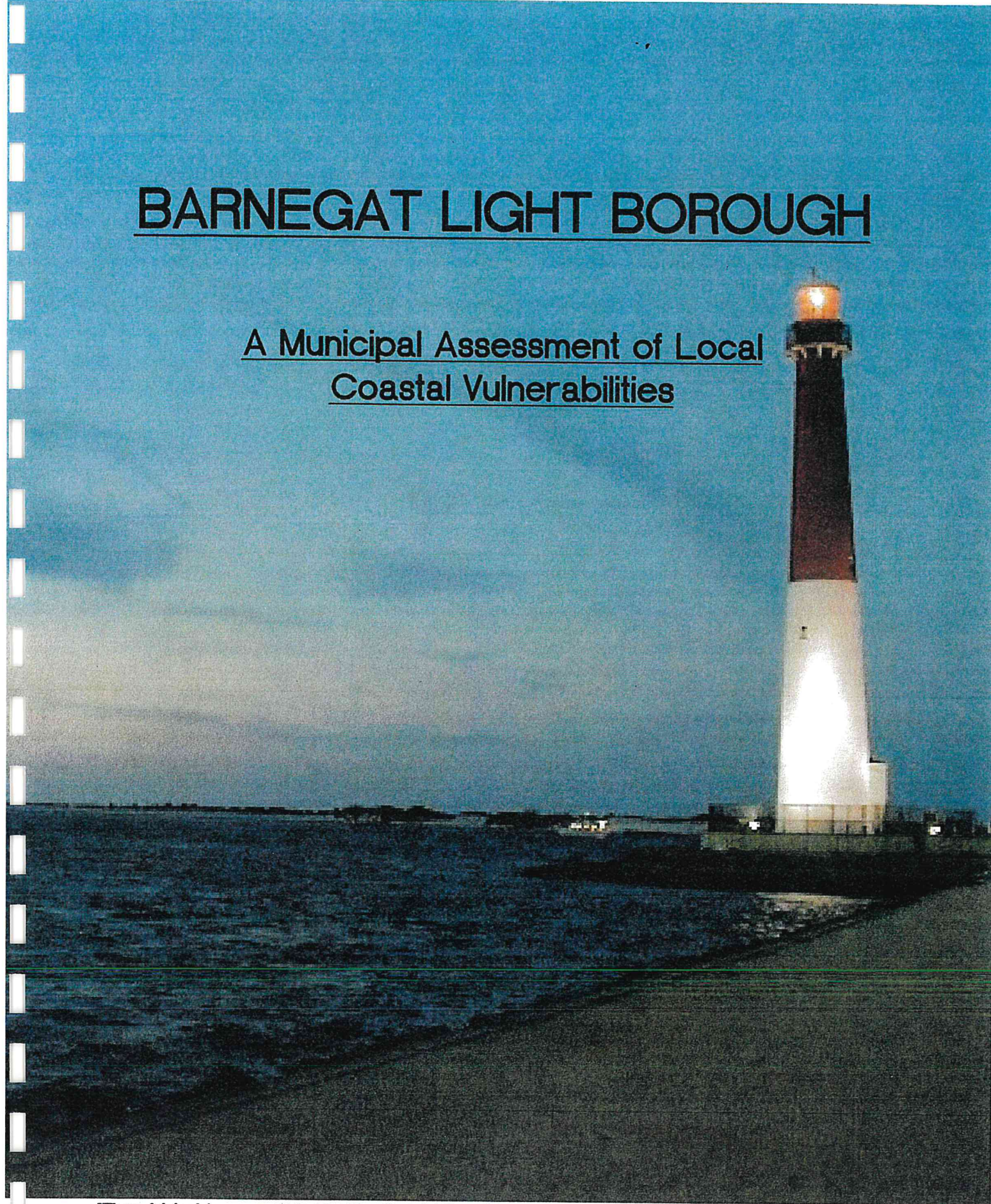


APPENDIX B

COASTAL VULNERABILITY ASSESSMENT

BARNEGAT LIGHT BOROUGH

A Municipal Assessment of Local Coastal Vulnerabilities



'Financial Assistance provided by: The Coastal Zone Management Act of 1972, as amended, administered by the Office of Coastal Management, National Oceanic and Atmospheric Administration (NOAA) through the Department Of Environmental Protection, Coastal Management Program'

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Borough of Barnegat Light

Barnegat Light, is located north of Harvey Cedars and at the northernmost end of Long Beach Island, a barrier island which consists of 6 municipalities, off the mainland coast of southern Ocean County. Long Beach Island, like other barrier islands in the southern part of the United States, has only one means of access via NJSH Route 72 and is geographically vulnerable to natural coastal hazards. The Borough encompasses approximately 0.852 square mile of which 0.731 square miles is land and is bordered to the east by the Atlantic Ocean and to the west by the Barnegat Bay and, consequently, suffered devastating damage from Superstorm Sandy in 2012. In 2010, the population of Barnegat Light was just 574 people but in the summer months, the population soars to well over 10,000 people.

Barnegat Light is home to several distinctive shops and restaurants as well as Viking Village, a maritime shopping area, the Barnegat Lighthouse State Park and numerous commercial fishing fleets with docking facilities on the northern end of the Borough. The only vehicular ingress and egress between the mainland and Barnegat Light is via the Route 72 Manahawkin Bay Bridge in Ship Bottom, also commonly referred to as "The Causeway". As a result, residents of Barnegat Light need to travel lower lying areas of Long Beach Township (Loveladies, North Beach), Harvey Cedars, Surf City, and Ship Bottom which becomes problematic for traffic attempting to navigate potential floodwaters as the number of roads to leave the Borough are limited. As residents and visitors to this shore community do not arrive by way of air, bus or train travel, all means of travel between the barrier island and the mainland occurs by way of personal transportation, making an evacuation a time consuming process. Due to these factors, the island wide Offices of Emergency Management typically starts issuing voluntary evacuation orders at least 72 hours in advance of a storm's anticipated impact. In addition, these same agencies will often issue mandatory evacuation orders in advance of County or State Mandated orders realizing the time and resources to fully evacuate the island. Lastly, the high number of lifelong residents who may have chosen to "ride out" significant storms like the Great Storm of 1962, the Storm of 1992 or even Superstorm Sandy in 2012 may be less inclined to heed the mandatory 72 hour evacuation orders. These people, if they do not leave, are often the last leaving the island and are often being evacuated by highwater vehicle and not utilizing their own transportation.

In our meeting with municipal residents and even some community leaders, we learned there is still very much a mixed view of the necessity to evacuate. Given the extreme damage to the communities south of Surf City, one would anticipate that during the next storm event, those people would certainly leave. Unfortunately, that expectation is not true. Instead, people feel they must protect their property during times of storm event though this isn't always rational. With the high number of homes that have been raised well above the desired FEMA Flood Elevations, we foresee the number of people staying in their homes and ignoring mandatory evacuation orders to be higher during the next event which will undoubtedly put a tremendous strain on emergency personnel and resources. During Superstorm Sandy, it is estimated that only about 50% of the population evacuated and at least 200 people remained in their homes due to the residents being over 65 years of age and the inability to bring pets to shelters on the

mainland. The lack of pet friendly shelters has since been addressed as part of the Ocean County Hazard Mitigation Plan. On October 31st, approximately 30 people were evacuated from the Borough and at least three medical episodes were reported.

The shuttle bus service on the island can be utilized during evacuation and stages in the Acme parking lot at 9600 Long Beach Boulevard in Long Beach Township.

The Borough supports its own public works and municipal building while Long Beach Township oversees the policing functions of the Borough. Since the island is only a few blocks wide, the ocean and bay fronts are easily accessible by anyone from anywhere in the Borough. This convenience is precisely what attracts so many vacationers this this area. On the contrary, this narrow swath of land with grid style streets could be the ingredients for impacts and damage from coastal hazards such as storm surge and Sea Level Rise. Historically, Barnegat Light, due to elevation and the existing natural sedges, does not see the level of flooding within the Borough as other parts of the island may experience. Based on the latest Preliminary Work Maps released by the Federal Emergency Management Agency, the majority of Barnegat Light lies within the 100-year floodplain and field inspections indicate that most unmitigated residential development sits at 6 FT feet or below in elevation in relationship to mean sea level. Therefore, a Category 1 hurricane, an intense extra tropical system like Super Storm Sandy or even a Nor'easter all pose a significant threat to this community but no significant impacts have been experienced in recent time. The fishing fleet, for example, which lies near the Barnegat Inlet was not impacted physically but was significantly impacted economically as the commercial boats remained intact but the more than 250 people employed by the fishing industry had no way to get to the docks as the communities to the south were dealing with destroyed infrastructure.

Since Sandy's impact in 2012, and even prior to, residents of this seashore community have noticed to more frequent flooding especially along Bayview Avenue. Any or all of these influences can cause nuisance flooding in the Borough. Described as a nuisance because the flooding typically impacts the streets and disrupts daily activity such as driving or accessing local businesses on foot, it often can cause more significant problems such as flood water intrusion into residential garages, first floors of businesses and can be problematic for traffic attempting to navigate these floodwaters. In particular in Barnegat Light, if flooding is occurring on other parts of the island, all traffic in Barnegat Light will need to travel south through Harvey Cedars, Surf City and Long Beach Township to utilize Ship Bottom as their point of evacuation via 8th and 9th Streets to the Manahawkin Bay Bridge. Even so, if evacuation due to an impending storm isn't required, nuisance flooding associated with Sea Level Rise can impact those in Barnegat Light from traveling out of the Borough. It should be noted that there is no large scale grocery store in the Borough and many services and conveniences are located elsewhere on the island or on the mainland therefore necessitating the need to leave the Borough.

This Coastal Vulnerability Assessment will specifically evaluate the Borough's level of exposure of its built environment, natural environment and social environment to storm surge related to a Category 1, 2 and 3 storm events as well as 1 FT, 2 FT and 3 FT of anticipated Sea Level Rise. During a recent discussions with Borough leaders regarding flooding events and a US Army Corps

of Engineers Back Bay Flooding Feasibility Study that is underway, these factors were agreed to be the most serious when determining coastal vulnerability of the Borough.

Vulnerability Assessment Introduction

The Borough of Barnegat Light was awarded a grant by the New Jersey Department of Environmental Protection (Department), Division of Coastal and Land Use Planning, with funding through a grant awarded by the National Oceanic and Atmospheric Administration, of the U.S. Department of Commerce, to support the development of a Coastal Vulnerability Assessment (CVA) Report. A Coastal Vulnerability Report is intended to provide coastal communities with the ability to assess their vulnerability to coastal hazards and then identify opportunities to address those mapped concerns.

