly cleaned. Very small mold spores can easily be inhaled, creating the potential for allergic reactions, asthma episodes, and other respiratory problems. Buildings should be properly cleaned and dried out to safely prevent mold growth (CDC, 2015).

Molds and mildews are not the only public health risk associated with flooding. Floodwaters can be contaminated by pollutants such as sewage, human and animal feces, pesticides, fertilizers, oil, asbestos, and rusting building materials. Common public health risks associated with flood events also include:

- Unsafe food
- Contaminated drinking and washing water and poor sanitation
- Mosquitos and animals
- Carbon monoxide poisoning
- Secondary hazards associated with re-entering/cleaning flooded structures
- Mental stress and fatigue

Current loss estimation models such as HAZUS-MH are not equipped to measure public health impacts. The best level of mitigation for these impacts is to be aware that they can occur, educate the public on prevention, and be prepared to deal with these vulnerabilities in responding to flood events.

Impact on General Building Stock

Exposure to the flood hazard includes those buildings located in the flood zone and potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value. In summary, there are 8,424 buildings located in 1-percent annual chance flood boundary with approximately \$7.8 billion of building/contents exposed (based on replacement cost value). This represents approximately 4.7-percent of the county's total general building stock inventory (approximately \$165.5 billion). There are 12,766 buildings located in the 0.2-percent annual chance flood boundary with approximately \$12 billion of building/contents exposed. This represents approximately 7.3-percent of the County's total general building stock inventory. The City of Burlington has the greatest exposure to its building stock for both the 1- and 0.2-percent annual chance flood events. Refer to Table 5.4.4-11 and Table 5.4.4-12 for the results of the 1- and 0.2-percent annual chance flood exposure on the general building stock.

The potential damage estimated by HAZUS-MH to the general building stock inventory associated with the 1-percent annual chance flood is approximately \$1.2 billion or less than 1-percent of the total building stock replacement cost value (structure and estimated contents). The potential damage estimated by HAZUS-MH 4.0 to the residential general building stock inventory associated with the 1-percent annual chance flood is \$605 million or less than 1-percent of the total building stock replacement cost value (structure and estimated contents). Refer to Table 5.4.4-13 for the potential losses estimated by HAZUS-MH 4.0 by municipality.



Table 5.4.4-11. Estimated General Building Stock Exposure to the 1-Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Replacement Cost Value	Total (All Occupancies) in the 1-Percent Annual Chance Flood Zone			
			# Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Bass River Township	1,863	\$1,027,917,130	530	28.4%	\$328,406,175	31.9%
Beverly City	964	\$471,487,138	10	1.0%	\$6,632,164	1.4%
Bordentown City	1,219	\$1,244,995,904	17	1.4%	\$9,767,552	0.8%
Bordentown Township	3,113	\$2,820,041,247	60	1.9%	\$64,670,462	2.3%
Burlington City	3,644	\$3,215,233,092	2,374	65.1%	\$2,194,748,648	68.3%
Burlington Township	7,757	\$8,013,259,672	124	1.6%	\$217,856,658	2.7%
Chesterfield Township	2,093	\$2,443,294,418	32	1.5%	\$59,466,822	2.4%
Cinnaminson Township	6,358	\$5,703,895,752	365	5.7%	\$195,202,321	3.4%
Delanco Township	1,562	\$1,422,201,479	129	8.3%	\$142,092,069	10.0%
Delran Township	5,191	\$5,145,622,596	297	5.7%	\$181,464,342	3.5%
Eastampton Township	2,499	\$1,687,017,512	212	8.5%	\$58,884,301	3.5%
Edgewater Park Township	2,567	\$2,307,285,215	6	0.2%	\$1,159,758	0.1%
Evesham Township	14,319	\$14,666,082,424	241	1.7%	\$209,842,379	1.4%
Fieldsboro Borough	242	\$139,371,126	8	3.3%	\$3,405,520	2.4%
Florence Township	2,522	\$2,787,263,607	48	1.9%	\$73,215,203	2.6%
Hainesport Township	2,747	\$3,447,208,735	85	3.1%	\$117,068,572	3.4%
Lumberton Township	4,009	\$5,459,557,257	218	5.4%	\$194,758,556	3.6%
Mansfield Township	2,798	\$4,056,501,589	70	2.5%	\$92,363,074	2.3%
Maple Shade Township	6,006	\$4,385,500,913	53	0.9%	\$86,328,706	2.0%
Medford Lakes Borough	1,909	\$1,280,050,871	88	4.6%	\$42,554,968	3.3%
Medford Township	10,627	\$12,845,907,494	480	4.5%	\$367,010,672	2.9%
Moorestown Township	8,736	\$10,108,801,626	178	2.0%	\$250,295,272	2.5%
Mount Holly Township	4,573	\$3,498,352,996	166	3.6%	\$124,879,749	3.6%
Mount Laurel Township	12,900	\$14,653,800,804	229	1.8%	\$260,222,222	1.8%
New Hanover Township	1,964	\$3,022,835,486	28	1.4%	\$17,056,530	0.6%
North Hanover Township	2,901	\$3,079,878,987	35	1.2%	\$117,216,744	3.8%
Palmyra Borough	2,713	\$1,788,398,557	209	7.7%	\$93,313,877	5.2%
Pemberton Borough	514	\$345,869,906	0	0.0%	\$0	0.0%
Pemberton Township	13,511	\$9,374,914,679	615	4.6%	\$792,660,953	8.5%
Riverside Township	2,868	\$2,039,139,951	201	7.0%	\$143,737,008	7.0%



Table 5.4.4-11. Estimated General Building Stock Exposure to the 1-Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Replacement Cost Value	Total (All Occupancies) in the 1-Percent Annual Chance Flood Zone			
			# Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Riverton Borough	1,274	\$916,434,789	37	2.9%	\$33,097,785	3.6%
Shamong Township	3,623	\$2,738,384,433	51	1.4%	\$16,751,317	0.6%
Southampton Township	7,982	\$6,722,347,774	340	4.3%	\$247,542,681	3.7%
Springfield Township	2,876	\$3,853,514,909	122	4.2%	\$177,045,818	4.6%
Tabernacle Township	4,452	\$3,619,040,765	23	0.5%	\$123,817,987	3.4%
Washington Township	939	\$597,426,933	339	36.1%	\$248,684,908	41.6%
Westampton Township	3,006	\$4,269,433,407	86	2.9%	\$110,182,624	2.6%
Willingboro Township	12,395	\$8,259,747,413	261	2.1%	\$140,529,678	1.7%
Woodland Township	1,323	\$1,656,748,246	57	4.3%	\$257,980,778	15.6%
Wrightstown Borough	485	\$411,963,035	0	0.0%	\$0	0.0%
Burlington County	173,044	\$165,526,729,867	8,424	4.9%	\$7,801,914,854	4.7%

Source: FEMA 2017, Burlington County, NJ Department of the Treasury, 2017

Note: The FEMA DFIRM boundaries were overlaid on the custom general building stock inventory; the structures with their centroids within the hazard are were totaled for each municipality.

