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SECTION 5 Risk Assessment

This section provides a profile and vulnerability assessment for the flood hazard in order to quantify the description, location, extent, history, probability, and impact of flood events in the Township of Brick. The Township is vulnerable to other natural and man-made hazards which are addressed in the Ocean County Multi-Jurisdictional All Hazard Mitigation Plan. This plan includes the vulnerability analysis of fifteen hazards impacting communities in Ocean County, New Jersey.

5.1 Hazard Profile

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

5.2 Hazard Description

Floods are one of the most common natural hazards in the U.S. 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) (Federal Emergency Management Agency [FEMA] 2008). 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.

In the State of New Jersey, some areas are more vulnerable to flooding than others. In fact, Ocean County, along with Cape May County, Atlantic County, Salem County, Hudson County, and Monmouth County, is recognized for having over 10% of its population residing in the 1-percent annual chance flood zone. Additionally, Ocean County (along with Monmouth, Cape May, and Atlantic Counties) has one of the greatest percentages of population located in the V-Zone (coastal areas susceptible to wave damage, as defined by FEMA). The jurisdictions most threatened by the flood hazard have also experienced the most increase in permits for new construction and in overall population growth. This results in a situation where millions of people work, live, travel through, or use recreational facilities located in areas subject to flooding. Areas outside recognized and mapped flood hazard zones can also experience flooding (New Jersey Hazard Mitigation Plan [NJ HMP] 2014).

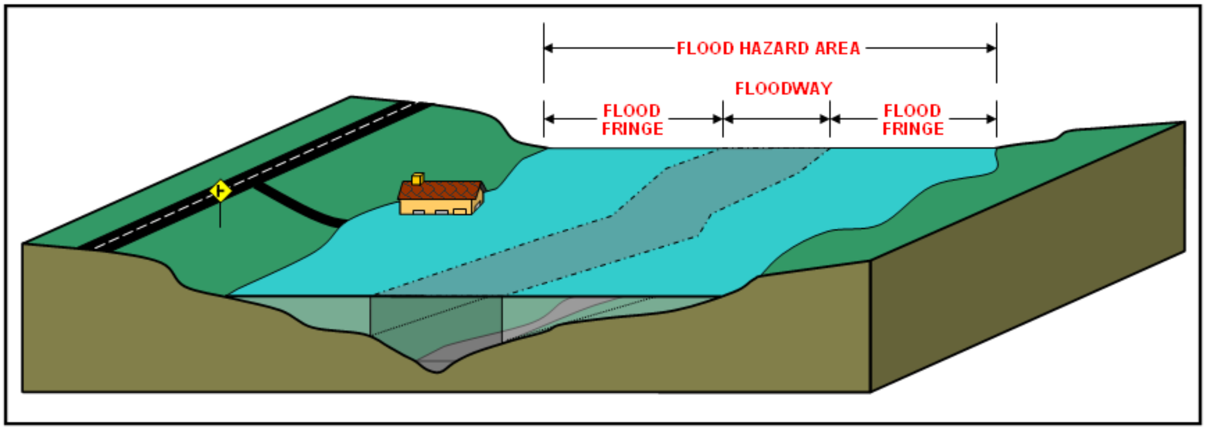
While Ocean County identified flooding as its primary hazard of concern, this hazard event particularly impacts the Township of Brick and other coastal jurisdictions in the county. The Township of Brick has the most privately-owned waterfront property of any municipality in New Jersey. This includes 1.79 miles of ocean-front property on the barrier island, 39.5 miles of river-front property, and 11.93 miles of bay-front property, totaling 53.2 miles. Of the 45,000 structures in the Township of Brick, over 10,000 are located in the 1-percent annual chance flood zone (Brick Township Strategic Recovery Planning Report [SRPR] 2014). The Township of Brick is particularly vulnerable to flooding from tropical storms, extra-tropical cyclones (Nor'easters), and severe thunderstorm activity, while local coastal flooding typically ties back to hurricanes (FEMA Flood Insurance Study [FIS] 2014). The Township's vulnerability to flooding is best demonstrated by the impact of Superstorm Sandy in 2012. Discussed in further detail later in this section, Superstorm Sandy caused significant damage to infrastructure, private property, the economy, and the community.

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. Defined in further detail in the 'Frequency' subsection of this profile, the 100-year flood (also known as the 1-percent annual chance flood) has a 1-percent chance of being equaled or exceeded each year.

This 1-percent annual chance flood is now the standard used by most federal and state agencies and by the National Flood Insurance Program (NFIP) (FEMA 2005).

Figure 5-1 depicts the flood hazard area, the flood fringe, and the floodway areas of a floodplain.

Figure 1. Floodplain



Source: New Jersey Department of Environmental Protection (NJDEP) Date Unknown

Most floods fall into three categories: riverine, coastal, and shallow (FEMA 2008). 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). For the purpose of this Flood Management Plan and as deemed appropriate by the Township of Brick Flood Management Plan Planning Committee (Planning Committee), riverine dam failure, coastal/tidal, and urban/stormwater are the main flood types of concern for the township. Additionally, the impacts of coastal erosion, storm surge, and sea level rise will also be discussed. These types of flood are further discussed below.

Riverine (Inland) Flooding Hazard

Riverine floods are the most common flood type. They 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 (FEMA 2008).