In addition, the five (5) other municipalities that make up Long Beach Island (LBI) are also analyzing their risks and vulnerabilities to coastal hazards under this program. In doing so and the Department understanding the interconnected resources and challenges the barrier island must contend with during times of significant weather events or federally declared disasters, the Department recommended the development of a Regional Coastal Vulnerability Assessment, which was accepted by all communities, and will address regional hazards and provide recommendations for the barrier island as a whole entity. The Department's objective with promoting a regional CVA Plan is to increase the resiliency of each municipality through consideration of the coastal hazards challenges and potential solutions of the entire island.

An associated component of assessing the Borough's vulnerability was to complete the Getting to Resilience Questionnaire with the technical assistance and support of Jenna Gatto and Lisa Auermuller of the Jacques Cousteau National Estuarine Research Reserve (JC NERR). The GTR questionnaire was initially developed and piloted by the NJDEP's Office of Coastal Management to foster municipal resiliency when confronted with coastal hazards and contains linkages, mitigation and adaptation actions to reduce vulnerability and increase preparedness. At a later date, the GTR process was adapted by the Coastal Training program at JC NERR, converted into a digital format, and placed on an interactive website. JC NERR then added additional linkages to the National Flood Insurance Program's Community Rating System (CRS), Hazard Mitigation Planning and Sustainable Jersey. Jenna Gatto, the region's Community Resilience Specialist, was able to meet with each municipality over the course of at least 2 meetings and provide community specific recommendations based on the outcomes of the questionnaire. All stakeholders are in agreement that this step was an ideal launch pad into the investigation of municipal coastal vulnerability.

Methodology

As noted above, the Borough of Barnegat Light received a grant from the NJDEP to complete the GTR process, a Municipal Public Access Plan and a Coastal Vulnerability Assessment. The CVA was developed by Owen, Little and Associates, Inc. (OLA) team of Land Use and Natural Hazard Mitigation Planners, Civil Engineers, GIS Specialists and Certified Floodplain Managers as well as

numerous stakeholders from the community including government officials and residents. This firm, Owen, Little & Associates, Inc., holds the professional appointment as Borough Engineer for the community of Barnegat Light and has done so for several years. With that, the office has accumulated a significant amount of data that was beneficial and valuable to this process such as base mapping and shapefiles attributed to the built environment including critical facilities and evacuation routes. This already obtained information allowed for an in-field update of the data to be required instead of a new inventory. However, numerous shapefiles had to be created for data sets such as those for water infrastructure. In coordination with JCNERR and assistance from Jennifer Rovito, GISP, at the Environmental Analysis and Communications Group of Edward J. Bloustein School of Planning and Public Policy, Rutgers University, provided data sets including those for Sea Level Rise and storm surge associated with the category 1, 2 and 3 hurricane.

It is important to note that although the Sandy Surge extent depicted on the maps appears to be severe, it has been noted by members of the community that the surge extent did not extend as far as shown. For example, portions of Bayview Avenue did flood but the entire road did not see water. In addition, the maps show water reaching as far as Central Avenue which was not documented on the ground. Water did breach the bay beach at 25th Street as well as the boat ramp at 10th Street and water did reach the roadway. Viking Village did also experience some inundation and some of the small stores did experience water intrusion. It is our understanding that no significant damage resulted and no flood insurance claims were paid as the result of any losses. Noted instances of damage resulted from wind only.

Review of elevation data and the high water marks provided by the USGS suggests that it is possible water did reach Central Avenue, with the varying differences of proof, and the notion that the tide occurred at night and likely receded quickly, it will take additional research to clearly define the surge extent of Superstorm Sandy.

Review of the SLOSH models for a Category 1 Hurricane in Barnegat Light indicate that flooding should be expected to be less expansive when compared to the flooding extent *shown on the map* of Superstorm Sandy, however, with local knowledge prevailing, we question the validity of the actual surge extent as explained above. Potential impacts appear to increase exponentially the stronger the storm event. A Category 3 Storm event would likely be catastrophic to the bayside areas and impacts will be felt throughout the community.

Also, scientists expect this area to be impacted by 1.5 FT of Sea Level Rise prior to 2050. As Sea Level Rise is anticipated to accelerate due to shrinking land ice and thermal expansion, scientists anticipate that that 3.5 FT of Sea Level Rise is very likely before 2100.

	Sea-level rise (feet)		
	Global	Bedrock	Shore
2030 central	0.5	0.7	0.8
2030 low	0.3	0.5	0.6
2030 high	0.7	1	1.1
2030 higher	0.9	1.2	1.4
2050 central	0.8	1.3	1.5
2050 low	0.5	0.9	1.1
2050 high	1.3	1.8	1.9
2050 higher	1.6	2.1	2.3
2100 central	2.5	3.1	3.5
2100 low	1.4	2.2	2.5
2100 high	4	4.6	4.9
2100 higher	4.6	5.5	5.9
2100 collapse	8.7	9.7	10

NJ sea level rise projection ranges and best estimates. K.G. Miller, R.E. Kopp, B.P. Horton, J.V. Browning and A.C. Kemp, 2013, A Geological Perspective on Sea Level Rise and its Impacts along the U.S. Mid Atlantic Coast. Earth's Future 1:3-18, doi:10.1002/2013EF000135

Tides

General tidal fluctuations along the Borough's bay shore, is from elevation -1.0 to elevation +1.5, or so; spring tides are as high as 2.0. Occasionally, maybe once a month, a "blow-out" low tide caused by high pressure and off-shore winds is recorded around elevation -1.5 or lower. Higher tide ranges are experienced at the time of full moons ("spring tides"), and tend to be greater in the winter months when the earth is closer to the moon.

More ominously, storm surge may accompany any severe coastal storm where an extreme low pressure system develops. With some storms a constant easterly wind will "stack up" the ocean waters, causing higher tides, which prevents the bay from emptying out the inlet, and back bay flooding occurs. Stronger and more persistent on-shore winds will mean higher and higher tides. This tends to happen up to four or more times a year and can reach elevations 3 or 4, or higher, flooding roadways and structures constructed close to grade. Being that the Borough lies at the southern side of the Barnegat Inlet and sees the immediate impacts from surges and tide relief, the Borough is spared from the extreme surge or tidal flooding events.

The U.S. Geological Survey (U.S.G.S.) recorded Superstorm Sandy's High Water Mark at 5.3 FT near the Barnegat Lighthouse in the northernmost portion of the Borough. Meanwhile, the tide

gauge at Route 72 failed at the height of the event but was estimated to have reached just under 6.5 FT. With ground surface elevations averaging around 5 to 6 FT, damage was very minimal. All elevations stated in this study are in feet and based on NAVD 1988.

Land Coverage and Topography

General topography of the areas west of Central Avenue is flat, with surface grades of 1 to 2 percent and road grades being even less. In order to achieve drainage flow, the roads have a "see-saw" profile, where low points are created every other block or so. These low areas create pockets, where storm water collects and will be subject to flooding when excessive rainfall, tidal tail water or debris clogging may occur. Where streets have been repaved or overlaid, due to the shallow gutter grades, puddling may occur and runoff is not able to reach the inlets.

Areas to the east of Central Avenue generally are sloped upward towards the Ocean. Elevation change ranges from 4 to 5 feet at the bay area to 14 feet at the eastern street-ends by the beaches.

Stormwater Collection and Disposal

Natural drainage ways exists within the Borough mainly along Bayview Avenue. Most of the Borough has been built on filled lands but wetland and sedge areas remain along the bayfront on Bayview Avenue.

In areas where the Bayfront properties were filled, stormwater runoff from these properties and streets does not naturally drain over the surface into the Manahawkin Bay and instead the stormwater is conveyed to the bay by drainage collection systems.

All of the collected runoff is directed westward through piping systems towards the Bay and outlets through the street-end bulkheads. These drainage collection systems are gravity flow pipe systems, sloping from east to west within the road right-of-ways.

As the Borough grew over the years, the development of the drainage collection system has appeared to be mostly unplanned, and has progressed in a piggyback fashion, with later areas of development simply connecting to the earlier systems, with little upgrade in capacity. Some of the pipe systems may be over 80 years old, and are undersized by today's engineering standards.

It should be noted that the ownership and responsibility for stormwater collection systems are shared by the Borough and Ocean County.

Sea Level Rise Vulnerability

Sea Level Rise is a documented threat to the Borough of Barnegat Light and the change in Sea Level Rise has been validated by members of the community over the years. The impending sea level will rise, due to glacial and ice sheet melting, and the risk of flooding will also increase due to the anticipated impacts from storms which may be more severe and more frequent. The

historical rate of Sea Level Rise along the New Jersey coast over the past half century was 3-4mm/year or 0.12-0.16 in/year and these rates are expected to increase. In the recent publication entitled "A Geological Perspective on Sea-Level Rise and its Impacts along the U.S. Mid-Atlantic Coast", authors Miller and Kopp state that in the year 2050, the best estimate for Sea Level Rise is 1.5 FT along the Jersey Shore. By the year 2100, the best estimate for Sea Level Rise is 3.5 FT along the same coast. In this context, the term "best" refers to a 50% likelihood of that extent of sea-level rise occurring.

Barnegat Light can expect to see the impacts of Sea Level Rise by about 2065 when 2 FT of rise is anticipated. Areas without bulkheading along Bayview Avenue are most vulnerable as they are not secured by structural barriers and are the first areas to flood during storm events. Three (3) feet of Sea Level Rise will impact all of Bayview Avenue but will not affect the most critical facilities such as wells, the fire department, first aid building and gas station. During Superstorm Sandy, the gas station on Central Avenue near 18th Street was critical as its generator allowed servicing of customers to obtain gas for their personal vehicles and generators. In addition, the distance between Barnegat Light and Ship Bottom is at least nine (9) miles which requires those at the northern part of the island to rely on this station for fuel.



Built Environment

Barnegat Light is a coastal resort community located on Long Beach Island, a barrier island, in southern New Jersey and offers an array of residential housing options, several retail and dining establishments and numerous parks and public access points to the ocean and bayfront all of which make this Borough a sought after destination for vacationers and a highly desirable area in which to live seasonally or year-round. There are approximately 27 blocks south to north, and 3 to 4 blocks from the Bay to the Ocean (east to west). The total land area of the Borough is approximately 0.852 square miles. As of May 2010, the borough had a total of 11.48 miles of roadways, of which 7.46 miles were maintained by the Borough and 4.02 miles by Ocean County.