Table 5.4.4-12. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Replacement Cost Value	Total (All Occupancies) in the 0.2-Percent Annual Chance Flood Zone			
			# Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Bass River Township	1,863	\$1,027,917,130	852	45.7%	\$557,034,227	54.2%
Beverly City	964	\$471,487,138	50	5.2%	\$24,194,626	5.1%
Bordentown City	1,219	\$1,244,995,904	19	1.6%	\$10,998,968	0.9%
Bordentown Township	3,113	\$2,820,041,247	78	2.5%	\$92,475,544	3.3%
Burlington City	3,644	\$3,215,233,092	2,905	79.7%	\$2,746,821,720	85.4%
Burlington Township	7,757	\$8,013,259,672	465	6.0%	\$546,728,337	6.8%
Chesterfield Township	2,093	\$2,443,294,418	32	1.5%	\$59,466,822	2.4%
Cinnaminson Township	6,358	\$5,703,895,752	573	9.0%	\$425,876,406	7.5%
Delanco Township	1,562	\$1,422,201,479	485	31.0%	\$360,805,718	25.4%
Delran Township	5,191	\$5,145,622,596	420	8.1%	\$298,976,437	5.8%
Eastampton Township	2,499	\$1,687,017,512	236	9.4%	\$65,086,684	3.9%
Edgewater Park Township	2,567	\$2,307,285,215	11	0.4%	\$4,595,037	0.2%



Table 5.4.4-12. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Replacement Cost Value	Total (All Occupancies) in the 0.2-Percent Annual Chance Flood Zone			
			# Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Evesham Township	14,319	\$14,666,082,424	296	2.1%	\$242,326,131	1.7%
Fieldsboro Borough	242	\$139,371,126	9	3.7%	\$3,593,195	2.6%
Florence Township	2,522	\$2,787,263,607	51	2.0%	\$75,315,270	2.7%
Hainesport Township	2,747	\$3,447,208,735	101	3.7%	\$143,335,791	4.2%
Lumberton Township	4,009	\$5,459,557,257	229	5.7%	\$201,938,177	3.7%
Mansfield Township	2,798	\$4,056,501,589	70	2.5%	\$92,363,074	2.3%
Maple Shade Township	6,006	\$4,385,500,913	123	2.0%	\$243,048,073	5.5%
Medford Lakes Borough	1,909	\$1,280,050,871	93	4.9%	\$43,641,024	3.4%
Medford Township	10,627	\$12,845,907,494	637	6.0%	\$569,556,858	4.4%
Moorestown Township	8,736	\$10,108,801,626	257	2.9%	\$346,356,682	3.4%
Mount Holly Township	4,573	\$3,498,352,996	479	10.5%	\$460,823,782	13.2%
Mount Laurel Township	12,900	\$14,653,800,804	694	5.4%	\$895,193,432	6.1%
New Hanover Township	1,964	\$3,022,835,486	28	1.4%	\$17,056,530	0.6%
North Hanover Township	2,901	\$3,079,878,987	35	1.2%	\$117,216,744	3.8%
Palmyra Borough	2,713	\$1,788,398,557	712	26.2%	\$552,888,735	30.9%
Pemberton Borough	514	\$345,869,906	2	0.4%	\$585,435	0.2%
Pemberton Township	13,511	\$9,374,914,679	675	5.0%	\$917,774,126	9.8%
Riverside Township	2,868	\$2,039,139,951	362	12.6%	\$250,453,649	12.3%
Riverton Borough	1,274	\$916,434,789	253	19.9%	\$190,429,316	20.8%
Shamong Township	3,623	\$2,738,384,433	71	2.0%	\$20,509,550	0.7%
Southampton Township	7,982	\$6,722,347,774	376	4.7%	\$258,973,214	3.9%
Springfield Township	2,876	\$3,853,514,909	131	4.6%	\$181,707,319	4.7%
Tabernacle Township	4,452	\$3,619,040,765	23	0.5%	\$123,817,987	3.4%
Washington Township	939	\$597,426,933	442	47.1%	\$329,355,215	55.1%
Westampton Township	3,006	\$4,269,433,407	101	3.4%	\$115,582,178	2.7%
Willingboro Township	12,395	\$8,259,747,413	332	2.7%	\$184,986,004	2.2%
Woodland Township	1,323	\$1,656,748,246	58	4.4%	\$258,508,844	15.6%
Wrightstown Borough	485	\$411,963,035	0	0.0%	\$0	0.0%
Burlington County	173,044	\$165,526,729,867	12,766	7.4%	\$12,030,396,860	7.3%



Source: FEMA 2017, Burlington County, NJ Department of the Treasury, 2017

Note: The FEMA DFIRM boundaries were overlaid on the custom general building stock inventory; the structures with their centroids within the hazard area were totaled for each municipality.

