

Coastal Vulnerability Assessment and Getting to Resilience: Old Bridge, NJ

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Prepared by the Environmental Analysis and Communications Group, Rutgers University,
for the Township of Old Bridge

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I. Introduction

This project was funded by the National Fish and Wildlife Foundation in support of the New Jersey Department of Environmental Protection, Coastal Zone Management Program.

As stated in the 2011 NJDEP document *New Jersey's Coastal Vulnerability Assessment and Mapping Protocol*, vulnerability is defined as the degree of exposure and inability of a human or natural system to cope with the effects of a natural hazard, including changing variability and extremes in weather and climate. By assessing vulnerabilities, communities can plan for future exposures and develop strategies for mitigating long-term risk; making communities more resilient.

This report assesses community vulnerability to sea level rise projected for the year 2050 along with a category 1 coastal storm surge.

The sea level rise projection data used is taken from the publication *A geological perspective on sea-level rise and its impacts along the U.S. mid-Atlantic coast* (Miller et al, 2013). This publication calls for a central projection of 1.5 feet of sea level rise along the shore in 2050.

Category 1 storm surge data was mapped using the Sea, Lake, and Overland Surge from Hurricanes (SLOSH) data developed by the National Weather Service/NOAA to estimate storm surge heights resulting from historical, hypothetical, or predicted hurricanes, taking into account the atmospheric pressure, size, forward speed, and track data of storms. According to the National Hurricane Center, Category 1 storm characteristics include:

- Sustained winds of 74-95 mph
- Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters.
- Large branches of trees will snap and shallow rooted trees may be toppled.
- Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.

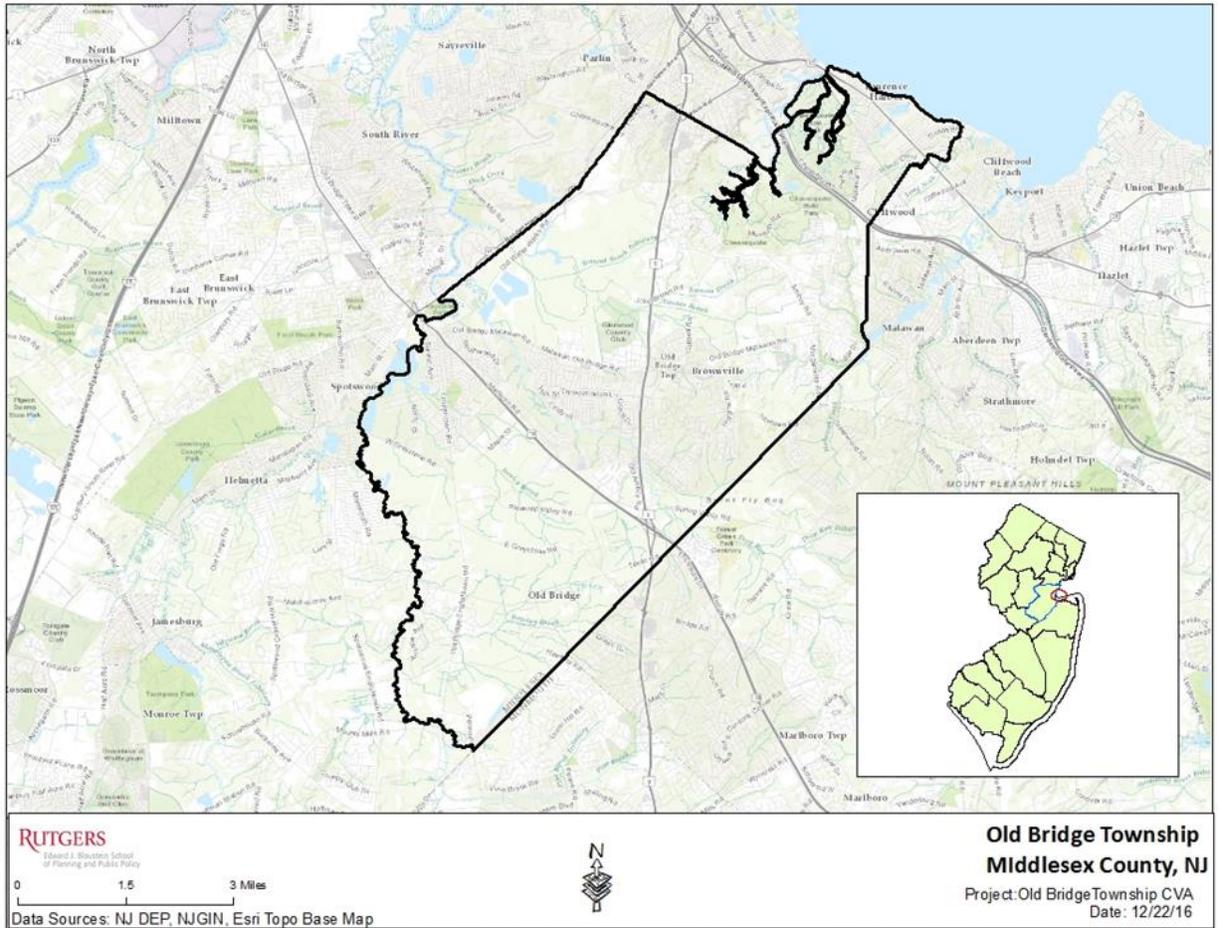
II. Community Profile

According to the 2012 US Census, the population of Old Bridge Township was 65,375, making it the 18th most populated municipality in the State. The median age of Old Bridge residents is 36.7 years old, the average household income is \$83,750, and the median home value of an owner occupied unit is \$331,100.