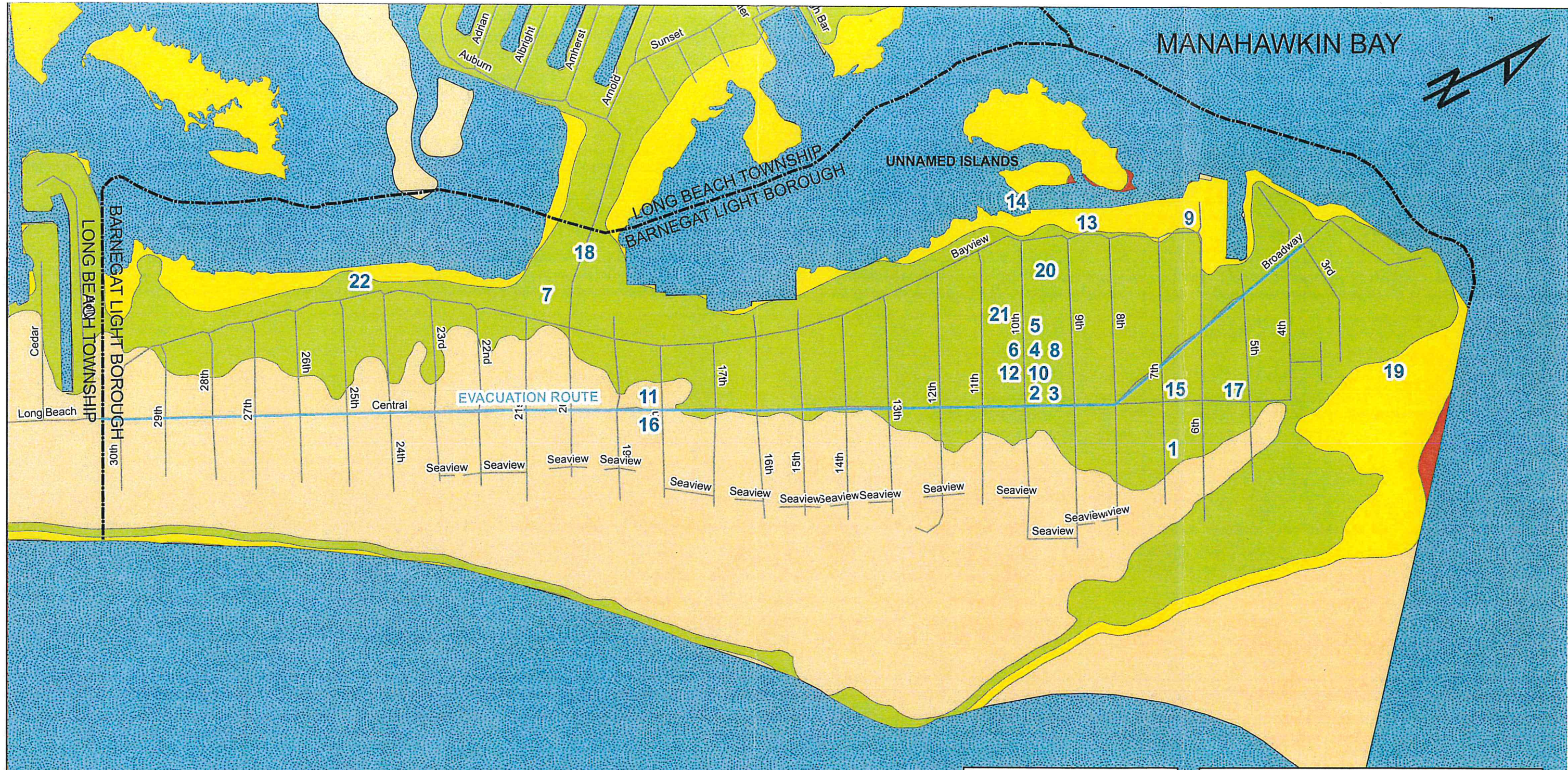
At the time of the 2010 United States Census, there were 574 people, 274 households, and 184.1 families residing in the borough. The population density was 785.1 per square mile and there were 1282 housing units at an average density of 1753.6 per square mile. The flux in population season to season greatly affects the economic, social and physical makeup of the Borough and it's often the year-round residents whom are most affected by these conditions. The summer population can reach 10,000 people or more. Barnegat Light is considered a fully developed municipality, with the exception of in-fill lots for redevelopment.

After the Storm of 1962, the Borough purchased a large extent of oceanfront property for the purpose of preservation and protection. Then in 2008, the Borough passed a referendum to permit a one cent Open Space Tax on property owners with the goal of sustaining a fund that would permit the acquisition of additional land in the Borough for public use should parcels become available. The tax generates approximately \$100,000 per year in revenue. In 2015, the last piece of open space became available and the Borough spent more than \$3,000,000.00 of tax payer funds to purchase the land which was the two (2) acre site of the former U.S. Coast Guard Barracks located at the Bayview Avenue and Sixth Street. If not preserved, the land would have supported the construction of 12 homes and been a negative detriment to the community. The Borough plans to use the site as a recreational area. Although not directly on tidal water, this parcel lies directly across the roadway and provides ample views of the waterfront. Barnegat Light prioritizes open and greenspace.

The Borough is unique in that it is accessible via only one (1) causeway which also serves five other municipalities. Increased vehicle and pedestrian traffic are concerns for this small community especially during the prime summer months when many vacationers are using the unfamiliar roads to drive, walk or ride bicycles. The grid-style road network in Barnegat Light and the composition of its blocks are essential for being able to provide multiple means egress during times of evacuation to the Manahawkin Bay Bridge.

There are many older homes and businesses, built prior to the March, 1962 Great Storm, that are not elevated or on pilings, and are only slightly above the existing street elevation. In past years, many homes have been elevated, but the remaining properties at grade elevation are susceptible to the threat of flooding from both tidal and rainfall events. Although these raised homes will be protected from floodwaters, they often provide a false sense of personal security as the surrounding infrastructure or communities will still be inundated. So although the habitable floors of the structure may not be impacted, a person's ability to leave will be.

Maps indicate that approximately 40% of the community is susceptible to storm surge inundation of a Category 1 hurricane, and most of the community will likely be affected by some extent of coastal flooding by a Category 2 storm. A Category 3 hurricane will be catastrophic to the Borough and evacuation from the Borough by land through all municipalities to the south will be impossible.



ATLANTIC OCEAN

MANAHAWKIN BAY



STORM SURGE LEVEL

	0-3 FEET
	3-6 FEET
	6-9 FEET
	>9 FEET

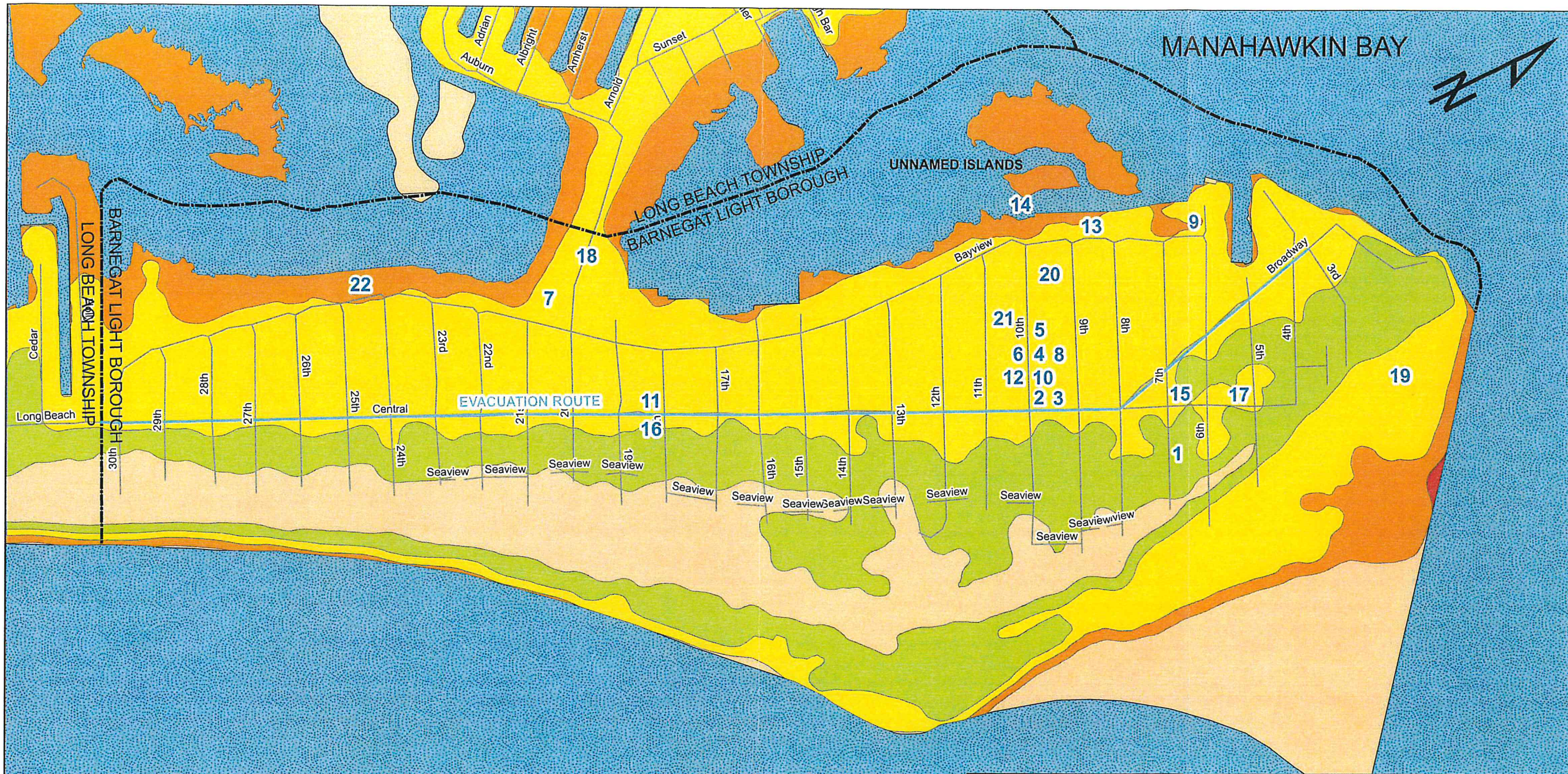
- 1 - BOROUGH HALL
- 2 - FIRE DEPARTMENT
- 3 - FIRST AID
- 4 - WATER DEPT./PUBLIC WORKS YARD
- 5 - WELL #2
- 6 - WELL #3
- 7 - WELL #4
- 8 - STAGING AREA
- 9 - U.S. COAST GUARD STATION
- 10 - MAINTENANCE BUILDING
- 11 - GULF GAS STATION
- 12 - POST OFFICE
- 13 - PUBLIC DOCK
- 14 - PUBLIC BOAT RAMP
- 15 - ST. PETER'S EPISCOPAL CHURCH
- 16 - ZION LUTHERAN CHURCH
- 17 - BARNEGAT LIGHT MUSEUM
- 18 - ACCESS TO HIGH BAR HARBOR
- 19 - BARNEGAT LIGHT STATE PARK
- 20 - BASEBALL FIELD
- 21 - BASKETBALL/TENNIS COURTS
- 22 - BAYVIEW PARK