Table 5.4.4-13. Estimated General Building Stock Potential Loss to the 1-percent Annual Chance Flood Event

Municipality	Total Replacement Cost Value	1-Percent Annual Chance Event							
		All Occupancies		Residential		Commercial		Industrial, Religious, Education and Government	
		Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total
Bass River Township	\$1,027,917,130	\$98,108,935	9.5%	\$32,063,779	3.1%	\$11,263,192	1.1%	\$54,781,964	5.3%
Beverly City	\$471,487,138	\$2,106,654	<1%	\$378,662	<1%	\$0	0.0%	\$1,727,992	<1%
Bordentown City	\$1,244,995,904	\$3,682,945	<1%	\$189,609	<1%	\$3,004,925	<1%	\$488,412	<1%
Bordentown Township	\$2,820,041,247	\$16,965,329	<1%	\$5,955,081	<1%	\$1,212,021	<1%	\$9,798,228	<1%
Burlington City	\$3,215,233,092	\$452,114,703	14.1%	\$254,514,061	7.9%	\$78,521,419	2.4%	\$119,079,223	<1%
Burlington Township	\$8,013,259,672	\$41,694,948	<1%	\$34,959,728	<1%	\$2,224,981	<1%	\$4,510,239	<1%
Chesterfield Township	\$2,443,294,418	\$17,053,346	<1%	\$8,804,419	<1%	\$0	0.0%	\$8,248,927	<1%
Cinnaminson Township	\$5,703,895,752	\$33,082,348	<1%	\$17,564,325	<1%	\$1,217,854	<1%	\$14,300,169	<1%
Delanco Township	\$1,422,201,479	\$15,320,918	1.1%	\$11,571,875	<1%	\$1,246,804	<1%	\$2,502,240	<1%
Delran Township	\$5,145,622,596	\$32,649,850	<1%	\$17,472,074	<1%	\$13,080,642	<1%	\$2,097,133	<1%
Eastampton Township	\$1,687,017,512	\$13,058,605	<1%	\$2,537,456	<1%	\$2,115,395	<1%	\$8,405,754	<1%
Edgewater Park Township	\$2,307,285,215	\$10,434	<1%	\$8,558	<1%	\$0	0.0%	\$1,876	<1%
Evesham Township	\$14,666,082,424	\$13,611,662	<1%	\$6,074,244	<1%	\$63,984	<1%	\$7,473,433	<1%
Fieldsboro Borough	\$139,371,126	\$513,300	<1%	\$513,300	<1%	\$0	0.0%	\$0	0.0%
Florence Township	\$2,787,263,607	\$16,913,921	<1%	\$719,091	<1%	\$4,007,344	<1%	\$12,187,487	<1%
Hainesport Township	\$3,447,208,735	\$44,043,475	1.3%	\$5,119,472	<1%	\$162,065	<1%	\$38,761,938	<1%
Lumberton Township	\$5,459,557,257	\$38,165,788	<1%	\$28,412,272	<1%	\$3,739,275	<1%	\$6,014,241	<1%
Mansfield Township	\$4,056,501,589	\$25,305,486	<1%	\$712,522	<1%	\$940,093	<1%	\$23,652,871	<1%
Maple Shade Township	\$4,385,500,913	\$2,744,663	<1%	\$2,012,216	<1%	\$309,696	<1%	\$422,750	<1%
Medford Lakes Borough	\$1,280,050,871	\$1,556,958	<1%	\$1,551,036	<1%	\$2,213	<1%	\$3,709	<1%
Medford Township	\$12,845,907,494	\$36,085,020	<1%	\$21,531,717	<1%	\$3,510,713	<1%	\$11,042,591	<1%
Moorestown Township	\$10,108,801,626	\$22,962,994	<1%	\$10,461,934	<1%	\$1,880,540	<1%	\$10,620,520	<1%
Mount Holly Township	\$3,498,352,996	\$18,525,170	<1%	\$13,257,276	<1%	\$1,242,965	<1%	\$4,024,929	<1%
Mount Laurel Township	\$14,653,800,804	\$31,823,704	<1%	\$22,402,621	<1%	\$411,498	<1%	\$9,009,584	<1%
New Hanover Township	\$3,022,835,486	\$4,896,176	<1%	\$193,669	<1%	\$0	0.0%	\$4,702,508	<1%
North Hanover Township	\$3,079,878,987	\$22,724,485	<1%	\$2,237,183	<1%	\$962,741	<1%	\$19,524,560	<1%
Palmyra Borough	\$1,788,398,557	\$7,954,249	<1%	\$3,704,028	<1%	\$1,157,364	<1%	\$3,092,858	<1%
Pemberton Borough	\$345,869,906	\$0	0.0%	\$0	0.0%	\$0	0.0%	\$0	0.0%
Pemberton Township	\$9,374,914,679	\$47,063,059	<1%	\$39,770,781	<1%	\$387,129	<1%	\$6,905,149	<1%
Riverside Township	\$2,039,139,951	\$17,301,486	<1%	\$7,396,326	<1%	\$1,347,288	<1%	\$8,557,872	<1%
Riverton Borough	\$916,434,789	\$2,777,240	<1%	\$1,557,507	<1%	\$0	0.0%	\$1,219,733	<1%
Shamong Township	\$2,738,384,433	\$1,564,073	<1%	\$961,360	<1%	\$0	0.0%	\$602,713	0.0%



Table 5.4.4-13. Estimated General Building Stock Potential Loss to the 1-percent Annual Chance Flood Event

Municipality	Total Replacement Cost Value	1-Percent Annual Chance Event							
		All Occupancies		Residential		Commercial		Industrial, Religious, Education and Government	
		Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total
Southampton Township	\$6,722,347,774	\$14,822,393	<1%	\$9,034,171	<1%	\$96,001	<1%	\$5,692,221	<1%
Springfield Township	\$3,853,514,909	\$25,342,380	<1%	\$8,011,267	<1%	\$2,410,260	<1%	\$14,920,853	<1%
Tabernacle Township	\$3,619,040,765	\$3,451,046	<1%	\$170,230	<1%	\$199,932	<1%	\$3,080,883	<1%
Washington Township	\$597,426,933	\$21,199,734	3.5%	\$11,563,229	1.9%	\$122,470	<1%	\$9,514,035	1.6%
Westampton Township	\$4,269,433,407	\$15,933,089	<1%	\$5,292,326	<1%	\$163,843	<1%	\$10,476,920	<1%
Willingboro Township	\$8,259,747,413	\$16,985,969	<1%	\$16,519,730	<1%	\$0	0.0%	\$466,239	<1%
Woodland Township	\$1,656,748,246	\$8,943,606	<1%	\$59,571	<1%	\$0	0.0%	\$8,884,035	<1%
Wrightstown Borough	\$411,963,035	\$0	0.0%	\$0	0.0%	\$0	0.0%	\$0	0.0%
Burlington County	\$165,526,729,867	\$1,189,060,143	<1%	\$605,258,706	<1%	\$137,004,647	<1%	\$446,796,790	<1%

Source: HAZUS-MH 4.0, Burlington County



NFIP Statistics

In addition to total building stock modeling, individual data available on flood policies, claims, Repetitive Loss (RL) properties and severe repetitive loss (SRL) properties were analyzed. FEMA Region 2 provided a list of residential properties with NFIP policies, past claims and multiple claims (RL and SRL properties). According to the metadata provided: “The (*sic* National Flood Insurance Program) NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are two or more losses reported which were paid more than \$1,000 for each loss. The two losses must be within 10 years of each other & be at least 10 days apart. Only losses from (*sic* since) 1/1/1978 that are closed are considered.”