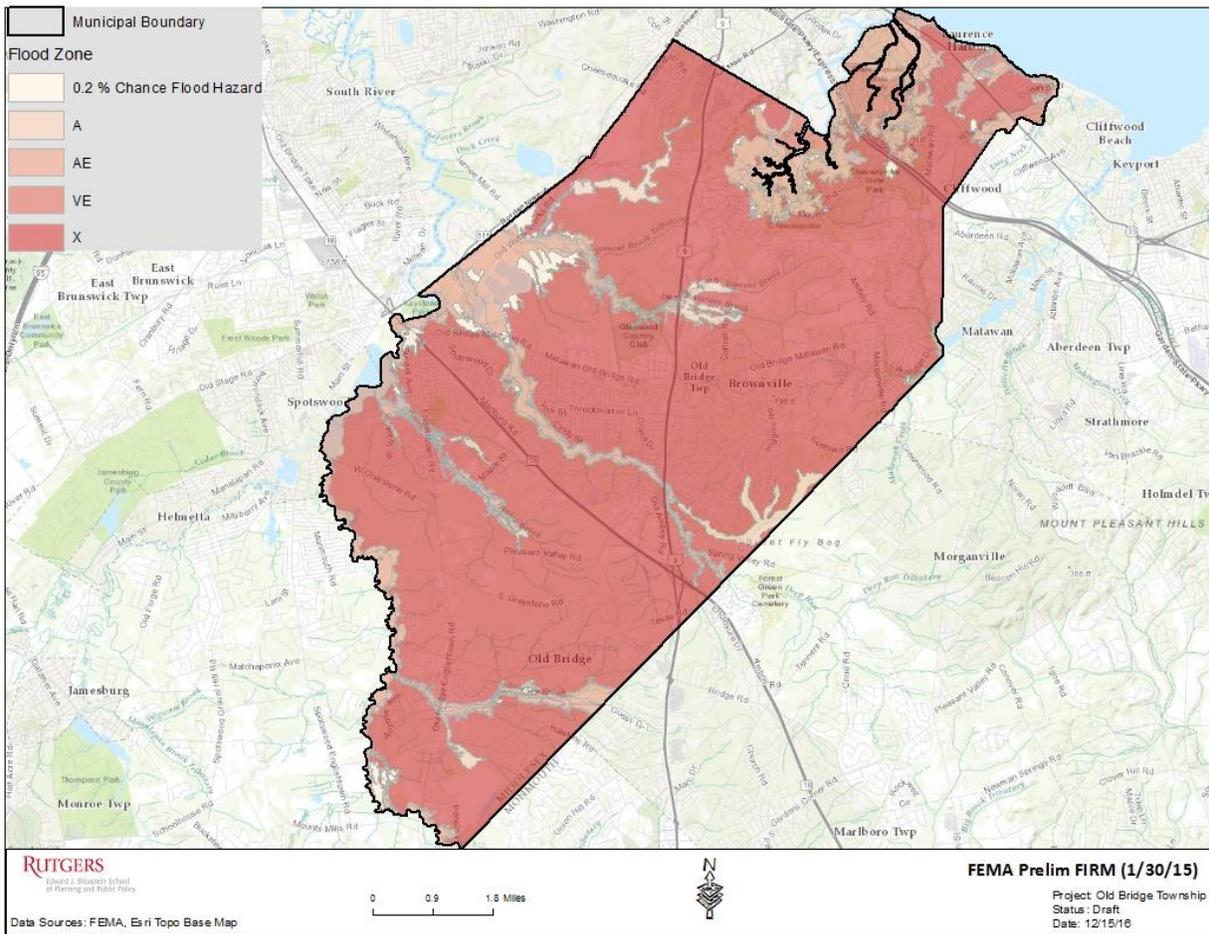
Unincorporated communities, localities, and census designated places within Old Bridge include Brownville, Laurence Harbor, Madison Park and Old Bridge CDP, Browntown, Brunswick Gardens, Cheesequake, Cottrell Corners, East Spotswood, Matchaponix, Moerls Corner, Morristown, Parlin, Redshaw Corner, Runyon, Sayre Woods South, South Old Bridge and Texas.

Of the 25 municipalities in Middlesex County, Old Bridge Township's 38 square miles of land area makes it the third largest Middlesex County municipality by land area and the 22nd largest by population density.