BARNEGAT LIGHT BOROUGH

**COASTAL VULNERABILITY ASSESSMENT
BUILT ENVIRONMENT VULNERABILITY
CATEGORY 1 STORM**

0 350 700 1,400 Feet

Owen, Little and Associates, Inc.
443 Atlantic City Boulevard
Beachwood, NJ 08722
(732)244-1090



MANAHAWKIN BAY



ATLANTIC OCEAN

STORM SURGE LEVEL

	0-3 FEET
	3-6 FEET
	6-9 FEET
	>9 FEET

- 1 - BOROUGH HALL
- 2 - FIRE DEPARTMENT
- 3 - FIRST AID
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- 22 - BAYVIEW PARK

BARNEGAT LIGHT BOROUGH

**COASTAL VULNERABILITY ASSESSMENT
BUILT ENVIRONMENT VULNERABILITY
CATEGORY 2 STORM**

0 350 700 1,400 Feet

Owen, Little and Associates, Inc.
443 Atlantic City Boulevard
Beachwood, NJ 08722
(732)244-1090

MANAHAWKIN BAY

MANAHAWKIN BAY



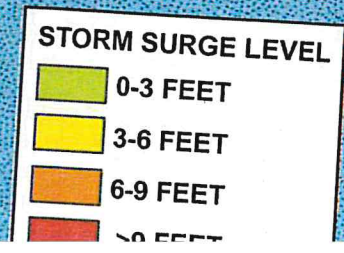
LONG BEACH TOWNSHIP
BARNEGAT LIGHT BOROUGH

UNNAMED ISLANDS

BARNEGAT LIGHT BOROUGH
LONG BEACH TOWNSHIP

ATLANTIC OCEAN

EVACUATION ROUTE



- 1 - BOROUGH HALL
- 2 - FIRE DEPARTMENT
- 3 - FIRST AID
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- 21 - BASKETBALL COURT

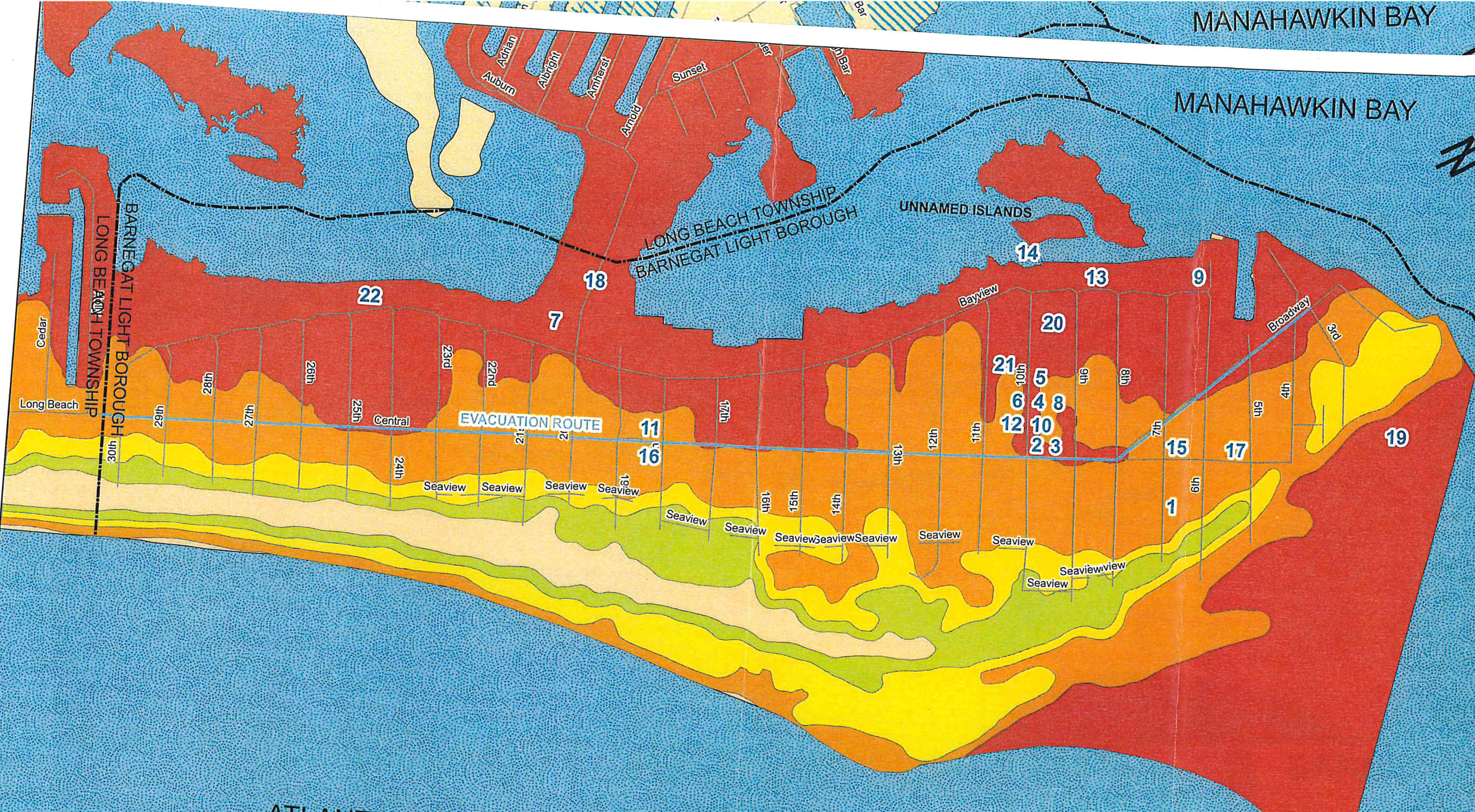
BARNEGAT LIGHT BOROUGH

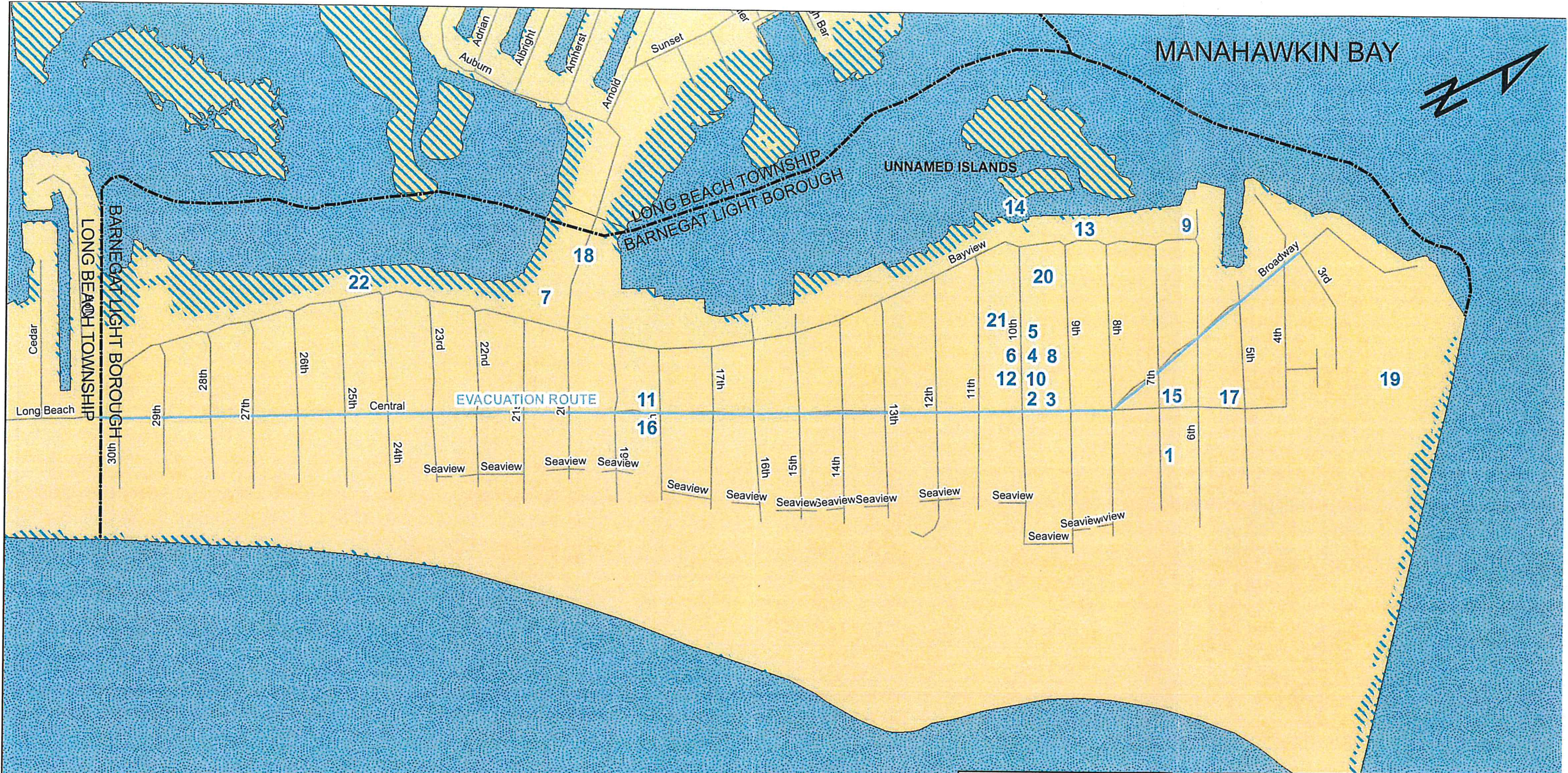
**COASTAL VULNERABILITY ASSESSMENT
BUILT ENVIRONMENT VULNERABILITY
CATEGORY 3 STORM**

Feet

0 350 700 1,400

Owen, Little and Associates, Inc.