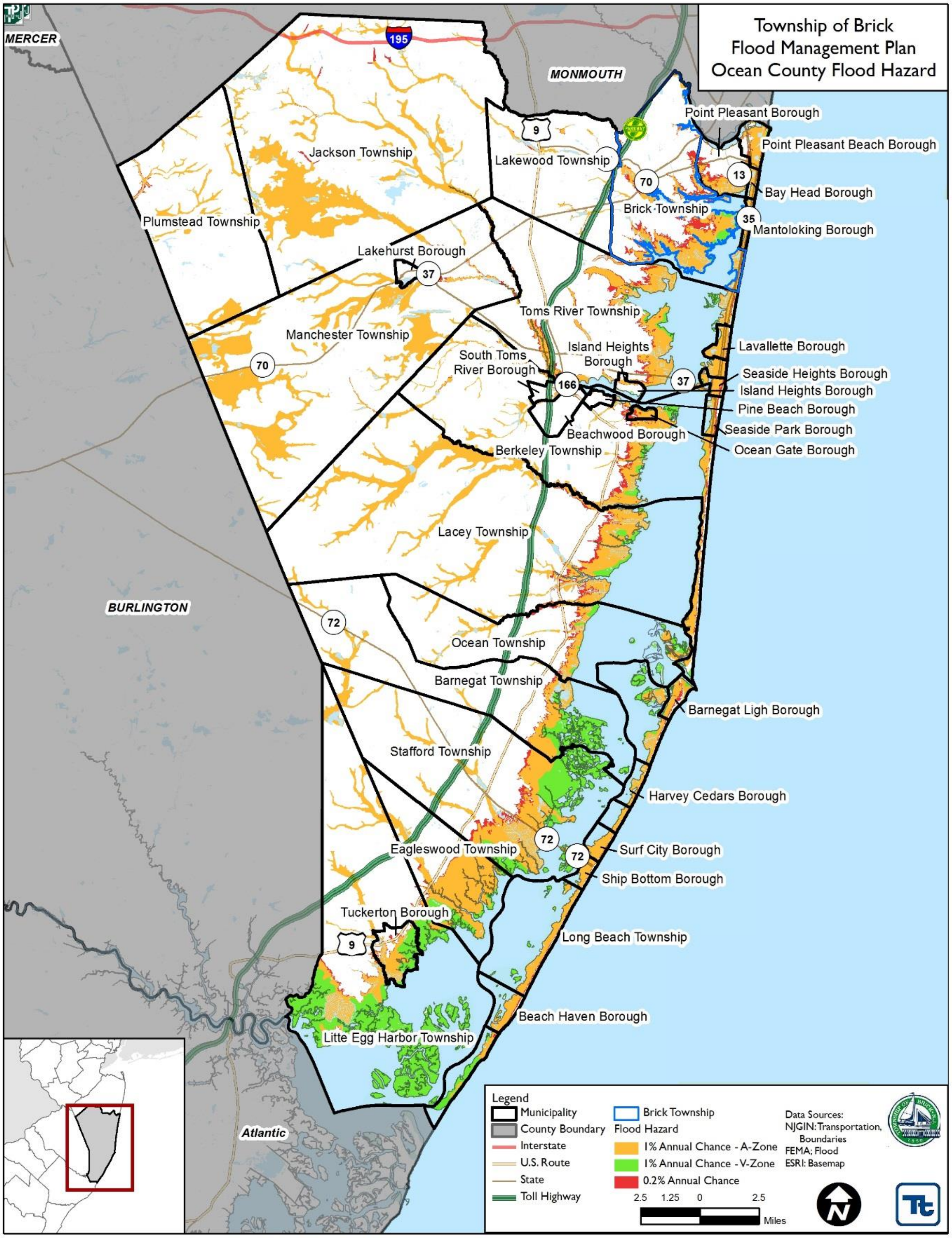
Flash floods are "a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). However, the actual time threshold may 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).

Riverine Flooding Location

Flooding in New Jersey, including the Township of Brick, is often the direct result of frequent weather events such as coastal storms, Nor'easters, heavy rains, tropical storms, and hurricanes. Floods are the most frequent natural hazards in New Jersey and the Township, and they can occur any time of the year. Areas of greatest risk occur in known floodplains where there is intense rainfall over a short period of time; prolonged rain over several days; and/or ice or debris jams causing rivers or streams to overflow (New Jersey Office of Emergency Management [NJOEM] 2006). Areas within a floodplain become inundated during a flooding event. The areas within the 1-percent annual chance flood areas have a higher chance of becoming inundated during storm events.

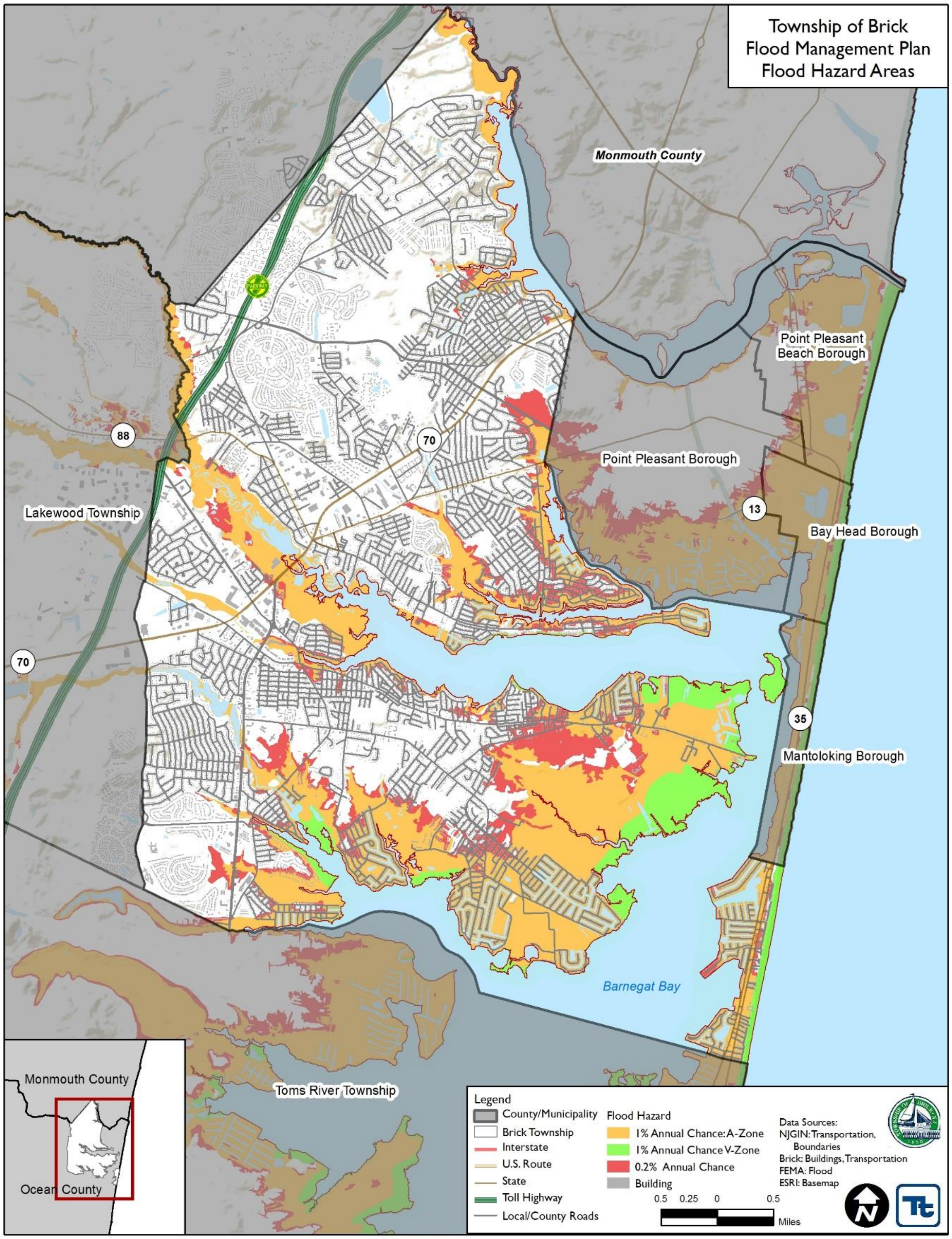
The 1-percent annual chance of flood hazard zones (both A and V-zones) and 0.2% annual chance flood zone throughout Ocean County are identified in Figure 5-2. Figure 5-3 provides a visual of the flood zones at the township level for the Township of Brick.