Map 1: Old Bridge Township, Middlesex County - NJ

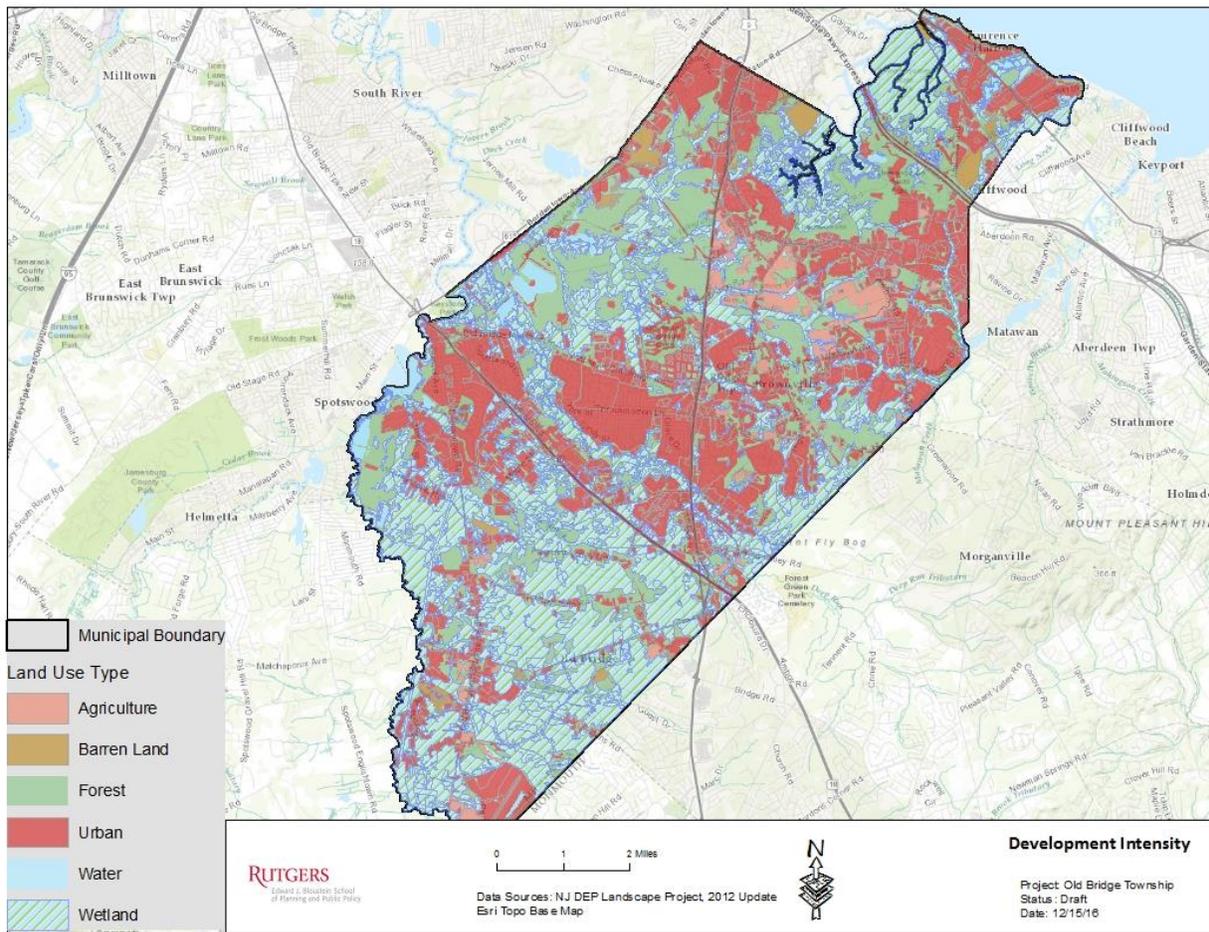


Map 2: FEMA Flood Zones



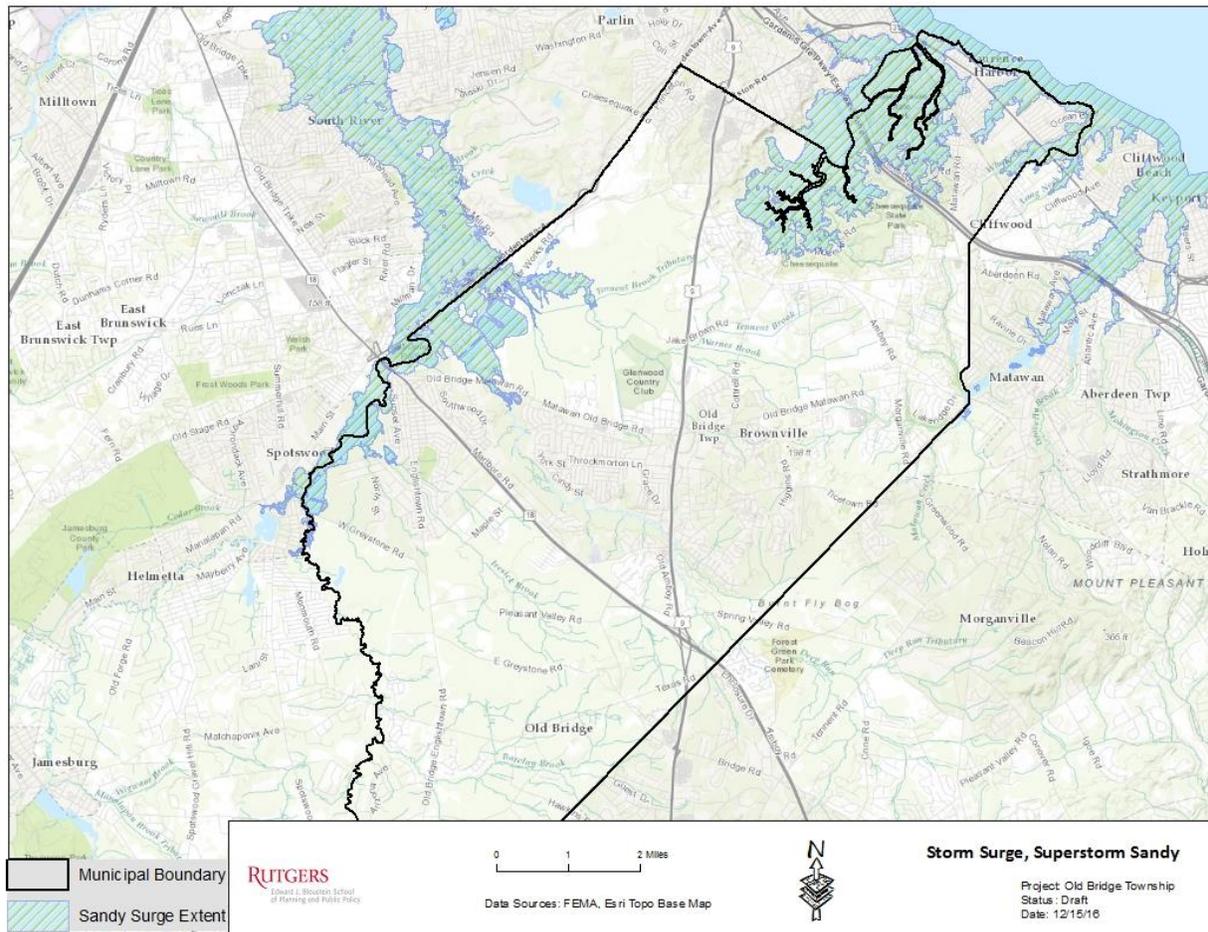
FEMA has designated the vast majority of land in Old Bridge as Zone X, meaning a Non Special Flood Hazard Area. Some populated areas located along Route 35 are located in Zone AE, meaning these areas are subject to inundation by the 1-percent-annual-chance flood event, Base Flood Elevations (BFEs) are shown, and mandatory flood insurance purchase requirements and floodplain management standards apply.