ATLANTIC OCEAN

MANAHAWKIN BAY

- 1 - BOROUGH HALL
- 2 - FIRE DEPARTMENT
- 3 - FIRST AID
- 4 - WATER DEPT./PUBLIC WORKS YARD
- 5 - WELL #2
- 6 - WELL #3
- 7 - WELL #4
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SEA LEVEL RISE

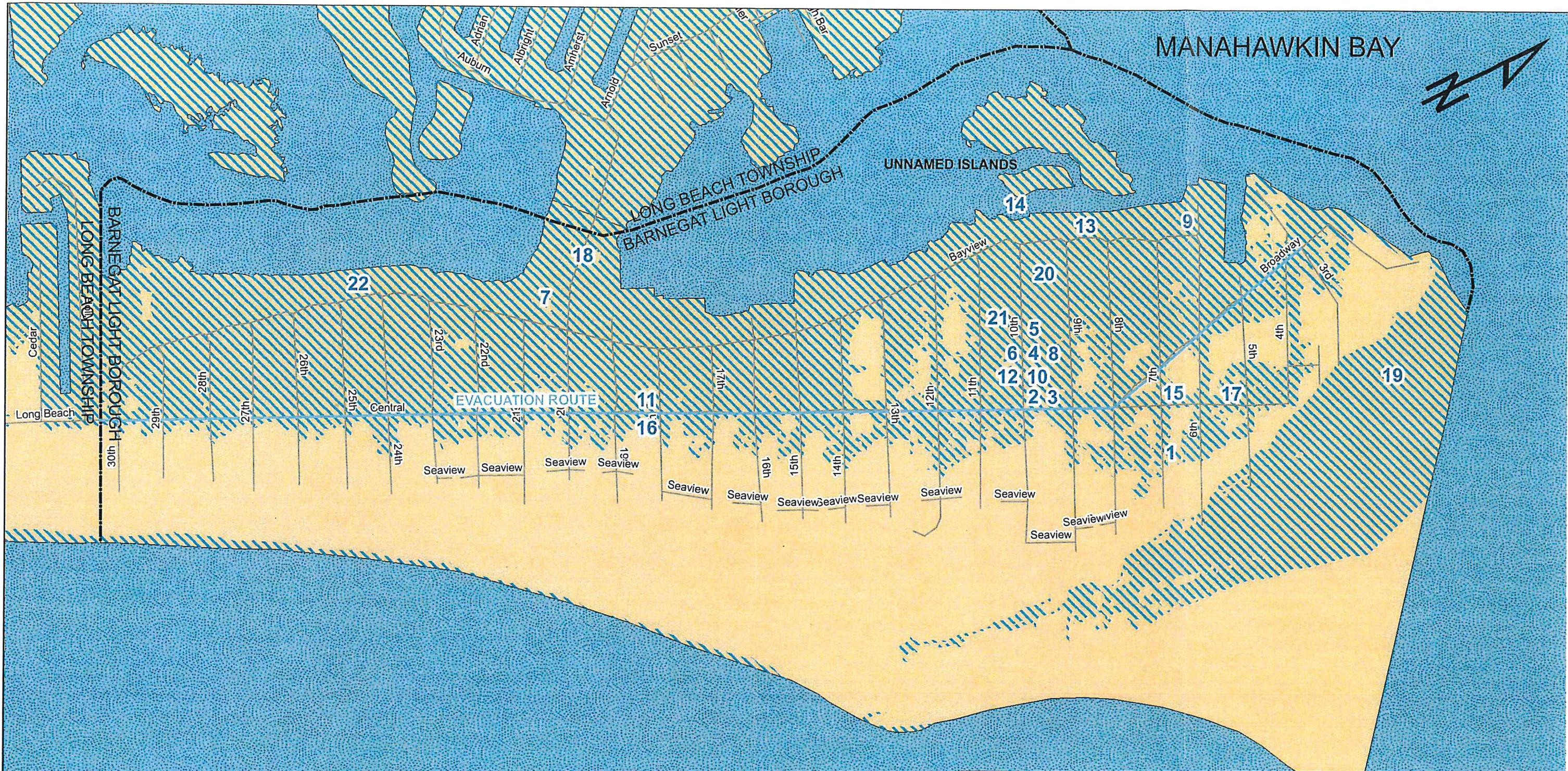
BARNEGAT LIGHT BOROUGH

**COASTAL VULNERABILITY ASSESSMENT
BUILT ENVIRONMENT VULNERABILITY**

ANTICIPATED SEA LEVEL RISE (1 FOOT)

0 350 700 1,400 Feet

Owen, Little and Associates, Inc.
443 Atlantic City Boulevard
Beachwood, NJ 08722
(732)244-1090



MANAHAWKIN BAY



ATLANTIC OCEAN

- 1 - BOROUGH HALL
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STORM SURGE

BARNEGAT LIGHT BOROUGH

**COASTAL VULNERABILITY ASSESSMENT
BUILT ENVIRONMENT VULNERABILITY
SUPERSTORM SANDY - STORM SURGE**

0 350 700 1,400 Feet

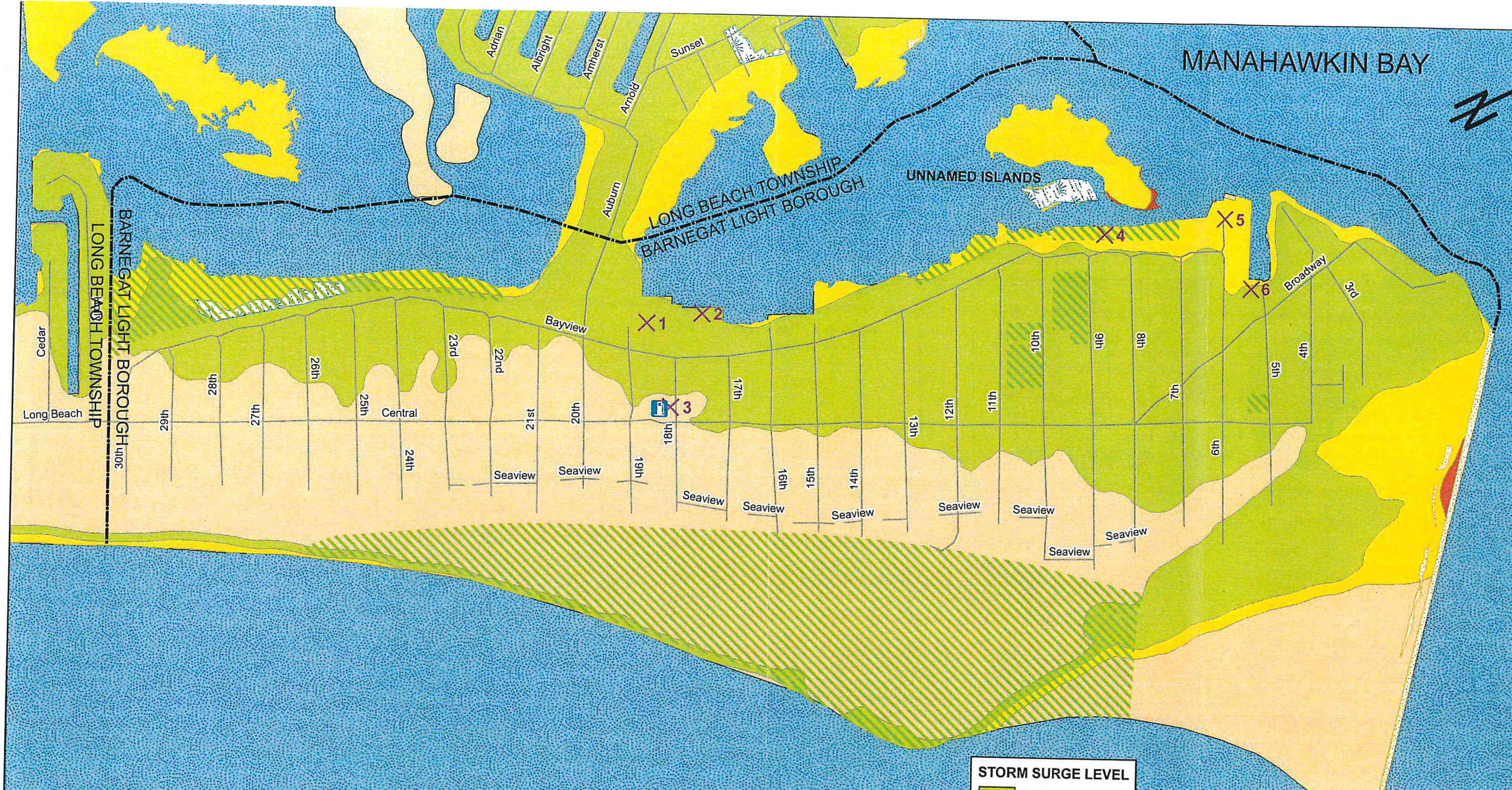
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Natural Environment

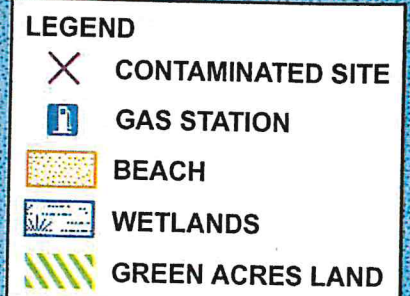
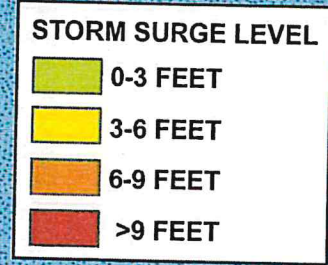
Barnegat Light's location on the barrier island between the Atlantic Ocean and the Barnegat Bay provide ideal habitat for wildlife and native plant species. The wide beaches, as the result of Borough land acquisition after the 1962 storm, are known to attract state and federally listed endangered species including nesting birds, plants and insects. The bayside areas are also lined with natural wetlands which are susceptible to both Sea Level Rise and storm surge. This wetlands area will be completely impacted with 2 Feet of Sea Level Rise. By approximately 2085, 3 Feet of Sea Level Rise will likely impact sections of Broadway as well as the Coast Guard Station. Also, Viking Village and the associated fishing fleet, being the central hub for commerce in the Borough, should be closely monitored in the future for impacts from Sea Level Rise.