SRLs were then examined for the county. According to section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a, an SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- Has at least four NFIP claim payments (including building and contents) over \$5,000 each, and the cumulative amount of such claims payments exceeds \$20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
- For both of the above, at least two of the referenced claims must have occurred within any 10- year period and must be greater than 10 days apart.

The location of the properties with policies, claims and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations is more accurate than others.

Table 5.4.4-16 summarizes the NFIP policies, claims and repetitive loss statistics for Burlington County. According to FEMA, Table 5.4.4-15 summarizes the occupancy classes of the repetitive loss and severe repetitive loss properties in Burlington County. The majority of the RL property occupancy class is single family residences (90.2-percent). All the SRL property occupancy class is also single-family residences (FEMA Region 2, 2017). This information is current as of October 31, 2017. Note, the severe repetitive loss counts below represent validated severe repetitive loss properties only. There are an additional 11 severe repetitive loss properties that have not been validated: nine single-family residences, one assumed condo, and one 2-4 family residence.

The location of the properties with policies, claims and characterized as RL and SRL properties were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations is more accurate than others.

Table 5.4.4-14. Occupancy Class of Repetitive Loss Structures in Burlington County

Occupancy Class	Total RL Loss Properties	Total Number of SRL Properties	Total (RL and SRL)
Single Family	167	15	182
Condo	3	0	3
2-4 Family	5	0	5
Other Residential	2	0	2
Non-Residential	8	0	8



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Occupancy Class	Total RL Loss Properties	Total Number of SRL Properties	Total (RL and SRL)
Burlington County	185	15	200

Source: FEMA Region 2, 2017

RL = Repetitive Loss

SRL = Severe Repetitive Loss

Note (1): Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2 and are current as of 12/31/2014.

Note (2): The total number of repetitive loss properties does not include severe repetitive loss properties.



Table 5.4.4-15. Occupancy Class of Repetitive Loss Structures in Burlington County, by Municipality

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family
Bass River Township	0	0	0	0	4	0	0	0	0	0
Beverly City	0	0	0	0	0	0	0	0	0	0
Bordentown City	0	0	0	0	2	0	0	0	0	0
Bordentown Township	0	0	0	0	1	0	0	0	0	0
Burlington City	0	0	0	0	10	0	0	0	0	0
Burlington Township	0	0	0	0	3	0	0	0	0	0
Chesterfield Township	0	0	0	0	0	0	0	0	0	0
Cinnaminson Township	1	0	0	0	15	0	0	0	0	2
Delanco Township	0	0	0	0	1	0	0	0	0	0
Delran Township	0	0	1	0	9	0	0	0	0	0
Eastampton Township	1	1	0	0	17	0	0	0	0	1
Edgewater Park Township	0	0	0	0	0	0	0	0	0	0
Evesham Township	0	0	0	0	4	0	0	0	0	0
Fieldsboro Borough	0	0	0	0	0	0	0	0	0	0
Florence Township	0	0	0	0	0	0	0	0	0	0
Hainesport Township	0	0	0	0	2	0	0	0	0	0
Lumberton Township	1	0	1	1	41	0	0	0	0	7
Mansfield Township	0	0	0	0	0	0	0	0	0	0
Maple Shade Township	2	1	0	1	0	0	0	0	0	0
Medford Lakes Borough	0	0	0	0	1	0	0	0	0	0
Medford Township	0	1	1	0	10	0	0	0	0	1
Moorestown Township	0	0	0	0	0	0	0	0	0	0
Mount Holly Township	0	0	2	0	3	0	0	0	0	0
Mount Laurel Township	0	0	0	0	2	0	0	0	0	0
New Hanover Township	0	0	0	0	0	0	0	0	0	0
North Hanover Township	0	0	0	0	0	0	0	0	0	0
Palmyra Borough	0	0	1	0	3	0	0	0	0	1



Table 5.4.4-15. Occupancy Class of Repetitive Loss Structures in Burlington County, by Municipality

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family
Pemberton Borough	0	0	0	0	0	0	0	0	0	0
Pemberton Township	0	0	0	0	4	0	0	0	0	0
Riverside Township	0	0	1	0	4	0	0	0	0	1
Riverton Borough	0	0	0	0	0	0	0	0	0	0
Shamong Township	0	0	0	0	1	0	0	0	0	0
Southampton Township	0	0	1	0	22	0	0	0	0	1
Springfield Township	0	0	0	0	0	0	0	0	0	0
Tabernacle Township	0	0	0	0	0	0	0	0	0	0
Washington Township	0	0	0	0	1	0	0	0	0	0
Westampton Township	0	0	0	0	4	0	0	0	0	1
Willingboro Township	0	0	0	0	2	0	0	0	0	0
Woodland Township	0	0	0	0	0	0	0	0	0	0
Wrightstown Borough	0	0	0	0	0	0	0	0	0	0
Burlington County	5	3	8	2	166	0	0	0	0	15

Source: FEMA, 2017

Note (1): Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of 10/31/2017

Note (2): The statistics were summarized using the Community Name provided by FEMA Region 2.

Note (3): The total number of repetitive loss properties does not include severe repetitive loss properties.