Map 3: Land Use



As seen in the map above, Old Bridge has a significant amount of urban development along the coast and surrounding wetland areas.

Map 4: Sandy Surge



Interestingly, the storm surge that resulted from Superstorm Sandy is similar to the extent of inundation that is projected to be seen in the year 2050 with 2 foot of sea level rise and in the event of a category 1 storm (shown on next map).

III. CVA Methodology

Prior to the first meeting, staff at Rutgers University had received draft asset data from staff at Sustainable Jersey and used this data to create draft mapping in preparation of the CVA meeting with municipal officials. The first CVA meeting was held on November 3rd at town hall. Municipal personnel in attendance to assist in identifying critical assets and finalizing mapping included:

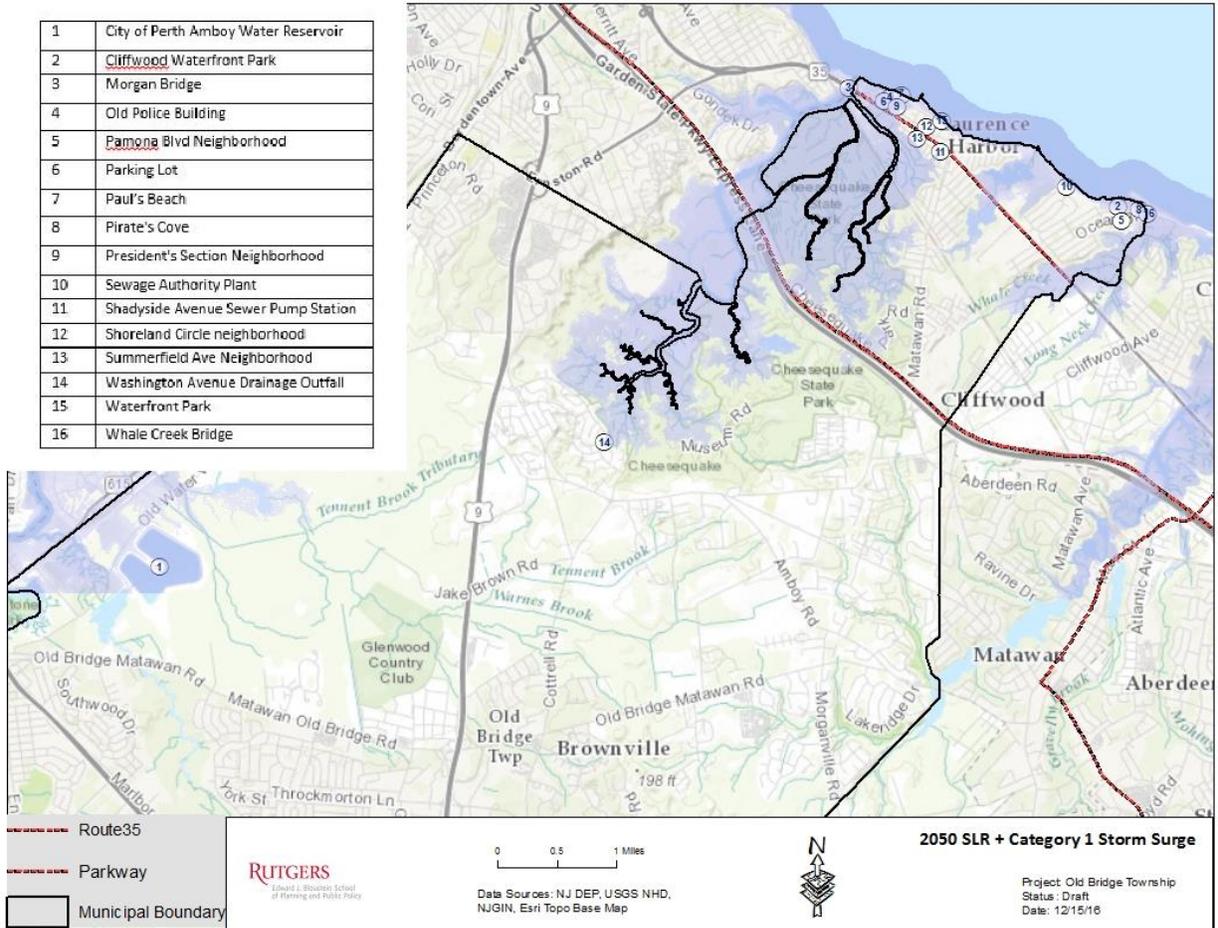
- Nicole Shapiro, Municipal Engineer
- Nancy Aughtry, MUA
- Karen Longo, Grant Write/Shared Services
- Mayor Owen Henry
- Thomas Gerity, OEM Coordinator
- Patrick Reardon, Code Services
- Damian Gil, Zoning