The continued threat of storms reinforced concerns about the stability of Barnegat Light's beaches. The construction of the existing jetty in the 1990s added a substantial amount of land to the community, much of which has been designated as parkland and the jetty has provided stabilization to the shoreline along the inlet, but requires frequent dredging. In fact, the Army Corps of Engineers (ACOE) has undertaken a project involving the Barnegat Inlet and associated channels. The project was started Per the ACOE *"The project provides for a channel 8 FT deep through the inlet and 10 FT deep through the outer bar, a channel of suitable hydraulic characteristics extending in a northwesterly direction from the inlet gorge to Oyster Creek channel and through the latter channel to deep water in the bay, and the maintenance of a channel 8 FT deep and 200 FT wide to connect Barnegat Light Harbor with the main inlet channel. The project has two rubble-mound jetties. The project length is about 4.5 miles as described above. It was originally completed in 1940, but the Supplemental Appropriation Act of 1985 contained language stating that the existing project had not worked as projected and, in fact, created a hazard to navigation. As a result, the following administratively approved modifications were constructed in 1991 as design deficiency measures: a new south jetty 4,270 feet in length along an alignment generally parallel to the existing north jetty, a navigation channel 300 feet wide to a depth of 10 feet below mean low water from the outer bar in the Atlantic Ocean to the north end of the existing sand dike in Barnegat Bay. The purpose of this project provides for a channel through the inlet and through the outer bar, a channel of suitable hydraulic characteristics extending in a northwesterly direction from the gorge in the inlet to Oyster Creek channel and through the latter channel to deep water in the bay, and the maintenance of a channel to connect Barnegat Light Harbor with the main inlet channel. The project also provides for protecting the inlet channel with two converging stone jetties."*

MANAHAWKIN BAY



ATLANTIC OCEAN




- CONTAMINATED SITES**
- 1 - VIKING VILLAGE INC.
 - 2 - BARNEGAT LIGHT YACHT BASIN
 - 3 - FRIENDLY MANAGEMENT CO.
 - 4 - ED'S BOAT RENTALS
 - 5 - U.S. COAST GUARD STATION
 - 6 - LIGHTHOUSE MARINA

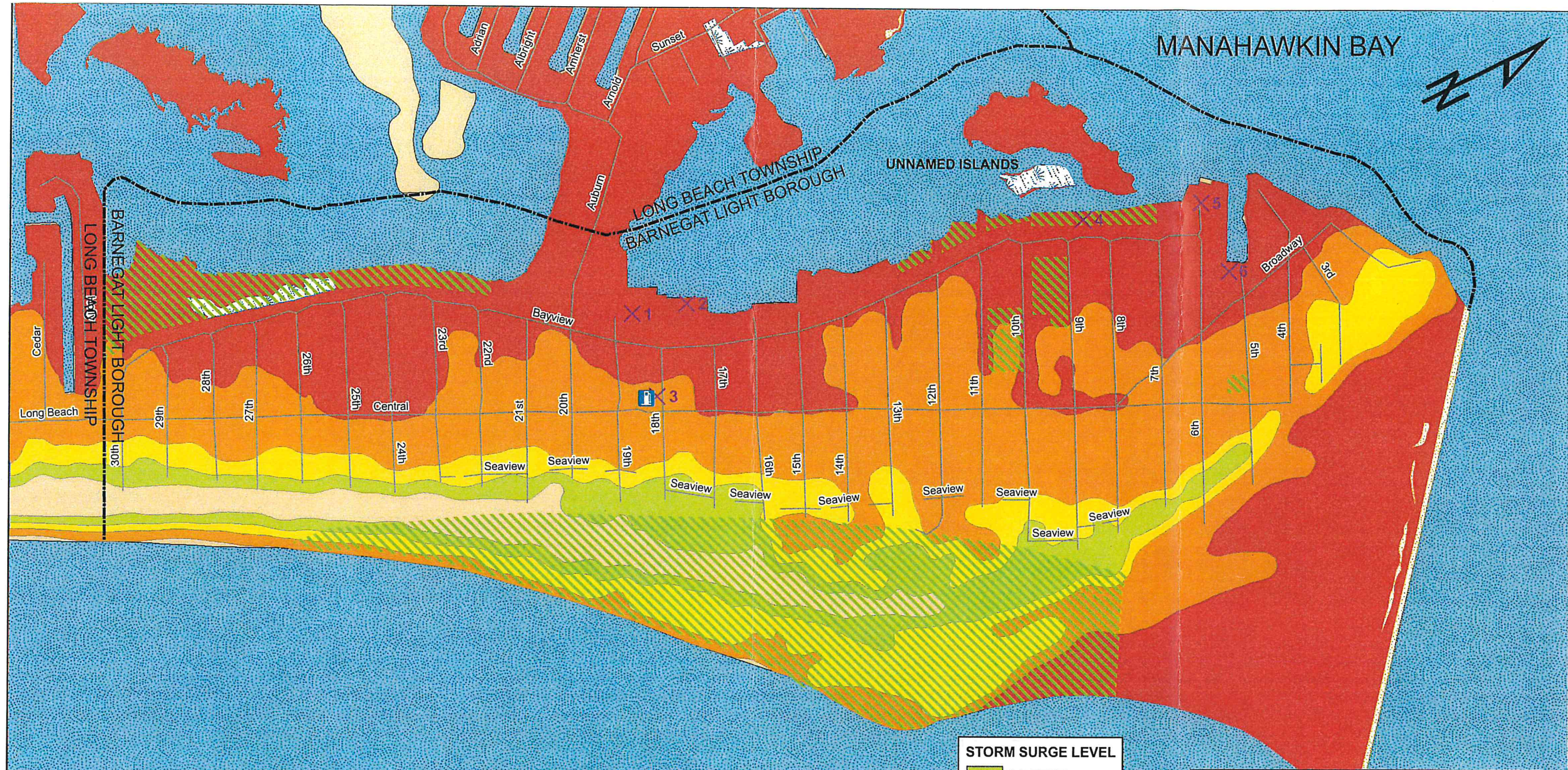
BARNEGAT LIGHT BOROUGH

COASTAL VULNERABILITY ASSESSMENT
NATURAL ENVIRONMENT VULNERABILITY
CATEGORY 1 STORM

0 350 700 1,400 Feet

Owen, Little and Associates, Inc.
 443 Atlantic City Boulevard
 Beachwood, NJ 08722
 (732)244-1090





MANAHAWKIN BAY

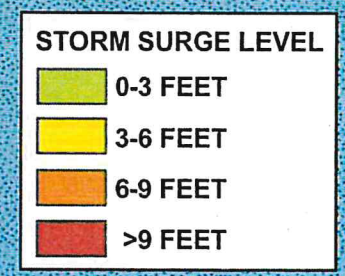


LONG BEACH TOWNSHIP
BARNEGAT LIGHT BOROUGH

UNNAMED ISLANDS

LONG BEACH TOWNSHIP
BARNEGAT LIGHT BOROUGH

ATLANTIC OCEAN



- CONTAMINATED SITES**
- 1 - VIKING VILLAGE INC.
 - 2 - BARNEGAT LIGHT YACHT BASIN
 - 3 - FRIENDLY MANAGEMENT CO.
 - 4 - ED'S BOAT RENTALS
 - 5 - U.S. COAST GUARD STATION
 - 6 - LIGHTHOUSE MARINA

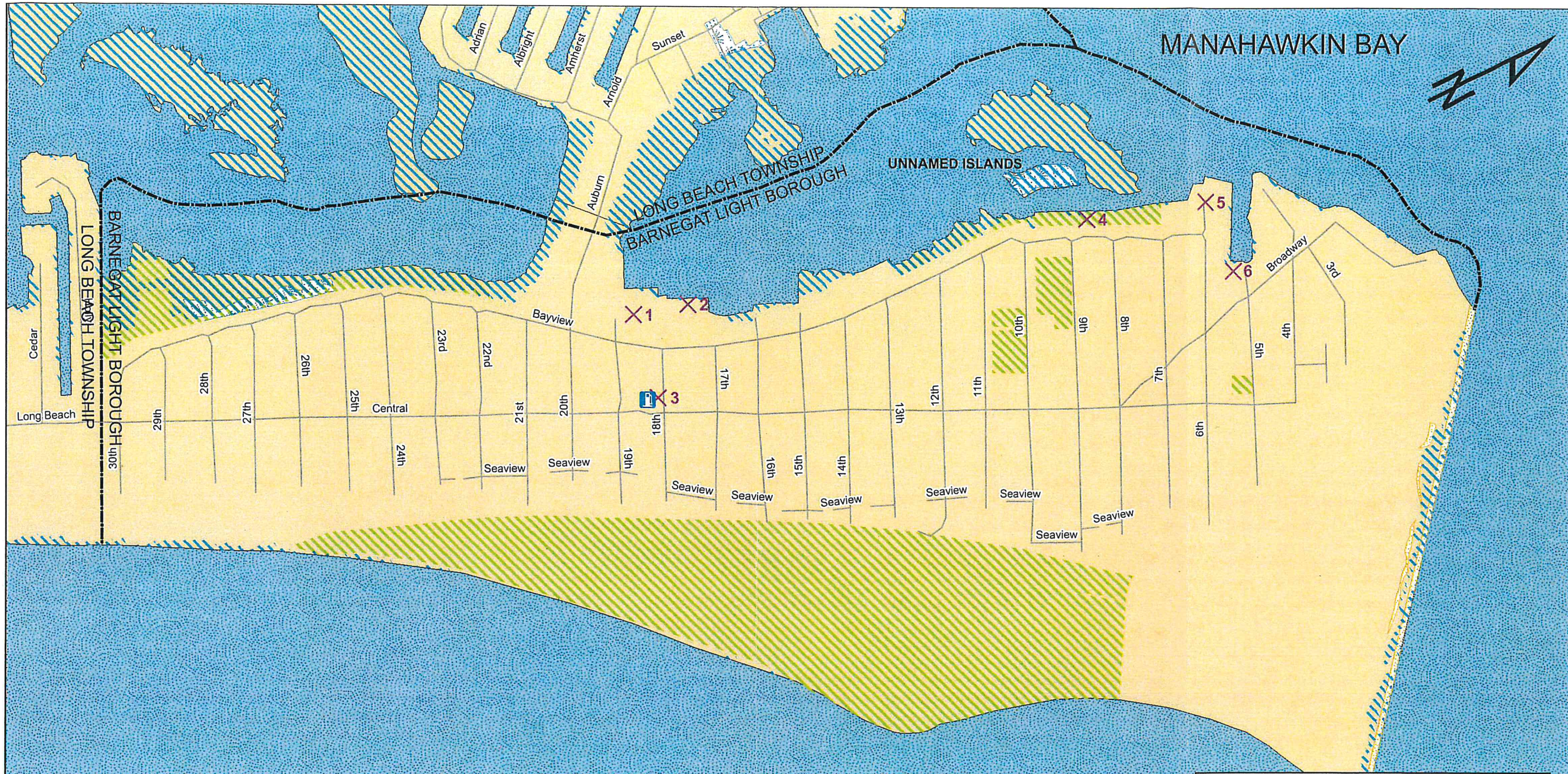
- LEGEND**
- CONTAMINATED SITE
 - GAS STATION
 - BEACH
 - WETLANDS
 - GREEN ACRES LAND