Table 5.4.4-16. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)
Bass River Township	68	59	\$2,085,531.76	4	0	4
Beverly	5	1	\$3,513.71	0	0	0
City of Bordentown	6	7	\$31,802.20	2	0	0
Bordentown	42	12	\$119,313.25	1	0	0
City of Burlington	976	240	\$621,951.30	10	0	895



Table 5.4.4-16. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)
Burlington Township	95	38	\$254,785.12	3	0	0
Chesterfield	11	2	\$2,128.40	0	0	11
Cinnaminson	220	153	\$1,172,340.97	16	2	13
Delanco Township	102	21	\$67,299.23	1	0	2
Delran Township	114	99	\$690,575.82	10	0	11
Eastampton Township	25	110	\$790,919.42	19	0	0
Edgewater Park Township	9	5	\$35,201.23	0	0	0
Evesham Township	169	37	\$250,315.31	4	0	0
Fieldsboro Borough (NP)	0	2	\$707.00	0	0	0
Florence Township	20	4	\$16,325.05	0	0	1
Hainesport Township	31	6	\$32,269.89	2	0	0
Lumberton Township	79	187	\$6,782,899.98	44	7	10
Mansfield	18	5	\$9,489.05	0	0	0
Maple Shade Township	27	7	\$240,619.32	4	0	0
Medford Lakes	82	28	\$251,645.28	1	0	2
Medford	249	179	\$3,355,285.87	13	1	2
Moorestown Township	140	58	\$312,472.02	0	0	0
Mount Holly	75	108	\$1,470,161.61	6	0	2
Mount Laurel	238	74	\$413,085.52	2	0	2
New Hanover	2	5	\$889.34	0	0	0
North Hanover	5	1	\$13,060.31	0	0	0
Palmyra	189	35	\$198,231.08	4	1	143
Pemberton	2	3	\$458.74	0	0	0
Pemberton Township	202	98	\$900,851.07	4	0	6
Riverside Township	64	49	\$515,071.80	5	1	2
Riverton	36	5	\$9,225.31	0	0	3



Table 5.4.4-16. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)
Shamong Township	23	7	\$8,926.85	1	0	0
Southampton Township	100	138	\$2,301,683.67	23	2	10
Springfield Township	13	8	\$137,767.37	0	0	0
Tabernacle Township	12	1	\$6,406.91	0	0	1
Washington Township	38	24	\$1,136,241.46	1	0	2
Westampton Township	49	20	\$199,139.41	4	1	0
Willingboro Township	177	30	\$688,095.88	2	0	1
Woodland Township	0	1	\$861.92	0	0	0
Wrightstown Borough	0	2	\$15,631.58	0	0	0
Burlington County	3,713	1,869	\$25,143,181.01	185	15	1,157

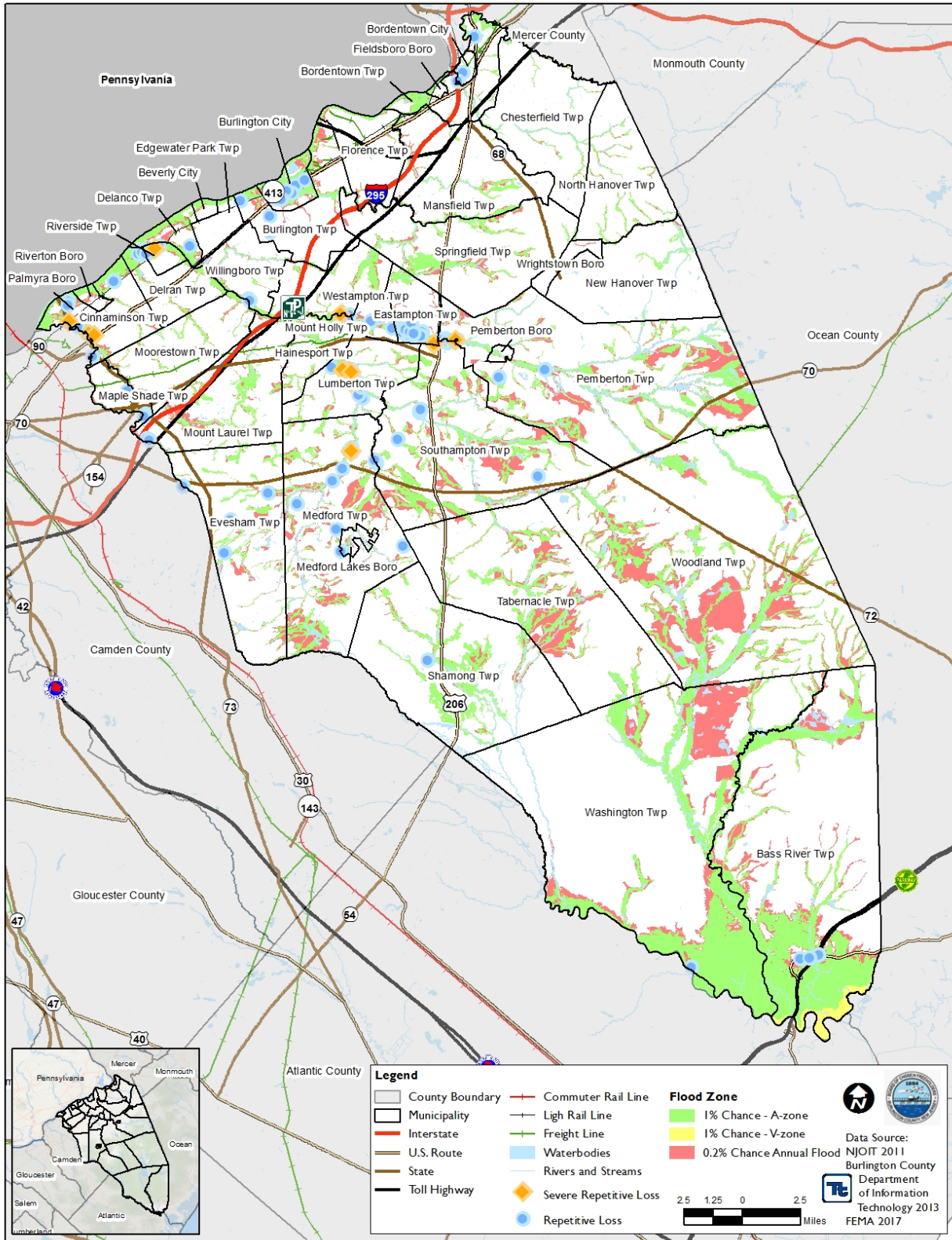
Source: FEMA Region 2 2017, 2018

- (1) Repetitive loss and severe repetitive loss statistics provided by FEMA Region 2 and are current as of 10/31/2017. Policy and claims statistics current as of 9/30/2018
Please note the total number of repetitive loss properties does not include the severe repetitive loss properties. The number of claims represents claims closed by 9/30/2018.
- (2) Total building and content losses from the claims file provided by FEMA Region 2.
- (3) The policies inside and outside of the flood zones are based on the addresses geocoded from the FEMA Region 2 policy file – 10/31/2017.

Notes: FEMA noted that where there is more than one entry for a property, there may be more than one policy in force or more than one GIS possibility.
A zero percentage denotes less than 1/100th percentage and not zero damages or vulnerability as may be the case.