Figure 2. FEMA Flood Hazard Areas in the County of Ocean



Source: FEMA 2015, NJGIN 2015
Note: FEMA Federal Emergency Management Agency NJGIN New Jersey Geographic Information Network

Figure 3. FEMA Flood Hazard Areas in the Township of Brick



Source: FEMA 2015, NJGIN 2015
Note: FEMA Federal Emergency Management Agency
NJGIN New Jersey Geographic Information Network

Although riverine, flash, and stormwater/urban flooding can occur anywhere in the Township of Brick, certain locations are more vulnerable or more likely to experience flooding than others in the Township. The Metedeconk River is the most frequent source of riverine flooding in the Township, based off previous occurrences and storm events. The Manasquan River, Barnegat Bay, Cedar Bridge Branch, and Beaverdam Creek are also sources of flooding, most typically due to the high percentage of impervious cover from land use, poor drainage facilities in the surrounding areas, and improper grading from development. Much of the Township has already been developed for residential, business, or other use, increasing the Township of Brick's vulnerability to flash flooding and urban flooding. While the Township has stormwater management systems in place in its residential neighborhoods, the capacity of the stormwater systems is not always sufficient. While more recently developed and renovated neighborhoods typically have systems with sufficient capacity, older neighborhoods frequently have stormwater management systems that have not been updated to handle current needs and populations, leading to insufficient drainage (Brick Township Stormwater Management Plan [Master Plan] 2007).

The following provides information regarding flood-prone areas in the Township. The main bodies of water (and sources of flooding) in the Township include the Manasquan River, Sawmill Creek, Beaverdam Creek, Metedeconk River, Cedar Bridge Branch, and Kettle Creek. Additionally, Barnegat Bay makes up the eastern border of the Township, and the Township is located in Watershed Management Area #13m Barnegat Bay. The Township is also located within four watersheds: Metedeconk River North Branch (NB), Manasquan River, Metedeconk River, and Kettle Creek/Barnegat Bay North. For details regarding the watershed management area and the watersheds, please refer to Section 4 (Township Profile).

Potential flood-level events are monitored and warnings are issued to residents when stream gages detect significant rises in water level from the action state of the waterway. Information on flooding levels for minor, moderate, and major events, as well as the action state, are presented under the 'Warning Time' subsection further in this profile.

Frequency

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1-percent chance of being equaled or exceeded in any given year. The "annual flood" is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a waterway.

The 100-year flood (or 1-percent annual chance flood) can be described as a bag of 100 marbles, with 99 clear marbles and one black marble. Every time a marble is pulled out from the bag, and it is the black marble, it represents a 100-year flood event. The marble is then placed back into the bag and shaken up again before another marble is drawn. It is possible the black marble can be picked one out of two or three times in a row, demonstrating that a "100-year flood event" could occur several times in a row (Interagency Floodplain Management Review Committee 1994).

The 100-year flood, which is the standard used by most federal and state agencies, is used by the NFIP as the standard for floodplain management and to determine the need for flood insurance. A structure located within a SFHA shown on a NFIP map has a 26% chance of suffering flood damage during the term of a 30-year mortgage.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the SFHA, this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the water elevation resulting from a given discharge level, which is one of the most important factors used in estimating flood damage.

The term "500-year flood" is the flood that has a 0.2% chance of being equaled or exceeded each year. The 500-year flood could occur more than once in a relatively short period of time. Statistically, the 0.2% (500-year) flood has a 6% chance of occurring during a 30-year period of time, the length of many mortgages. The 500-year floodplain is referred to as Zone X500 for insurance purposes on flood insurance rate maps (FIRM). Base flood elevations or depths are not shown within this zone and insurance purchase is not required in this zone.

Severity

Generally the severity of flooding can be measured by peak discharge rates. Table 5-1 lists peak flows used by FEMA to map the floodplains of the Township as noted in the preliminary FIS for the Township (FEMA, 2014).

Table 5-1. Summary of Peak Discharges within Township of Brick

Source/Location	Drainage Area (square miles)	Discharge (cubic feet/second)			
		10-Year	50-Year	100-Year	500-Year
North Branch Metedeconk River (at downstream corporate limits)	18.08	500	730	850	1,180

Source: FEMA FIS 2014

Peak discharge information for other identified water courses in the Township including the Manasquan River, Sawmill Creek, Beaverdam Creek, Cedar Bridge Branch, Kettle Creek and the Barnegat Bay are not available as of this writing.

Another way to consider the severity of flooding is to review the stillwater elevations for a water source. Stillwater elevations are the projected elevation of floodwaters in the absence of waves resulting from wind or seismic effects. In coastal areas, stillwater elevations are determined when modeling coastal storm surge; the results of overland wave modeling are used in conjunction with the stillwater elevations to develop base flood elevations. Table 5-2 shows the stillwater elevations identified in the effective FIS for the Township.

Table 5-2. Summary of Stillwater Elevations for Waterways within the Township of Brick

Source/Location	Elevation (feet NAVD)			
	10-Year	50-Year	100-Year	500-Year
Manasquan River	5.4	6.6	7.2	8.8
North Branch Metedeconk River	3.2	4.3	4.8	6.1
Kettle Creek	3.2	4.3	4.8	6.1
Barnegat Bay (entire shoreline within the Borough of Point Pleasant and the Township of Brick)	3.2	--	4.8	6.1

Source: FEMA FIS 2006

Note: *The 2014 FIS did not contain stillwater elevations for the Township of Brick waterways; it only contained stillwater elevations for transects. This information is included in the appropriate table.*
NAVD *North American Vertical Datum of 1988*

While riverine flooding severity can be measured by discharge rates, FEMA evaluates the potential impact of a flood event along the coastline through coastal hydraulic analysis, which consists of a combination of transect layout, field reconnaissance, erosion analysis, and overland wave modeling. Transects show the elevation of the ground both onshore and offshore, and they are the locations where the overland wave height modeling occurs. Transects are selected through consideration of local topography, land use, shoreline features, and shoreline orientation to capture the most useful data. The transects selected for the analysis recorded in the FIS are the sites of primary flooding in both the Township of Brick and Ocean County. In addition to considering wave heights, the coastal hydraulic analysis also evaluated stillwater elevations. Table 5-3 provides the transect data from the township's most recent FEMA FIS. Where applicable, the table includes riverine transect analysis data as well.