BARNEGAT LIGHT BOROUGH

COASTAL VULNERABILITY ASSESSMENT
NATURAL ENVIRONMENT VULNERABILITY
CATEGORY 3 STORM

0 350 700 1,400 Feet

Owen, Little and Associates, Inc.
443 Atlantic City Boulevard
Beachwood, NJ 08722
(732)244-1090



MANAHAWKIN BAY

ATLANTIC OCEAN

BARNEGAT LIGHT BOROUGH

**COASTAL VULNERABILITY ASSESSMENT
NATURAL ENVIRONMENT VULNERABILITY**

ANTICIPATED SEA LEVEL RISE (1 FOOT)

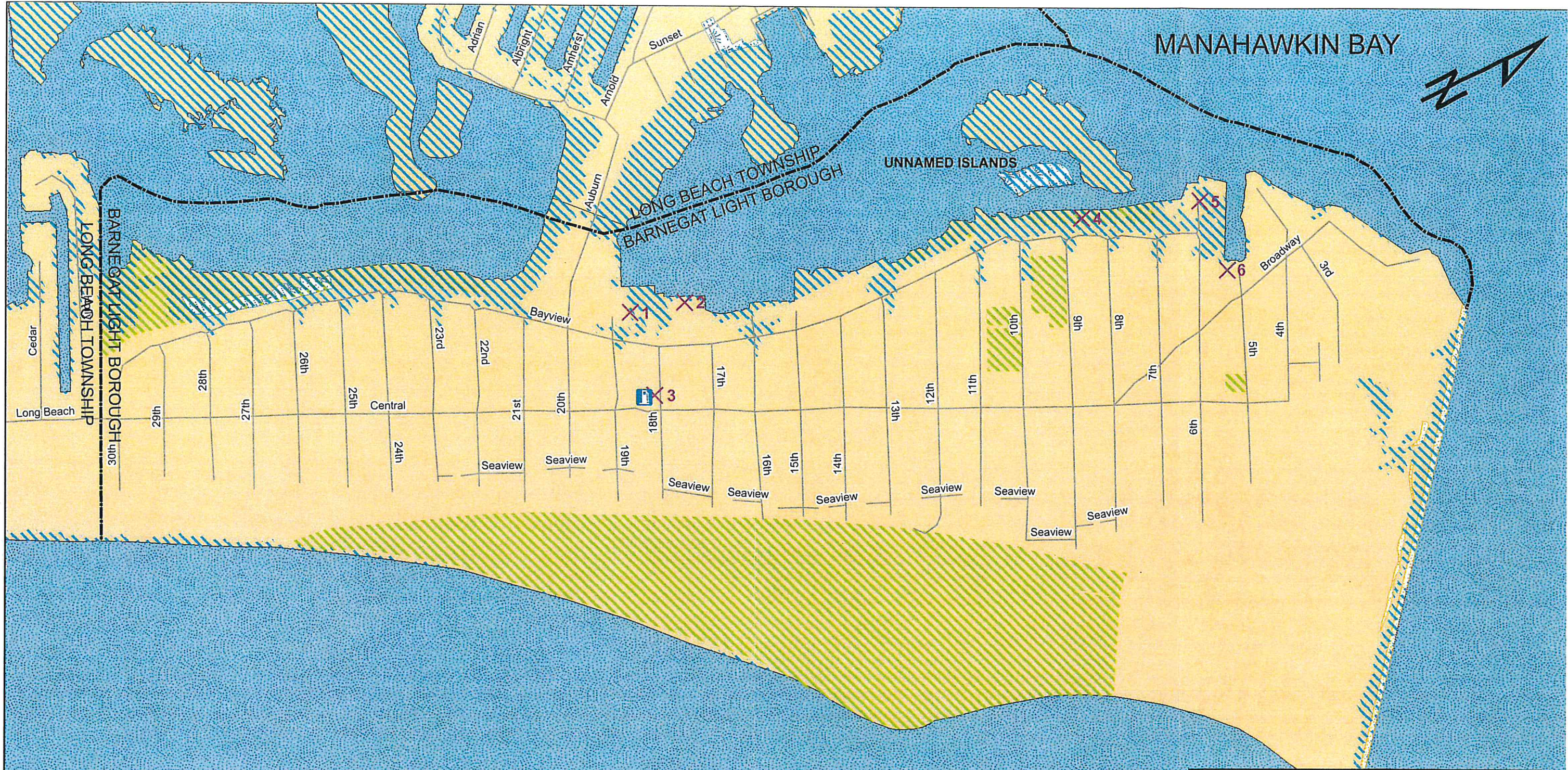
0 350 700 1,400 Feet

Owen, Little and Associates, Inc.
443 Atlantic City Boulevard
Beachwood, NJ 08722
(732)244-1090

- CONTAMINATED SITES**
- 1 - VIKING VILLAGE INC.
 - 2 - BARNEGAT LIGHT YACHT BASIN
 - 3 - FRIENDLY MANAGEMENT CO.
 - 4 - ED'S BOAT RENTALS
 - 5 - U.S. COAST GUARD STATION
 - 6 - LIGHTHOUSE MARINA

SEA LEVEL RISE

- LEGEND**
- CONTAMINATED SITE
 - GAS STATION
 - BEACH
 - WETLANDS
 - GREEN ACRES LAND



ATLANTIC OCEAN

MANAHAWKIN BAY

- CONTAMINATED SITES**
- 1 - VIKING VILLAGE INC.
 - 2 - BARNEGAT LIGHT YACHT BASIN
 - 3 - FRIENDLY MANAGEMENT CO.
 - 4 - ED'S BOAT RENTALS
 - 5 - U.S. COAST GUARD STATION
 - 6 - LIGHTHOUSE MARINA

SEA LEVEL RISE

- LEGEND**
- CONTAMINATED SITE
 - GAS STATION
 - BEACH
 - WETLANDS
 - GREEN ACRES LAND

BARNEGAT LIGHT BOROUGH

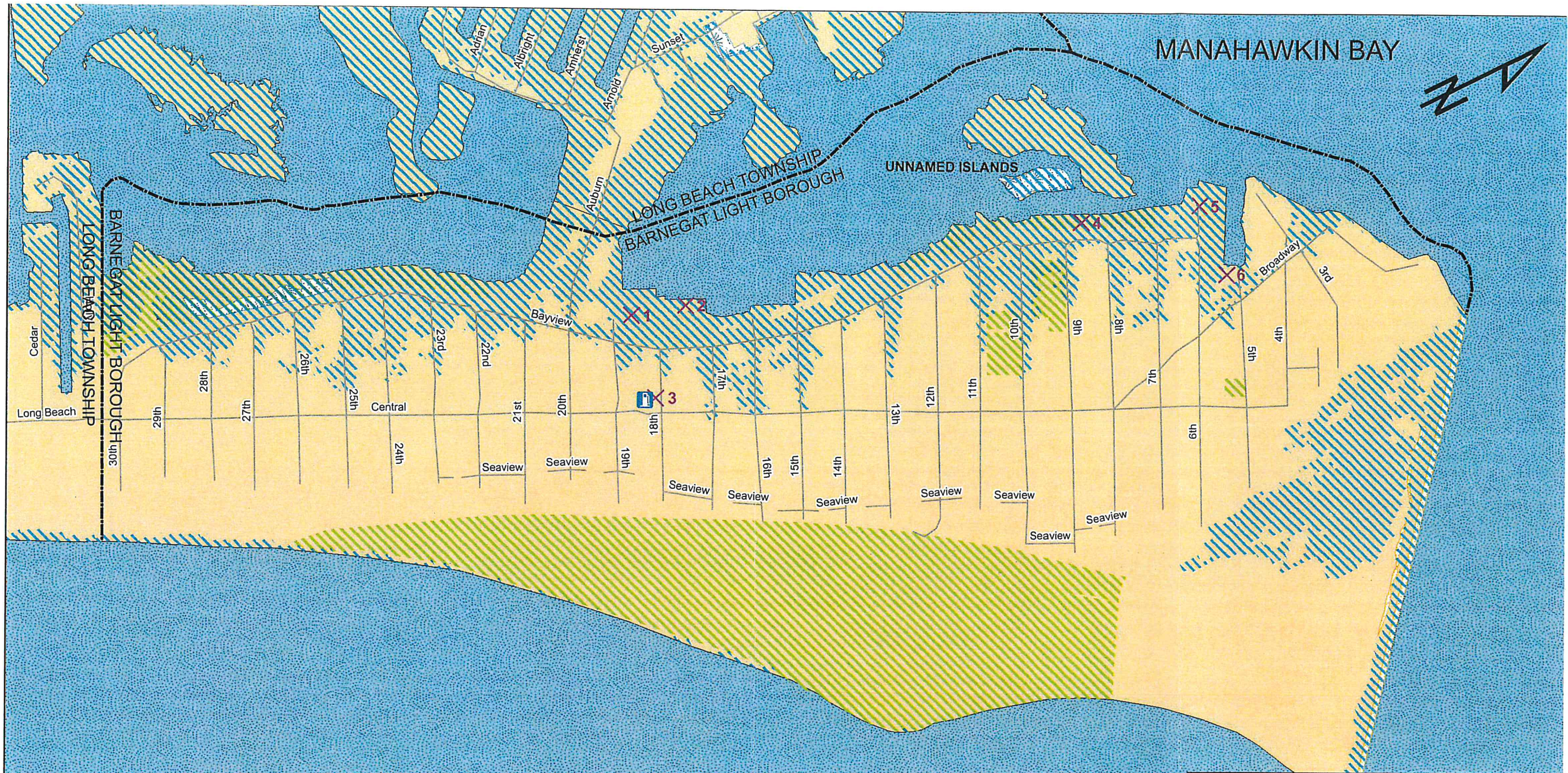
COASTAL VULNERABILITY ASSESSMENT
NATURAL ENVIRONMENT VULNERABILITY

ANTICIPATED SEA LEVEL RISE (2 FEET)