Figure 5.4.4-4. NFIP Repetitive and Severe Repetitive Loss Areas in Burlington County





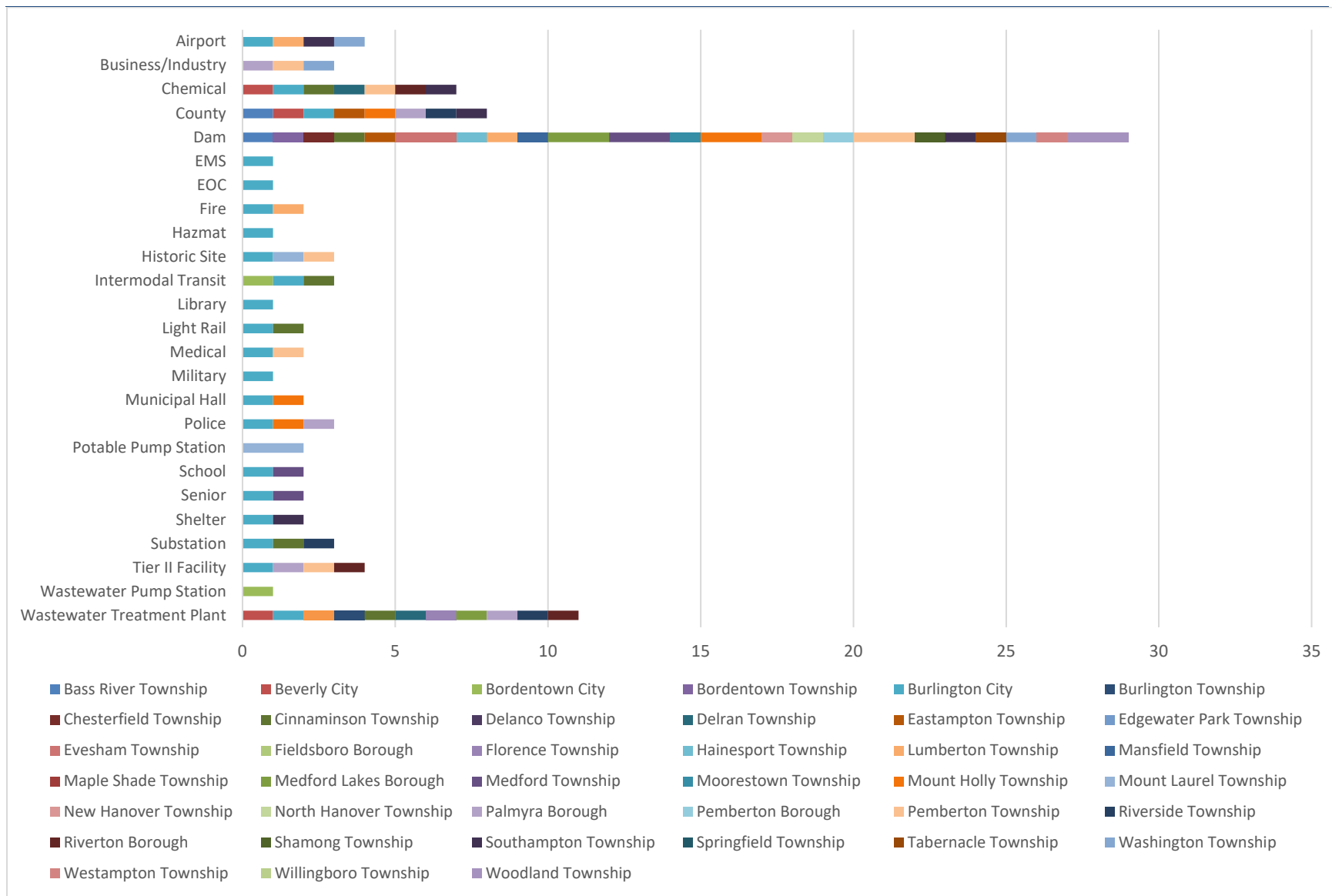
Impact on Critical Facilities

It is important to determine what critical facilities and infrastructure may be at risk to flooding, and who may be impacted should damage occur. Critical services during and after a flood event may not be available if critical facility structures are directly damaged or transportation routes to access these critical facilities are impacted. Roads that are blocked or damaged can isolate residents and can prevent access throughout the planning area, including for emergency service providers needing to get to vulnerable populations or to make repairs. Major roadways that may be impacted by the 1-percent annual chance flood event include I-295, NJ-38, NJ-413, NJ-70, NJ-72, NJ-73, NJ-90, US-130, US-302, US-9, the Garden State Parkway, and The NJ Turnpike. Bridges washed out or blocked by floods or debris also can cause isolation. Water and sewer systems can be flooded or backed up, causing health problems. Floodwaters can get into drinking water supplies, causing contamination. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers and streams.

Critical facility exposure to the flood hazard was examined. In addition, HAZUS-MH 4.0 was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Tables G-11 through G-14 in Appendix G summarizes these results. Figure 5.4.4-5 and Figure 5.4.4-6 display the number of critical facilities located in the FEMA flood zones by type and by jurisdiction. Dams have the greatest exposure to both the 1- and 0.2-percent annual chance flood events of all these critical facility types; there are 29 dams located in the 1-percent annual chance flood event boundary and 32 dams located in the 0.2-percent annual chance flood event boundary.