When a CVA is completed, community assets from four general areas are indexed, these areas include:

- Community Resources
- Critical Infrastructure and Facilities
- Natural Resources
- Vulnerable Sites and Populations.

After deliberation, Old Bridge Township’s final list of assets consisted of the 16 locations and two evacuation routes mapped below.

Map 5: Vulnerable Assets with Sea Level Rise for 2050 and Category 1 Storm Surge



After identifying the assets, depth projections were mapped and listed using combined data provided by the New Jersey Department of Protection for the storm surge from a category 1 storm coupled with sea level rise projected for the year 2050.

Table 1. Vulnerable Assets and Depth Projections

Name	Asset Number	Projected Depth with SLR 2050/Cat 1 Storm (feet)
City of Perth Amboy Water Reservoir	1	Access road (old Water Works Rd) 1 foot at northeast and up to 6 feet southwest. Reservoir itself generally between 11-12ft.
Cliffwood Waterfront Park	2	7ft
Morgan Bridge	3	9-10ft in center of Route 35
Old Police Building	4	2-3ft
Pomona Blvd Neighborhood	5	0-3ft north east at Raritan to Ocean Blvd, 4-6ft southern end of Raritan Blvd, 0-3ft south of Pomona Blvd
Parking Lot	6	9ft
Paul's Beach	7	1-2ft
Pirate's Cove	8	10-11ft closer to water, 0-4ft at access roads and parking
President's Section Neighborhood	9	4-11ft with highest depths along northwest edge
Sewage Authority Plant	10	Under 1 foot at northwest edge of site
Shadyside Avenue Sewer Pump Station	11	1-2ft
Shoreland Circle Neighborhood	12	0-2ft at northeast edge
Summerfield Ave Neighborhood	13	Southwest edge 6-10ft, 10-11ft along Lantana, 1-3ft at corner of Shadyside and Summerfield, 0-7ft in rear of Shadyside Ave
Washington Avenue Drainage Outfall	14	0-2ft
Waterfront Park	15	0-3ft at east end, 5-9 feet in front of Shoreline Circle Neighborhood, 0-4 feet in front of President's Section Neighborhood, 9-10 feet north of President's Section neighborhood, 8-10ft at most northwestern edge
Whale Creek Bridge	16	About 13ft at center of Ocean Blvd
Route 35		9ft before Morgan Bridge, 7-8ft in front of Marina, 1-5ft in front of President's Section Neighborhood, 0-7ft at marquis Creek, 5-9ft at southeastern end
GSP		0-4ft at northern edge of town at Cheesquake State Park