Table 5-3. Transect Data in the Township of Brick

		Starting Wave Conditions for the 100-Year Flood			Starting Stillwater Elevation (feet NAVD) Range of Stillwater Elevations (feet NAVD)			
Flood Source	**Transect**	**Coordinates**	**Significant Wave Height**	**Peak Wave Period**	**10-Year**	**50-Year**	**100-Year**	**500-Year**
Manasquan River	1	N 40.105073 W 74.096389	1.62	2.28	6.8	8.6	9.3	10.5
Manasquan River	2	N 40.094354 W 74.085057	1.67	2.33	6.8	8.5	9.1	10.3
Atlantic Ocean	14	N 40.029256 W 74.051492	18.92	13.98	7.1 4-7.1	9.2 6.4-9.2	10.1 7.4-10.1	12.2 9.6-12.2
Atlantic Ocean	15	N 40.021936 W 74.053220	19.15	13.98	7.1 3.9-7.1	9.2 6.3-9.2	10.0 7.3-10.0	12.2 9.5-12.2
Atlantic Ocean	16	N 40.015948 W 74.054657	19.44	14.00	7.2 4.0-7.2	9.3 6.3-9.3	10.1 7.3-10.2	12.2 9.5-12.3
Atlantic Ocean	17	N 40.008315 W 74.056716	19.28	14.07	7.3	9.3 6.2-9.3	10.1 7.2-10.1	12.2 9.5-12.2
Barnegat Bay	84	N 39.998920 W 74.081430	3.19	3.26	3.9 3.7-3.9	6.1 6.1-6.2	7.1 7.1-7.2	9.3 9.2-9.3
Barnegat Bay	87	N 40.057795 W 74.064079	2.60	2.74	3.8 3.6-3.9	6.3 6.1-6.4	7.4 7.2-7.5	10.1 10.1-10.2
Metedeconk River	88	N 40.055952 W 74.081676	2.26	2.62	3.9 3.7-3.9	6.3 6.0-6.3	7.4 7.0-7.5	10.2 10.1-10.4

Flood Source	Transect	Starting Wave Conditions for the 100-Year Flood			Starting Stillwater Elevation (feet NAVD) Range of Stillwater Elevations (feet NAVD)			
		Coordinates	Significant Wave Height	Peak Wave Period	10-Year	50-Year	100-Year	500-Year
Metedeconk River	89	N 40.055865 W 74.100744	2.10	2.53	3.8	6.3	7.4	10.3
Metedeconk River	90	N 40.056693 W 74.112268	1.68	2.23	3.7	6.1 6-6.1	7.3 7.0-7.3	10.2 10.1-10.2
Metedeconk River	91	N 40.062490 W 74.123279	1.58	2.19	3.8	6.3	7.4 7.1-7.4	10.4 10.2-10.4
Metedeconk River	92	N 40.053320 W 74.125179	1.44	2.21	3.7	6.0	7.1	10.2
Metedeconk River	93	N 40.049649 W 74.112644	1.75	2.27	3.8	6.3	7.4	10.3
Metedeconk River	94	N 40.049611 W 74.095754	2.08	2.53	3.5 3.4-3.5	6.3 6.2-6.3	7.4	10.2
Metedeconk River	95	N 40.048871 W 74.082997	2.20	2.56	3.6 3.6-3.8	6.3 5.8-6.3	7.4 7.0-7.4	10.2 9.8-10.2
Barnegat Bay	96	N 40.030559 W 74.076239	2.90	3.29	3.9 2.7-3.9	6.3 5.8-6.3	7.3 7.0-7.3	9.5 9.4-9.9
Barnegat Bay	97	N 40.017982 W 74.081212	3.29	3.45	3.9 3.2-3.9	6.2 5.8-6.2	7.2 6.9-7.2	9.4 9.1-9.4
Kettle Creek	98	N 40.016300 W 74.102401	3.05	3.32	3.9 3.6-3.9	6.2 5.7-6.2	7.1 6.8-7.2	9.4 9.1-9.4
Kettle Creek	99	N 40.024288 W 74.118366	2.21	2.55	3.9 1.0-3.9	6.3 5.5-6.3	7.2 6.8-7.2	9.4 9.1-9.4
Kettle Creek	100	N 40.021940 W 74.125405	2.19	2.46	3.9 3.5-3.9	6.2 6.1-6.2	7.2 7.0-7.2	9.4 9.1-9.5

Source: FEMA FIS 2014
N North W West NAVD North American Vertical Datum of 1988

The U.S. Geological Survey (USGS) provides other resources for tracking the severity and potential incidents for a coastal flooding event. The tide gage for Barnegat Bay at Mantoloking (the tide gage nearest Township of Brick), tracks tide elevations. This gage recorded a maximum elevation of 3.81 feet (from crest-stage) on December 11, 1992, and a minimum elevation of an estimated -1.6 feet on October 30, 2006 (with the note that a lower tide likely occurred on February 16, 2007, but this record is missing). In addition, the tide gage records also note the monthly mean for gage height from May 1, 2000, to September 30, 2009:

- January: -0.01 feet
- February: -0.27 feet
- March: 0.02 feet
- April: 0.15 feet
- May: 0.24 feet
- June: 0.40 feet
- July: 0.40 feet
- August: 0.42 feet
- September: 0.50 feet
- October: 0.36 feet
- November: 0.14 feet
- December: -0.06 feet

Additionally, 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).