Figure 5.4.4-5. Number of Critical Facilities Located in the 1-percent Annual Chance Flood Zone

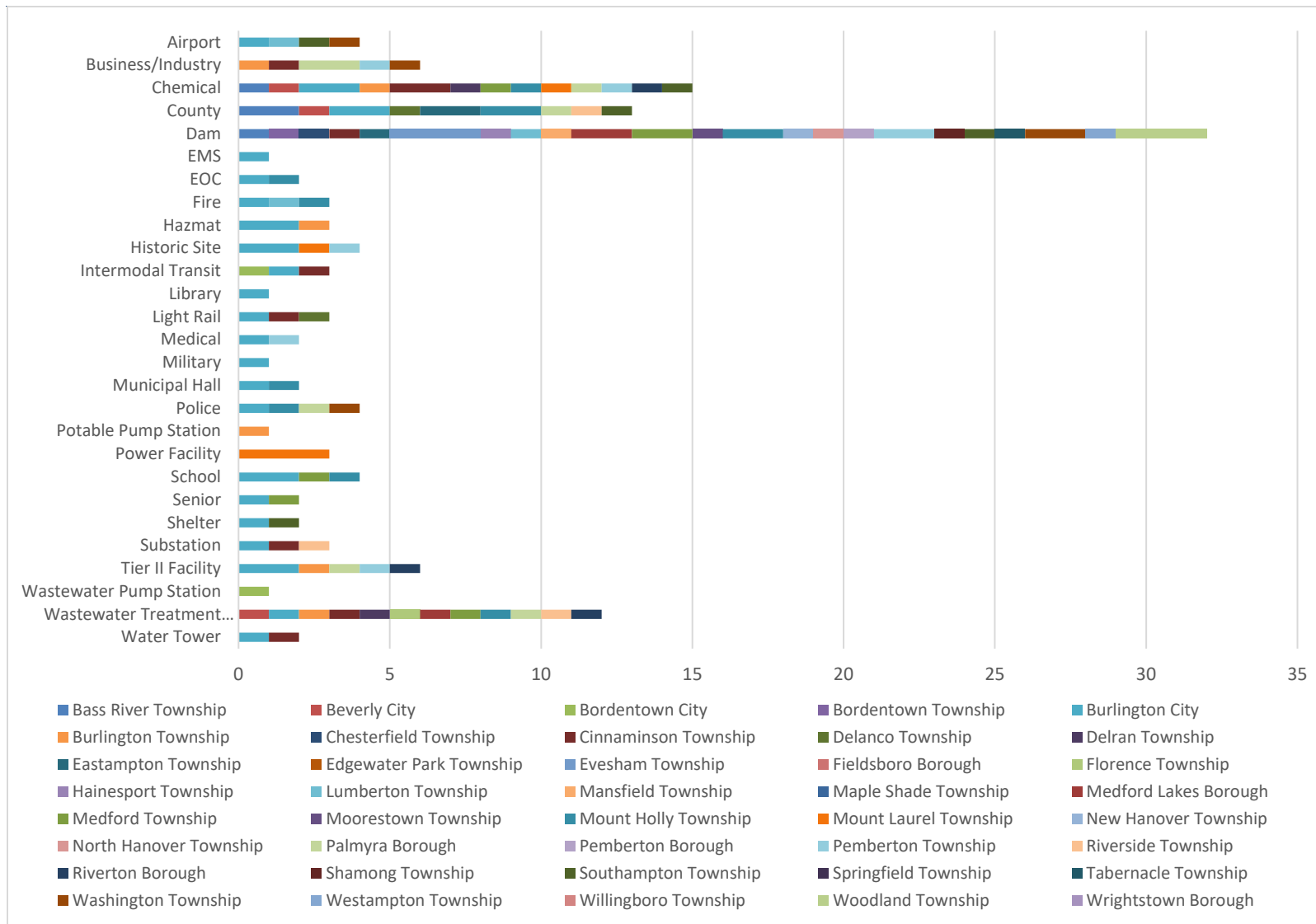


Source: FEMA 2017, Burlington County





Figure 5.4.4-6. Number of Critical Facilities Located in the 0.2-Percent Annual Chance Flood Zone



Source: FEMA 2017, Burlington County



Impact on the Economy

For impact on economy, estimated losses from a flood event are considered. Losses include but are not limited to general building stock damages, agricultural losses, business interruption, impacts to tourism and tax base to Burlington County. Damages to general building stock can be quantified using HAZUS-MH as discussed above. Other economic components such as loss of facility use, functional downtime and social economic factors are less measurable with a high degree of certainty.

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur; and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. Refer to the 'Impact on General Building Stock' subsection which discusses these potential losses. These dollar value losses to the County's total building inventory replacement value (based on estimated replacement cost value), in addition to damages to roadways and infrastructure, would greatly impact the local economy.

HAZUS-MH estimated the amount of debris generated from the 1-percent annual chance flood event. The model breaks down debris into three categories: 1) finishes (dry wall, insulation, etc.); 2) structural (wood, brick, etc.) and 3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. Table 5.4.4-17 summarizes the debris estimated for the 1-percent flood annual chance event.

Please note this table only represents estimated debris generated by riverine flooding and does not include additional potential damage and debris which may be generated with the presence of wind.

Table 5.4.4-17. Estimated Debris Generated from the 1-Percent Annual Chance Flood Event

Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
18,358	16,175	1,232	951

Source: HAZUS-MH 4.2.

Impact on the Environment

Floodplains serve beneficial and natural functions on ecological/environmental, social and economic levels. Areas in the floodplain that typically provide these natural functions and benefits are wetlands, riparian areas, sensitive areas, and habitats for rare and endangered species. However, floods can also lead to negative impacts on the environment. According to FEMA, well-known, water-related functions of floodplains include the following. Disruption of natural systems and the benefits they provide can have long-term consequences for entire regions.

- Natural flood and erosion control
- Provide flood storage and conveyance
- Reduce flood velocities
- Reduce flood peaks
- Reduce sedimentation
- Surface water quality maintenance
- Process organic wastes
- Moderate temperatures of water
- Groundwater recharge
- Filter nutrients and impurities from runoff
- Promote infiltration and aquifer recharge
- Reduce frequency and duration of low surface flows.



To determine the exposure of the natural and beneficial land in Burlington County to the flood hazard, the acreage of wetlands, forested land, and endangered species was calculated. Refer to Table 5.4.4-18.

Table 5.4.4-18. Acreage of Natural and Beneficial Land Located in the Floodplain

Wetlands	Area in the 1- Percent Annual Chance Floodplain (acres)	Area in the 0.2- Percent Annual Chance Floodplain (acres)
Wetlands	62,633	64,603
Forest	8,479	10,120
Endangered Species	72,321	75,451

Source: NJDEP 2017, NJDEP 2015, FEMA 2017

In addition, floods may generate large amounts of tree and construction debris (refer to Table 5.4.4-17), disperse household hazardous waste into the fluvial system, and contaminate water supplies and wildlife habitats with extremely toxic substances. Long duration floods could exacerbate environmental problems because clean-up will likely be delayed, and contaminants have the potential of remaining in the environment for a longer period of time.