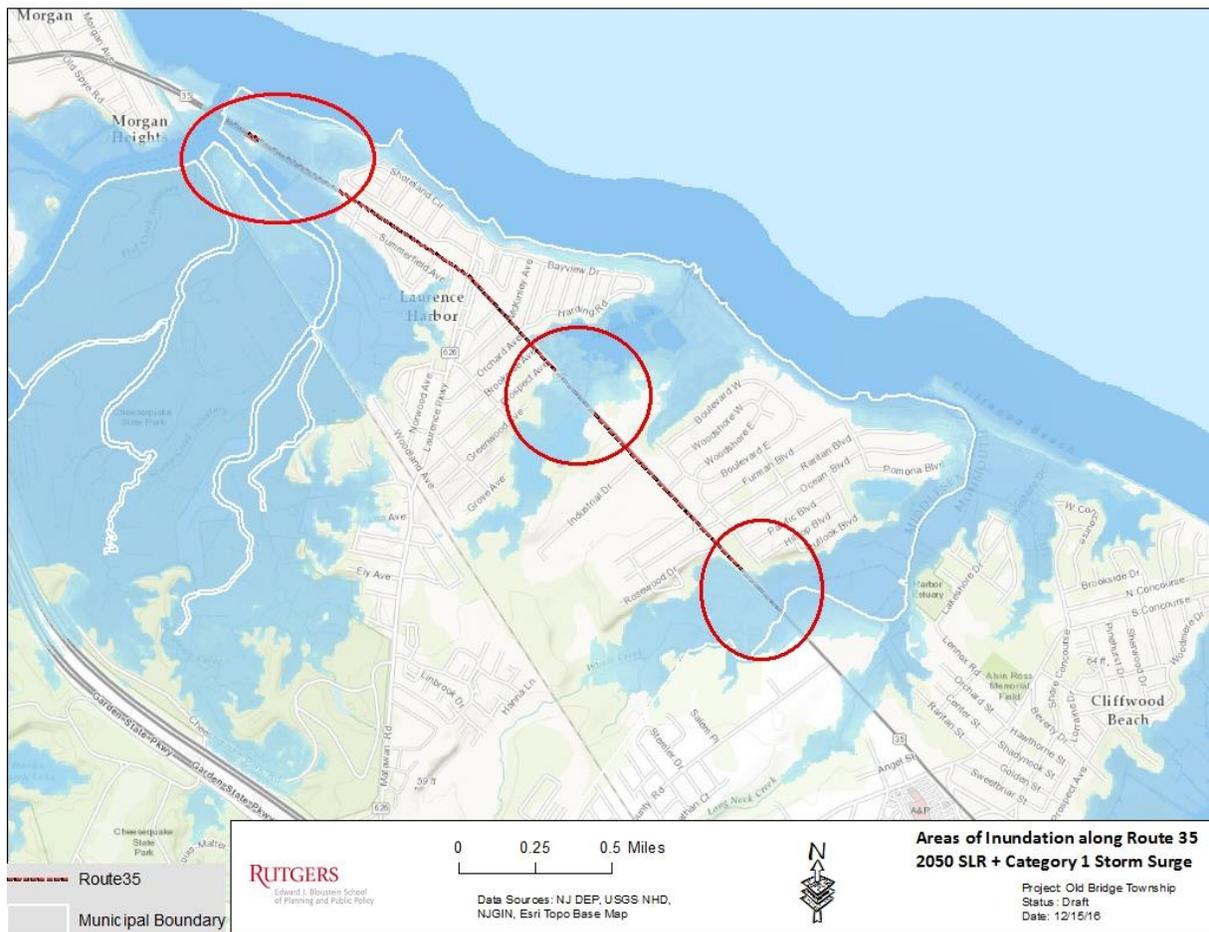
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ability is most critical to the town: flooding of Route 35 and coastal erosion.

Route 35

Route 35 is important to day to day travel throughout the town and between neighboring municipalities (Keyport and South Amboy), critical as an evacuation route for those living east of the highway, and Route 35 is also critical as a commercial district in the town.

Map 6: Areas of Inundation along Route 35



With its direct exposure to the Raritan Bay, Route 35 is projected to experience anywhere from 0 – 9 feet throughout the length of the town. The greatest projected depth of 9 feet is seen before the Morgan Bridge. Similarly, 7-8 feet of inundation is projected for the portion of the highway east of the Raritan Marina. Evacuation out of adjacent residential areas is likely to be impacted by the projected 1-5 feet of inundation at the President’s Section Neighborhood, 0-7 feet at the wetland areas, and 5-9 feet at the southeastern end Route 35 at the Whale Creek.