Coastal Flooding Hazard

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. Coastal flooding is 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 New Jersey. 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

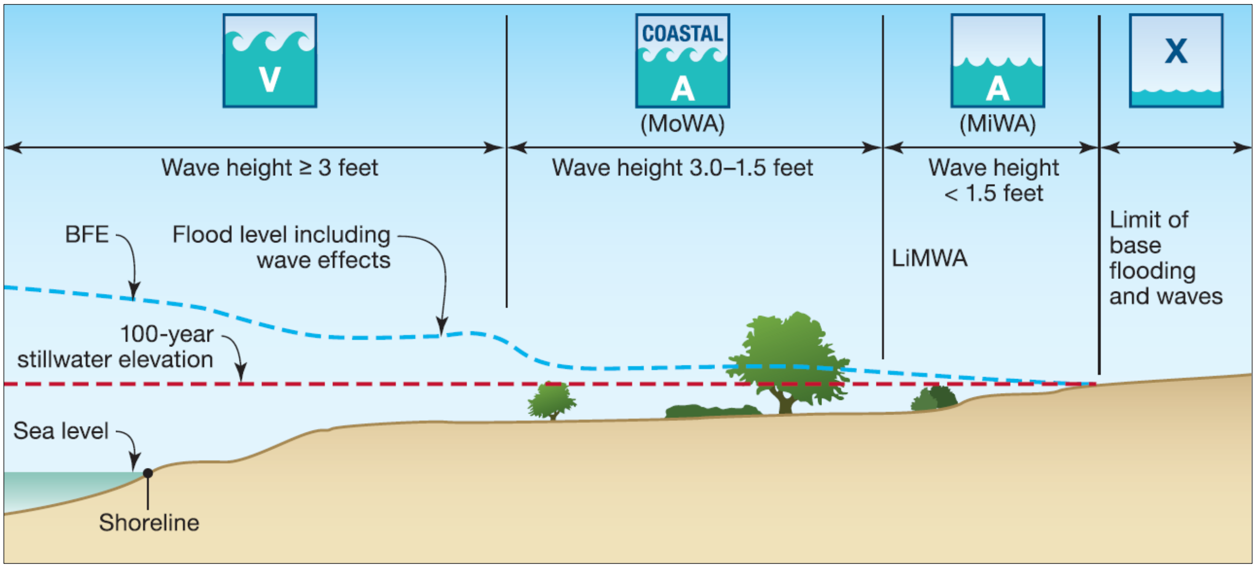
  High-velocity flows can be created or exacerbated by the presence of man-made or natural obstructions along the shoreline and by weak points formed by roads and access paths that cross dunes, bridges or canals, channels, or drainage features.

- *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).

According to the 2011 Coastal Construction Manual, FEMA P-55, Zone V (including Zones VE, V1-30, and V) identifies the Coastal High Hazard Area. This is the portion of the special flood hazard area (SFHA) that extends from offshore to the inland limit of a primary frontal dune along an open coast and any other portion of the SFHA that is subject to high-velocity wave action from storms or seismic sources. The boundary of Zone V is generally based on wave heights (3 feet or greater) or wave run-up depths (3 feet or greater). Zone V can also be mapped based on the wave overtopping rate (when waves run up and over a dune or barrier). Zone A or AE, identify portions of the SFHA that are not within the Coastal High Hazard Area. These zones are used to designate both coastal and non-coastal SFHAs. Regulatory requirements of the NFIP for buildings located in Zone A are the same for both coastal and riverine flooding hazards. Zone AE in coastal areas is divided by the limit of moderate wave action (LiMWA). The LiMWA represents the landward limit of the 1.5-foot wave (FEMA 2011). The LiMWA is indicated on the Township Preliminary FIRM dated January 30, 2015.

The area between the LiMWA and the Zone V limit is known as the Coastal A-Zone (CAZ) (for building codes and standard purposes) and as the Moderate Wave Action area (by FEMA flood mappers). This area is subject to wave heights between 1.5 and 3 feet during the base flood. The area between the LiMWA and the landward limit of Zone A is known as the Minimal Wave Action area, and is subject to wave heights less than 1.5 feet during the base flood (FEMA P-55 2011). Figure 5-4 shows a typical transect illustrating Zone V, the Coastal A-Zone and Zone A, and the effects of energy dissipation and regeneration of a wave as it moves inland. Wave elevations are decreased by obstructions such as vegetation and rising ground elevation (FEMA 2011). Since the LiMWA is delineated on the FIRM, the 2016 Uniform Construction Code requires new buildings and substantially improved buildings to comply with the requirements for Zone V. However, federal flood insurance in CAZs is rated using Zone A rates (lower than Zone V rates (NJAFM Quick Guide 2015).

Figure 4. Transect Schematic of Zone V, Coastal A-Zone, Zone A, and Zone X



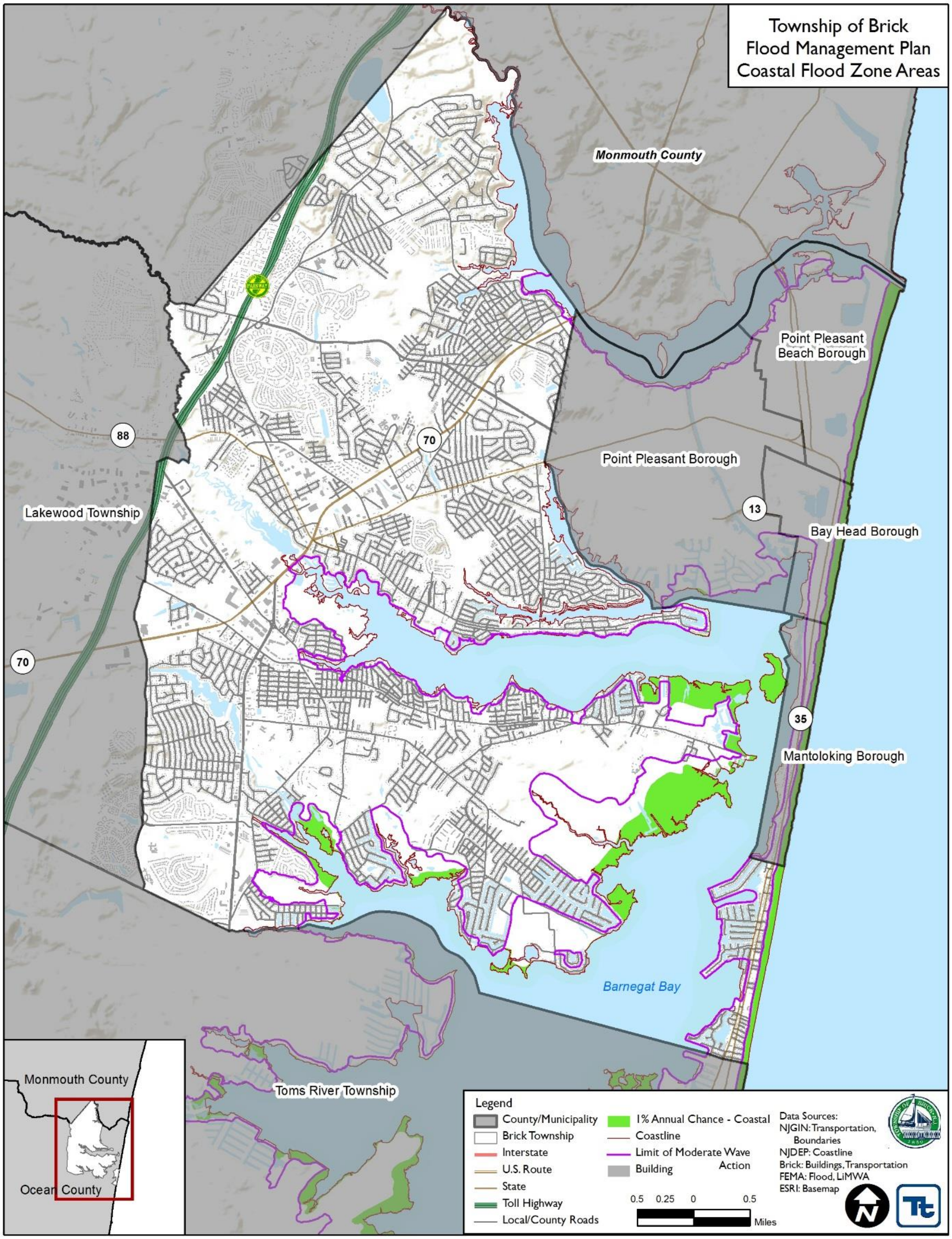
Source: FEMA 2011
< Less than
≥ Greater than or equal to
BFE Base Flood Elevation
LiMWA limit of moderate wave action
MiWA Minimal Wave Action area
MoWA Moderate Wave Action area