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 flood hazard if located within the identified hazard areas. Figure 5.4.4-7 illustrates the identified areas of potential new development in relation to the flood boundaries. It is the intention of the county and all participating municipalities to discourage development in vulnerable areas or to encourage higher regulatory standards on the local level.

There are 35 recent and proposed developments around the County exposed to the 1- and 0.2-percent annual chance flood event boundaries; 32 of these developments are located within the 1-percent annual chance flood event boundary. Mount Laurel Township has the most developments located in the hazard area (7 developments in the 1-percent annual chance flood event boundary). The Townships of Bordentown, Delran, and Riverside each have 1 development located within the 0.2-percent annual chance flood event boundary. Refer to each jurisdictional annex for the results of each exposure analysis on new development.

Effect of Climate Change on Vulnerability

As discussed earlier, annual precipitation amounts in the region are projected to increase by 0-10% by the 2020s and 5-10% by the 2050s (NPCC 2013). Additionally, according to the Sustainable Jersey Climate Change Adaptation Task Force, the region will experience an increase of 10-25% in the frequency of intense precipitation events. Increased rainfalls have the potential to affect drinking water, increase the risk to flash flooding and riverine flooding, and flood critical transportation corridors and infrastructure. Increases in precipitation may alter and expand the floodplain boundaries and runoff patterns, resulting in populations, buildings, and critical facilities and infrastructure that were previously outside the floodplain. This increase in exposure would result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by future flooding events due to loss of service or access.

Change of Vulnerability



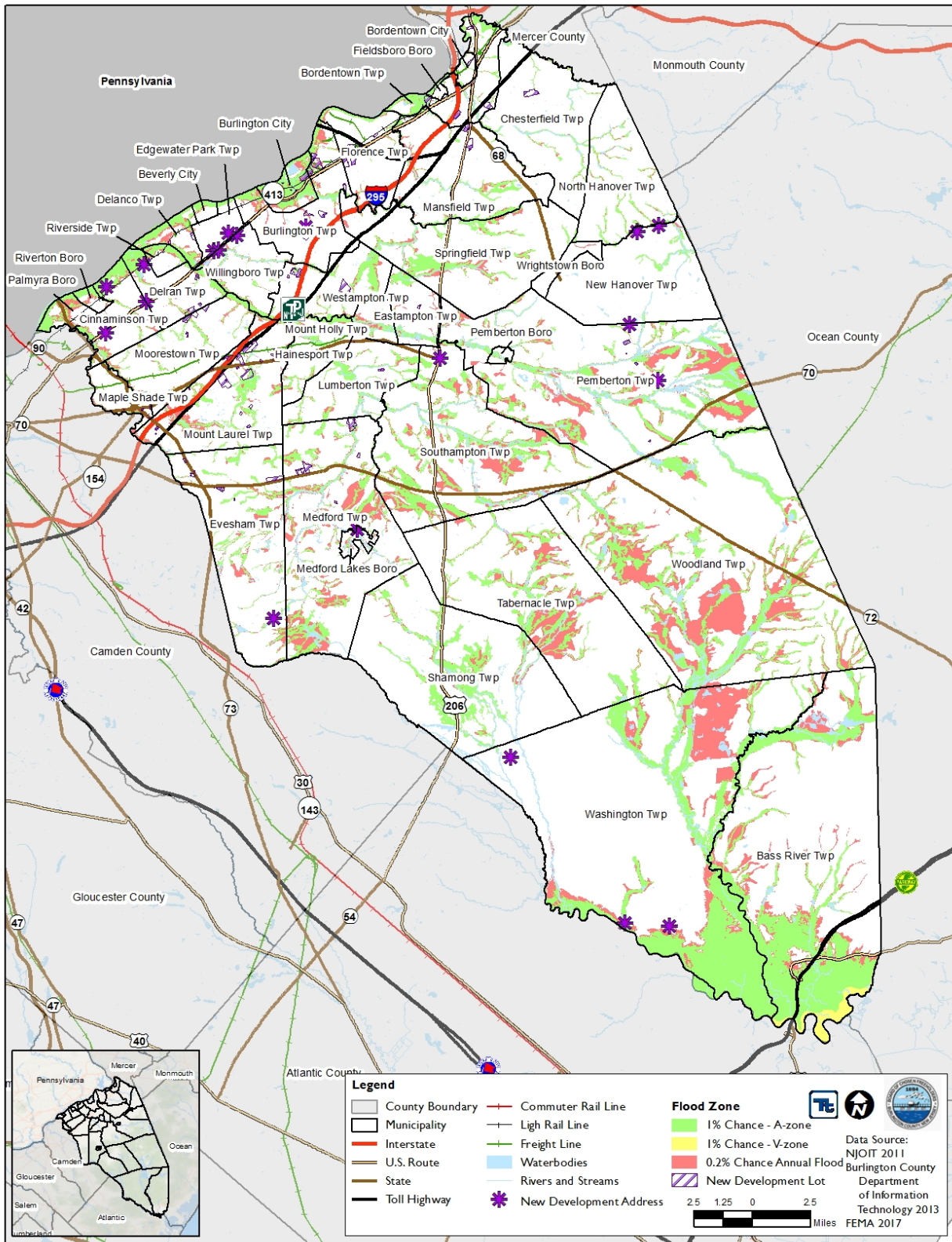
Burlington County and its municipalities continue to be vulnerable to the flood hazard. However, there are several differences between the exposure and potential loss estimates between this plan update to the results in the 2014 HMP. The building inventory and critical facilities were updated and a more accurate flood depth grids used to estimate potential losses in HAZUS-MH due to the availability of their DFIRM.

The 2014 HMP utilized the improvement value at the parcel level. For this plan update, the potential loss analysis was conducted using a custom county-wide building inventory using the MODIV tax assessment data and replacement cost value based on 2018 RS Means valuations. The 2014 HMP potential loss estimates were calculated at the Census Block level in HAZUS-MH 2.1; however, the 2017 update estimates potential losses at the structure level using the updated building inventory in HAZUS-MH 4.0.

For this plan update, an updated depth grid was used. The depth grid was integrated into HAZUS-MH 4.0, and the model was run to estimate potential losses at the structure level utilizing the custom-building inventory developed for this plan update. Overall, this vulnerability assessment uses a more accurate and updated building inventory and updated flood mapping which provides more accurate estimated exposure and potential losses for Burlington County.



Figure 5.4.4-7. Potential New Development and Flood Boundaries



Source: FEMA 2017 and Burlington County