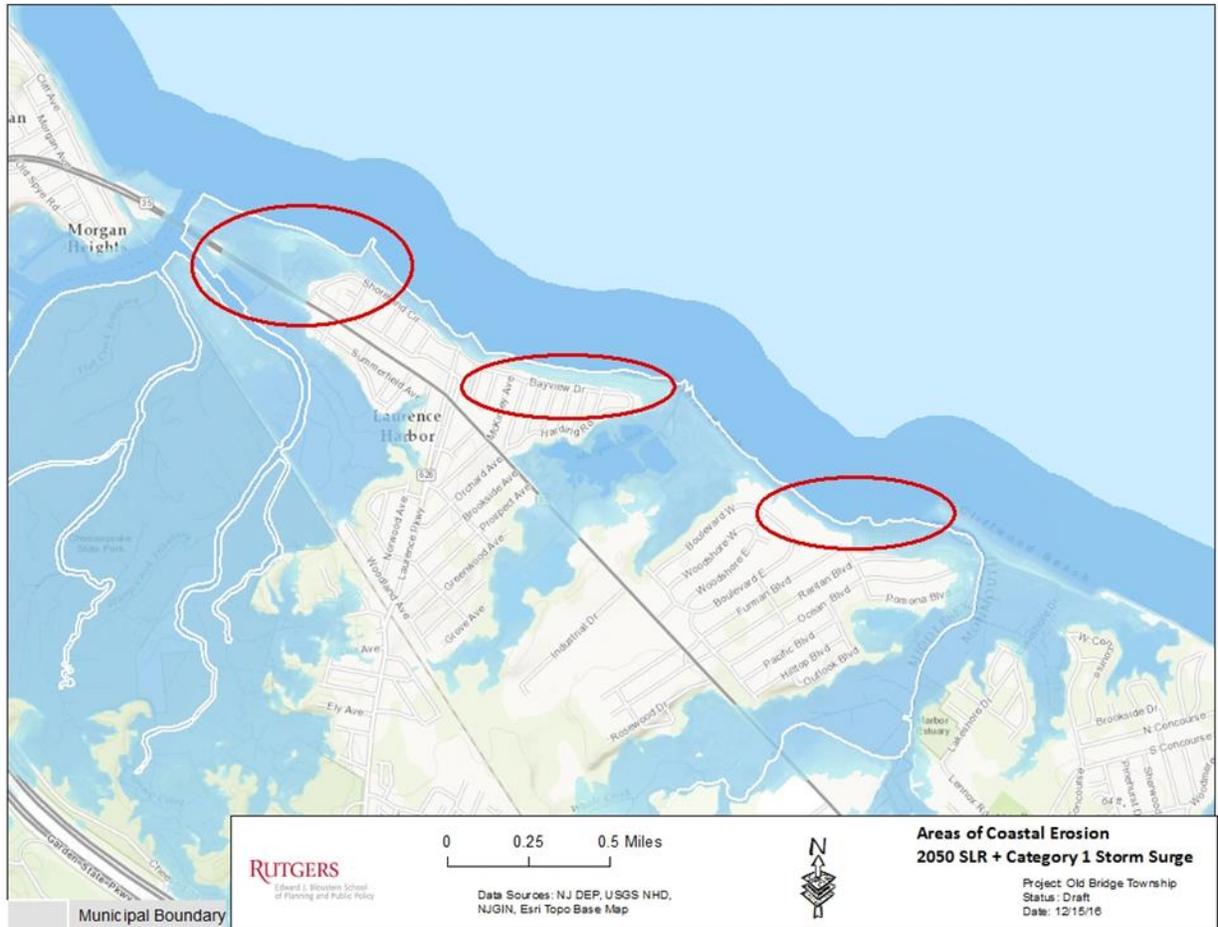
According to the municipality, while elevation of the highway is unlikely, the roadway would benefit from drainage improvement projects along the length of the road, but particularly in the areas of projected inundation noted above. There may also be opportunities for natural barriers to be constructed or enhanced where Route 35 crosses over the wetland area as well as at the Whale Creek.

The 2015 update to the Middlesex County Hazard Mitigation Plan doesn’t specifically call out mitigation projects for flooding issues along Route 35.

Coastal Erosion

Infrastructure and housing located along the Raritan Bay are vulnerable to wave action, storm surge and future projected sea level rise as periodic erosion of the beachfront occurs.

Map 7: Areas of Coastal Erosion



Particularly vulnerable are the Shoreland Circle and Pomona Blvd Neighborhoods. The Shoreland Circle neighborhood is projected to experience inundation up to 2 feet closest to the shore while the Pomona Blvd neighborhood is projected to experience inundation depths up to 3 feet closest to the Bay and 6 feet at the Whale Creek.

Recommendations from the Middlesex County Hazard Mitigation Plan that are in line with the CVA

The 2015 update to the Middlesex County Hazard Mitigation Plan notes that portions of Paul's Beach have experienced significant shoreline erosion in the past. To combat erosion, Old Bridge Township has participated in property acquisition (27 in the Pauls' Beach neighborhood) as well as dune stabilization and replenishment. The County had also replenished a portion of the beach in 2016 but the dirt has since washed away. The HMP update recommends the permanent stabilization of Shoreline Circle to

protect from future erosion, as well as acquisition and/or elevation of repetitive loss properties. The Plan lists these projects as being “high” priority but grant dependent.

Community Rating System (CRS)

Old Bridge Township is not currently a CRS participating community. Old Bridge does, however, participate in the National Flood Insurance Program (NFIP), with 227 policies in force. There are 7 Repetitive Loss Properties and 1 Severe Repetitive Loss Properties located in the Township. ¹

There are CRS points available for special structural and nonstructural efforts to solve existing flooding problems related to coastal erosion. This can include implementing coastal erosion, dune, and beach regulations in areas such as Paul’s Beach. Wetland protection measures, such as the wetland area that crosses Route 35 and the Whale Creek area, as well as open space preservation can also garner CRS points.

Getting to Resilience (GTR)

GTR is an online self-assessment process tool to assist communities to reduce vulnerability and increase preparedness by linking planning, mitigation, and adaptation. Through this assessment, municipalities will find out how r preparedness can be worth valuable points through FEMA’s Community Rating System and Sustainable Jersey. Below are key recommendation pulled out from the assessment output. The final output in its entirety is available for municipal officials upon request.

Section I. Risk and Vulnerability Assessments

- Draft a Shoreline Change Analysis to measure changes in shoreline through processes of accretion and erosion. Areas can then be targeted for restoration and land use consideration based on historic data. Models for completing a shoreline change analysis are available through USGS and NOAA. NJDEP maintains shoreline change mapping data through their GIS department and this data can be downloaded and used for free by municipalities.
- Utilize the Nature Conservancy’s Restoration Explorer. According the Restoration Explorer, Old Bridge has 29.7 miles of shoreline available for shoreline restoration techniques. The five techniques cited in the program include a nature-based living shoreline, a living reef breakwater, marsh sill, a breakwater, and an ecologically enhanced revetment. The color on the map imagery indicates how many of these techniques are applicable along the shoreline in Old Bridge.