Coastal Flooding Location

Coastal communities are vulnerable to the damaging impacts of major storms along the coastline of New Jersey. The coastal zone of New Jersey includes 8 counties and 126 municipalities, including the Township of Brick. With regards to Ocean County specifically, the county has the longest oceanfront shoreline of any county in New Jersey, with 45.2 miles of coastline. Approximately 70% of this coastline is developed (31.8 miles), increasing the county's vulnerability to coastal flooding and coastal erosion significantly (Ocean County Hazard Mitigation Plan [OC HMP] 2014).

The coastal boundary of New Jersey encompasses the Coastal Area Facility Review Act (CAFRA) area and the New Jersey Meadowlands District. The coastal area includes coastal waters to the limit of tidal influence including: the Atlantic Ocean (to the limit of New Jersey's seaward jurisdiction); Upper New York Bay, Newark Bay, Raritan Bay, and the Arthur Kill; the Hudson, Raritan, Passaic, and Hackensack Rivers; and the tidal portions of the tributaries to these bays and rivers. The Delaware River and Bay and other tidal streams of the Coastal Plain are also in the coastal area, as is a narrow band of adjacent uplands in the Waterfront Development Area beyond the CAFRA area. Figure 5-5 provides a visual representation of the 1-percent annual chance flood areas for the V-Zone in the Township of Brick. These areas have a greater chance of experiencing coastal flooding, wave damage, storm surge, and coastal erosion during a storm event.

Figure 5. The Township of Brick Coastal Flood Zone Areas



Source: NJDEP 2015, NJGIN 2015, FEMA 2015

The 2013 New Jersey Beach Profile Network (NJBPN) for Ocean County examines the recovery efforts and current status of the coastlines in Ocean County and the Township of Brick. The report notes that the Township of Brick experienced a lower level of damage from Superstorm Sandy along its shoreline (compared to other impacted coastlines) but still required cleanup from dune breaches that brought sand to the interior. Between the spring and fall of 2013, the beach in the Township of Brick regained 37 cubic yards per foot through a replenishment program (as the offshore region lost 32 cubic yards per foot).

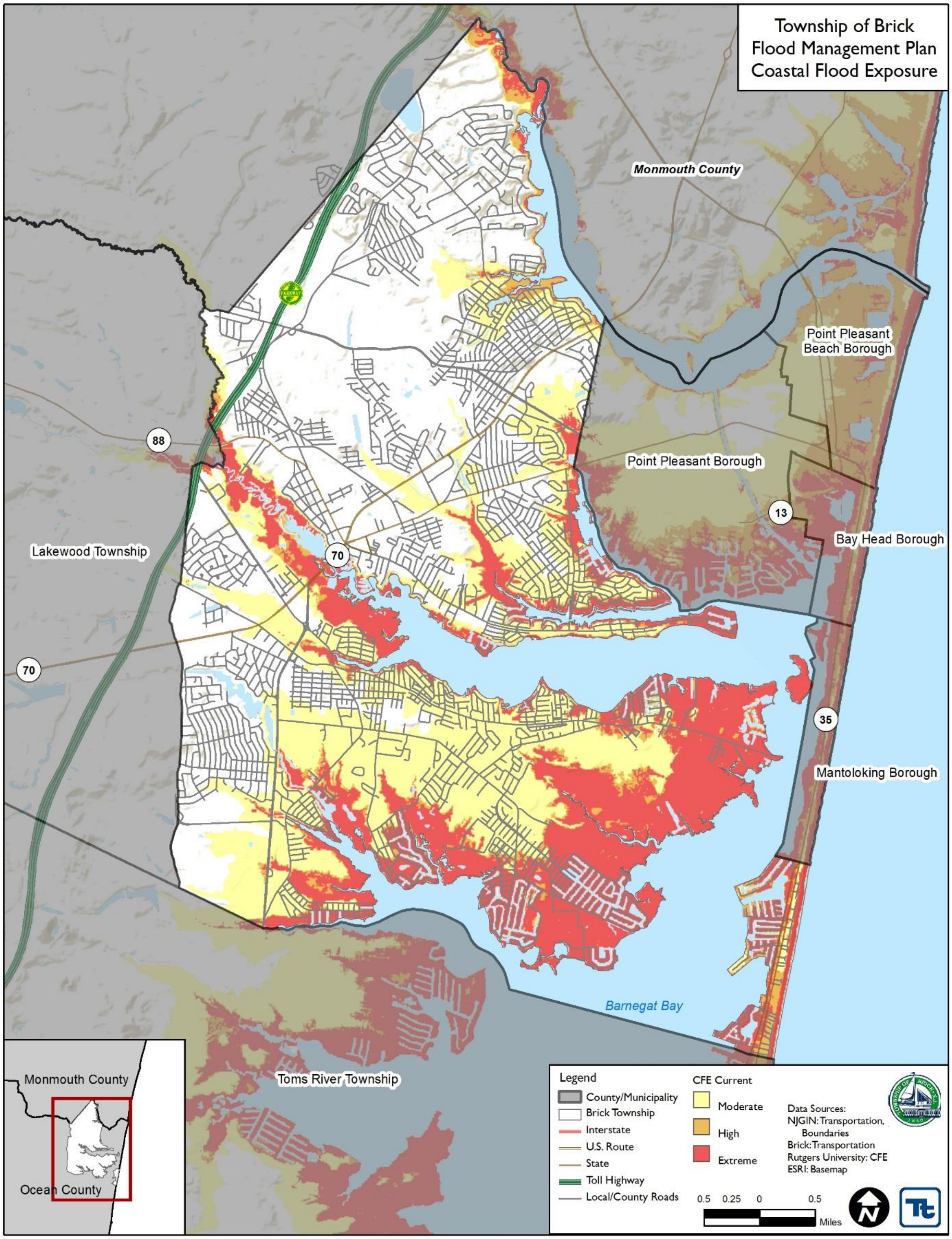
Storm surge, detailed below, also contributes to coastal flooding. Storm surges inundate coastal floodplains by dune overwash, tidal elevation rise in inland bays and harbors, and backwater flooding through coastal river mouths. Strong winds can increase in tide levels and water-surface elevations. Storm systems generate large waves that run up and flood coastal beaches. The combined effects create storm surges that affect the beach, dunes, and adjacent low-lying floodplains. Shallow, offshore depths can cause storm-driven waves and tides to pile up against the shoreline and inside bays. Based on an area's topography, a storm surge may inundate only a small area (along sections of the northeast or southeast coasts) or storm surge may inundate coastal lands for a mile or more inland from the shoreline.