¹ Middlesex County Hazard Mitigation Plan, 2015



Graphic 1. Screenshot from Restoration Explorer, Old Bridge Waterfront Park The Restoration Explorer identifies this area as being compatible with all four shoreline enhancement techniques to combat erosion occurring at the waterfront area.

- Utilize SLOSH Mapping and Data to better understand where storm surge has and is likely to occur in the future. Township officials stated that they were not aware of SLOSH data. The Sea, Lake and Overland Surges from Hurricanes (SLOSH) model is a computerized numerical model developed by the National Weather Service (NWS) to estimate storm surge heights resulting from historical, hypothetical, or predicted hurricanes by taking into account the atmospheric pressure, size, forward speed, and track data. These parameters are used to create a model of the wind field which drives the storm surge.

The SLOSH model consists of a set of physics equations which are applied to a specific locale's shoreline, incorporating the unique bay and river configurations, water depths, bridges, roads, levees and other physical features. (<http://www.nhc.noaa.gov/surge/slosh.php>)

SLOSH mapping was done as part of the CVA for a category 1 storm in the year 2050 (accounting for 2050 sea level rise). Officials should consider using the publicly available data going as it is updated, to update their risk mapping.

- Track Repetitive Loss Properties and map alongside hazards to obtain a clear picture of where to focus outreach and mitigation strategies. Municipal officials can obtain repetitive loss data from FEMA and keep an in-house database of properties to track any mitigation projects that have or will be done in the future. The property owners can also be targeted for outreach regarding flood management and assistance programs and funding that may be available. These properties can also be mapped alongside coastal hazards and an analysis done to display greater risks in the future and the need for greater mitigation actions, including land use and zoning changes within the municipality.
- Map Risk in relationship to Vulnerable Populations, e.g. elderly, children, poor, disabled, and linguistically isolated. While the Middlesex County Hazard Mitigation Plan identifies various vulnerable populations with the county, these populations are not mapped alongside hazard areas.
- Map Risk in relationship to Economic Resources, e.g. major employers. Old Bridge has a robust economic development program led by the Mayor's Office of Economic Development. The program encourages "green" business practices to promote, in one category, green building and landscaping

techniques. Added to this could be the mapping of local businesses and major employers with their relationship to areas of coastal hazards for floodproofing and stormwater planning, as well as to inform future commercial land use decisions.

- Complete a buildout analysis and compare to the Extent of Storm Surge Scenarios and Sea Level Rise. Doing so could ensure that vulnerable areas are not subject to high development intensities, and therefore protecting people, property, and infrastructure from flood damage.
- *Municipal officials should receive Training on and Utilize HAZUS. HAZUS is a nationally applicable standardized methodology that estimates potential losses from earthquakes, hurricane winds and floods. The Federal Emergency Management Agency (FEMA) developed HAZUS under contract with the National Institute of Building Sciences (NIBS). (<https://www.fema.gov/hazus>). FEMA offers HAZUS training courses on their website. An ArcGIS subscription and working knowledge of ArcGIS are needed to utilize the program.*

Section II. Public Engagement

- *Conduct Outreach to Floodplain Residents/Involve Community in Identification of Storm Surge and Sea Level Rise Impacts/hazard vulnerability as valuable opportunity at which municipal officials can inform the public of coastal hazards and hear public input on possible mitigation strategies. Including participatory mapping exercises at which residents can visualize their home and other important locations in relation to coastal hazards can encourage residents to think about the future of not only their home, but land use in the community as a whole.*

Section III. Planning Integration

- Include resilience, address hazards, identify potential impacts to infrastructure, land use, housing, and community facilities in the Municipal Master Plan as a means to address vulnerability through land use planning
- Adopt a Floodplain Management Plan, aside from solely an ordinance. The Plan should specifically call out techniques the town has used and could use in the future to protect the natural floodplain function, as well as nearby homes and infrastructure.
- Update the Stormwater Management Plan to include new/updated policies to reduce stormwater runoff and drainage problems specific to area of high impervious surface. In the plan, identify any connections to the HMP.
- Going beyond a Capital Improvement Budget, create a Plan that calls out projects specific to flood mitigation/drainage system maintenance, both existing and those problems projected for the future. Ensure that the Plan considers the threat of coastal hazards and sea level rise when upgrading existing municipal infrastructure.
- Adopt a Shoreline Management Plan to address the hazards and needs for mitigation and stabilization projects along the shoreline of the municipality. Include in the plan threats from storm surge, projected sea level rise, and any habitat at the site.

Section IV. Disaster Preparedness and Recovery

- Aside from relying on local knowledge, municipal officials can gather and post online or in an official Evacuation Plan frequently flooded areas, areas prone to closure due to flood, and where roadblocks are likely to be positioned. This strategy/Plan should also clearly communicate weather/hazard conditions that would spur an evacuation, what, if any, are the responsibility of

municipal official, a necessary timeframe for evacuations, designated routes, and what emergency management equipment would need to be moved out of a flooded area.

Section V. Hazard Mitigation Implementation

- Using future projected data, the municipality should consider relocating public buildings, critical infrastructure, and facilities out of areas likely to flood.
- The municipality should consider utilizing impact fees or user fees (such as an open space tax) to acquire properties prone to flooding. These funds could also be used for wetland and Shoreland restoration projects.