Coastal Flood Exposure

In order to evaluate coastal flood exposure, the Coastal Hazard Profiler tool developed by NJADAPT creates maps showing the people, places, and assets exposed to flood hazards and sea level rise. Areas with the potential for flood exposure are divided into three ranking levels of moderate, high, or extreme. The more frequent the flood exposure, the higher ranking an area receives. NJADAPT is a collaboration of academic institutions, government agencies, businesses, and nongovernmental organizations to evaluate the impact of climate change on various populations, places, and assets in New Jersey. It is designed to integrate high-quality data on climate change into state and community planning and decision-making.

High and extreme exposure areas are those that are exposed to relatively frequent flooding and include those areas subject to the most powerful wave impacts. In the Township of Brick, areas along the Metedeconk River, Atlantic Ocean, and Barnegat Bay are identified as having a high or extreme exposure to coastal flooding. The areas identified as having moderate exposure also have small areas of high to extreme exposure. Although multiple areas of the township were identified as having high or extreme exposure, the largest area of exposure is along the Atlantic Ocean and Barnegat Bay. In addition, all of the barrier island was identified in the high or extreme coastal exposure zone (NJADAPT 2014). The figure below shows the ranking (Moderate, High, and Extreme) of coastal flooding exposure for the coastal areas of the Township of Brick.

Figure 6. Coastal Flood Exposure in the Township of Brick



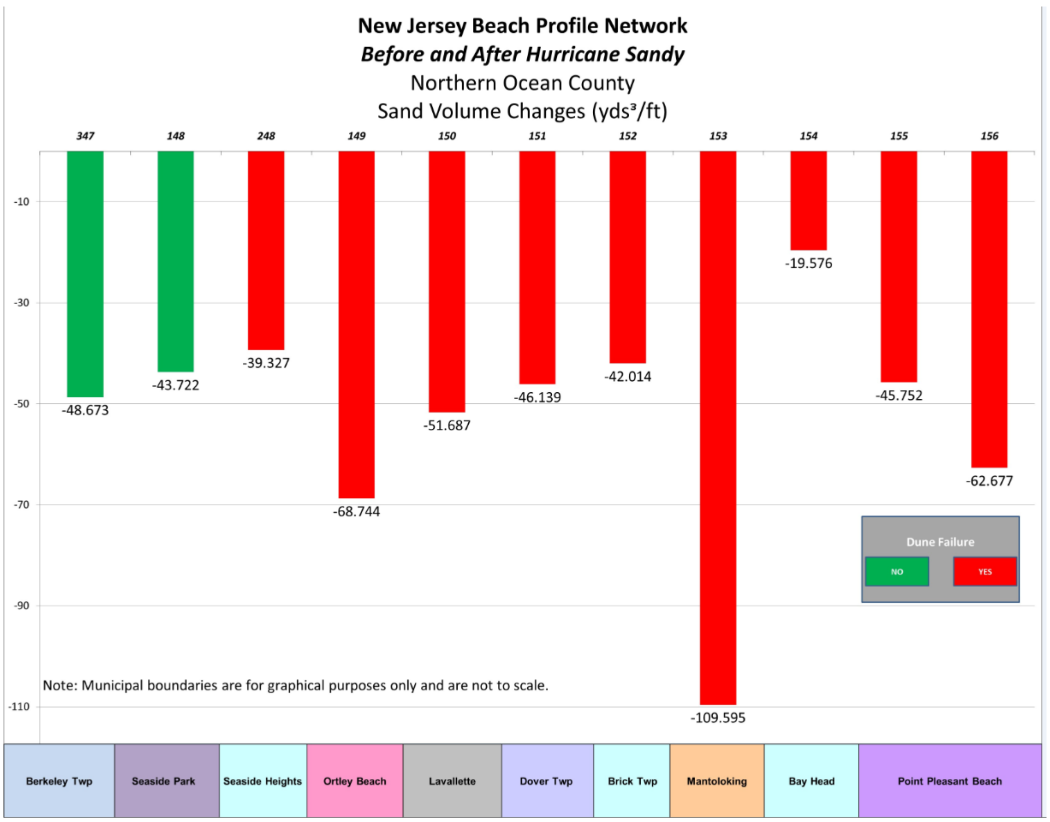
Source: Rutgers University Center for Remote Sensing and Spatial Analysis

Coastal Erosion Frequency

Coastal erosion is a frequent event and occurs because of both natural and human activities. All beaches are affected by coastal erosion, but the rate and severe erosion events vary in frequency. Chronic erosion is the gradual recession of a shoreline over a period of decades and will be impacted by wave heights, development, and climate changes. Episodic erosion occurs in response to flood events or coastal storms, such as Superstorm Sandy, and is characterized by a rapid recession of the shoreline. Because coastal erosion is tied closely to other activities, frequency rates and severity levels are best evaluated in conjunction with other related hazards' probabilities and by analyzing secondary impacts from storms, human actions, and other factors. Figure 5-7 below indicates the beach volume and shoreline changes over the past 25 years. Survey sites 151 and 152 indicate the shoreline retreat within the Township of Brick.

Figure 7. Coastal Erosion Trends in Ocean County

Source: Stockton (2015)



Flood Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger.

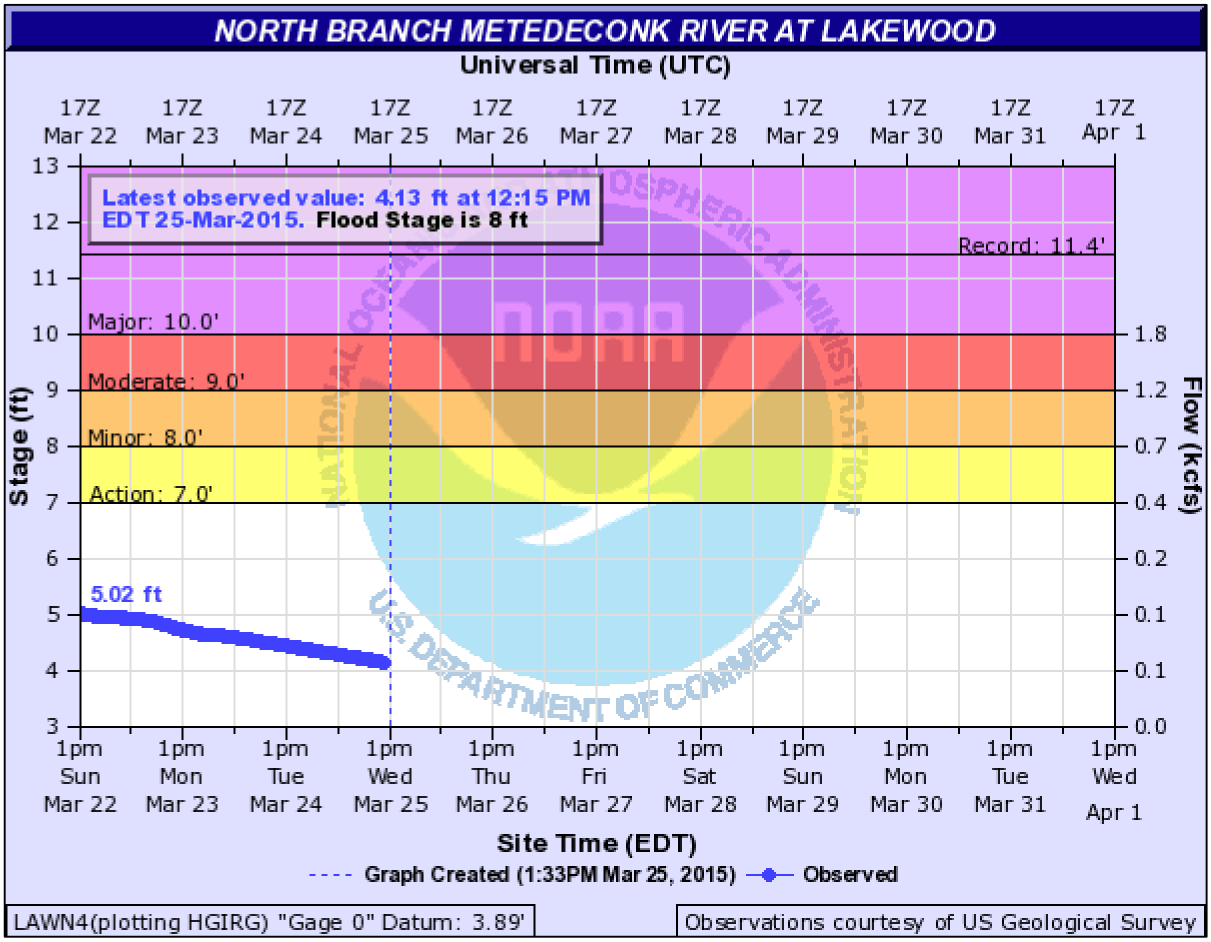
Each watershed has unique qualities that affect its response to rainfall. A hydrograph, which is a graph or chart illustrating stream flow in relation to time (see Figures 5-8 to 5-10) is a useful tool for examining a stream's response to rainfall. Once rainfall starts falling over a watershed, runoff begins and the stream begins to rise. Water depth in the stream channel (stage of flow) will continue to rise in response to runoff even after rainfall ends. Eventually, the runoff will reach a peak and the stage of flow will crest. It is at this point that the stream stage will remain the most stable, exhibiting little change over time until it begins to fall and eventually subside to a level below flooding stage.

The potential warning time a community has to respond to a flooding threat is a function of the time between the first measurable rainfall and the first occurrence of flooding. The time it takes to recognize a flooding threat reduces the potential warning time for a community that has to take actions to protect lives and property. Another element that characterizes a community's flood threat is the length of time floodwaters remain above flood stage.

The Township's flood threat systems consists of a network of precipitation gages throughout the watersheds, tide gages along the coastline, and stream gages at strategic locations in the township that constantly monitor and report stream levels. This information is fed into a USGS forecasting program, which assesses the flood threat based on the amount of flow in the stream (measured in cubic feet per second). Because coastal flooding is the community's most significant concern, the Township supports the placement of tide gages in or near corporate limits. The closest tide gage to the Township is the Barnegat Bay at Mantoloking, NJ. This gage is maintained by the USGS and has the site number of 01408168. For more information on this tide gage, please refer to the 'Severity' subsection earlier in this Flood Profile. In addition to this program, data and flood information is provided by the NWS. All of this information is analyzed to evaluate the flood threat and possible evacuation needs.

The following figures consist of hydrographs for major waterways in or near the Township of Brick (if gages inside the Township were not available, the nearest gages outside corporate limits were used for graphing). The hydrographs provide real-time data with action levels, minor, moderate, and major flood stages in relation to current river heights.

Figure 8. North Branch of the Metedeconk River Hydrograph near Lakewood, NJ



Source: NOAA NWS 2015

Notes:

EDT	*Eastern Daylight Time*
ft	*feet*
kcfs	*Kilo cubic feet per second*