Feet

0 350 700 1,400

Owen, Little and Associates, Inc.
 443 Atlantic City Boulevard
 Beachwood, NJ 08722
 (732)244-1090



ATLANTIC OCEAN

MANAHAWKIN BAY

LONG BEACH TOWNSHIP
BARNEGAT LIGHT BOROUGH

UNNAMED ISLANDS

SEA LEVEL RISE

LEGEND
 X CONTAMINATED SITE
 G GAS STATION
 BEACH
 WETLANDS
 GREEN ACRES LAND

CONTAMINATED SITES
 1 - VIKING VILLAGE INC.
 2 - BARNEGAT LIGHT YACHT BASIN
 3 - FRIENDLY MANAGEMENT CO.
 4 - ED'S BOAT RENTALS
 5 - U.S. COAST GUARD STATION
 6 - LIGHTHOUSE MARINA

BARNEGAT LIGHT BOROUGH

COASTAL VULNERABILITY ASSESSMENT
 NATURAL ENVIRONMENT VULNERABILITY

ANTICIPATED SEA LEVEL RISE (3 FEET)

0 350 700 1,400 Feet

Owen, Little and Associates, Inc.
 443 Atlantic City Boulevard
 Beachwood, NJ 08722
 (732)244-1090

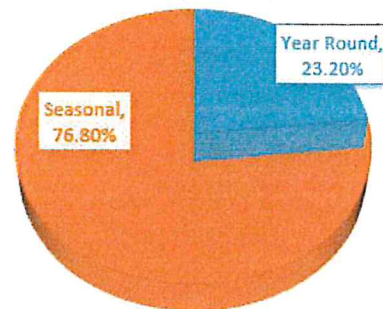
Social Environment

Barnegat Light is a seasonal community with approximately 574 year-round residents and upwards of 10,000 seasonal residents. The community is comprised of a diversified age range and over 41% of its population is 65 years or older. The census data also shows that of the 274 households in the Borough, 9.9% had children under the age of 18 living with them and the average family size was 2.48. In addition, the data indicates that 19.1% of households had someone living alone who was 65 years of age or older. The

analysis suggests that seasonal visitors likely pose the most risk in terms of general awareness and responsiveness as they may not be cognizant of their geographical location and the associated risk of flooding at their position. This is true especially in Barnegat Light where low lying areas and nuisance flooding associated with wind direction and heavy rainfall can quickly become problematic.

Initially, our team of Hazard Mitigation Planners intended to utilize the Social Vulnerability Index (SVI) prepared by the Agency for Toxic Substances and Disease Registry (ATSDR) a federal public health agency of the U.S. Department of Health and Human Services, based in Atlanta, Georgia, to analyze factors that contribute to a community's social vulnerability. These factors include socioeconomic status, household composition and disability, minority status and language as well as housing and transportation. The principal obstacle with the data set is its restriction to census block only which is a common theme amongst data sets for social factors. Although some communities can utilize field knowledge of the area to supplement the data set, it was determined by the team that the population and community is too small to see a diversity in the category range. With the Borough being less than one square mile, assigning a range would essentially provide a homogenous outcome.

BARNEGAT LIGHT HOUSING OCCUPANCY



Next, the team considered creating its own index, using information that may be obtained by the local Office of Emergency Management or Health Department, anticipating that this source may include homebound residents, those with a disability, or those without vehicles. However, the local agencies in this region no longer maintain a list like this. In addition, the team learned that

Social Vulnerabilities		
Housing		
	#	(%)
Total Housing Units	1259	100%
Occupied Housing Units	293	23.20%
Seasonal Use Only	966	76.80%
In group Quarters	0	0
Mobile Home Housing	0	0
Income		
Below Poverty level		4.00%
Median Household Income		\$80,703
Race		
	(%)	
Percent Minority	1.90%	
Speak only English	93.80%	
Age		
	(%)	
Age 5 and under	1.70%	
Age 17 and under	7.30%	
Age 65-74	17.60%	
Age 75 +	23.50%	

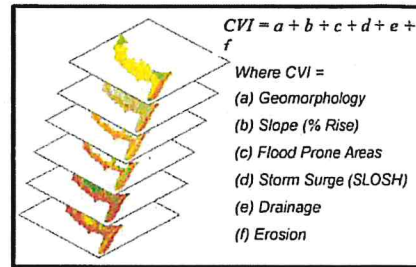
many people who may be considered vulnerable in a hazardous situation are reluctant to disclose this information to community officials. If the Borough was to initiate a survey such as this, it would have to be updated frequently as the needs of the contributors change frequently.

With such a small community, both in regards to size and year round population, and without a nursing home, assisted living facility, age restricted housing development or subsidized public housing projects, it's impossible to accurately measure social vulnerability in a map format. Community OEM Coordinators and other municipal officials have a greater understanding and capacity at the local level to assist those who may require additional assistance during a storm event.

Analysis of some social factors, shown above, indicate that there is not a clear year round population to which the Borough could seek additional outreach programs. Local knowledge indicates that the aging population has been in place in the Borough for decades and is familiar with storm events and the need to evacuate in a timely manner. In addition, during Superstorm Sandy, approximately 50% of the residents abided by the mandatory evacuation order and there were not significant cases of rescue during the event. The main cause of concern was the lack of functional utilities which did cause additional people to leave after the storm was over.

Coastal Vulnerability Index

By definition, a CVI allows for six variables to be related in a quantifiable manner that expresses the relative vulnerability of the coast to physical changes due to future sea-level rise or other coastal hazards ¹. This method yields numerical data that cannot be equated directly with particular physical effects. It does, however, highlight areas where the various effects of coastal hazards may be the greatest. Once each section of coastline is assigned a vulnerability value for each specific data variable, the coastal vulnerability index (CVI) is calculated as the square root of the product of the ranked variables divided by the total number of variables; where, a = geomorphology, b = slope (% Rise) , c = flood prone areas, d =Storm Surge (SLOSH) , e = drainage, and f = erosion. The calculated CVI value is divided into quartile ranges to highlight different vulnerabilities within the park. The CVI ranges (lower – major water) reported here apply only to Barnegat Light Borough and may vary from other CVI's prepared by alternate agencies. The CVI map for Barnegat Light is provided on the following page.



Source: NJDEP, NJCCVAMP, December 2011

Coastal Vulnerability Index

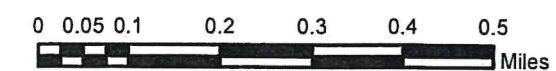
Barnegat Light Borough, Ocean County

The Coastal Vulnerability Index (CVI) was developed to help assess the vulnerability and resiliency of New Jersey coastal communities to natural hazards. While storm surge inundation and sea level rise are the primary factors influencing coastal flooding threats, those factors alone may not fully define the risk of coastal communities to both chronic and episodic hazards. As a layer combining data on flood zones, geomorphology, slope, soil erosion, soil drainage, soil flooding frequency, and ground elevation, as well as on storm surge inundation and water elevation changes, the CVI may provide a more complete picture of the flood hazard potential of coastal communities. In this map, the index is used to define three levels of relative vulnerability; Lower, Moderate, and Higher. More risk levels could be used, or break points between levels adjusted, as additional site specific data are examined. This process of fine tuning the CVI will be done by working with individual municipalities through a grant program aimed at improving the resiliency plans of New Jersey's coastal communities.

Legend

CVI 2050	Facilities	Transportation
Lower	Fire Stations	Interstates
Moderate	Law Enforcement	US Highways
Higher	Medical Facilities	NJ Highways
Major Water	Rail Station	Toll Routes
Water Features	Schools	500 Routes
Streams		County Routes
Waterbodies		Passenger Rail
Municipalities		
Municipalities		

The CVI spatial data set is for informational purposes only. It is a preliminary screening layer for use in conjunction with other community specific data in the development of effective coastal management plans. It is not a final layer defining the actual vulnerability of any community to flooding or storm events, either for present day conditions, or those predicted under sea level rise scenarios. It was generated using the best available information, but has not had rigorous review of its use for modeling site specific coastal conditions. Those reviews may require additional contributing and final generated data sets to be edited to more accurately represent actual conditions. The review and refinement of the data set should be done in conjunction with a wide range of partners, including local municipal experts. Additional data sets not used to prepare the CVI will also be needed to refine the outputs and tailor the data to the specific characteristics of individual communities.



1 inch equals 0.25 miles

September 2014



Getting to Resilience

Barnegat Light is governed under the Borough form of New Jersey municipal government. The governing body consists of a Mayor and a Borough Council comprising six council members, with all positions elected at-large on a partisan basis as part of the November general election. A mayor is elected directly by the voters to a four-year term of office. The Borough Council consists of six members elected to serve three-year terms on a staggered basis, with two seats coming up for election each year in a three-year cycle. The governing body is cognizant of the borough's susceptibility and is prepared to address coastal hazards impacts, associated resiliency and sustainability within the community. The Council has the support of residents and business owners to undertake projects to enhance the quality of life surrounding nuisance flooding issues and recognize the significance of addressing current flooding issues now to combat the anticipated conditions in the future.

The Getting to Resilience process had excellent representation from the municipal leaders and department heads including representatives from Public Works, Borough Council, Police Department, Office of Emergency Management, Municipal Clerk, Construction/Zoning Official and Borough Engineer/Planner, as well as outside agency support from the NJDEP. The group participated in an open discussion about the Borough's strengths and challenges involving resiliency and allowed JCNERR to present associated mapping depicting Sea Level Rise, Storm Surge and Sandy Flooding Extent. The group also completed all 5 sections of the Getting to Resilience questionnaire and JCNERR provided a recommendations report based on linkages from the GTR website, notes taken during the group's discussion, various municipal plans and ordinances, and various mapping from outside agencies.

The following are some of the highlights from the five-part questionnaire:

Risk and Vulnerability Assessments

- **Examine municipal plans, strategies and ordinances and reconsider rewriting sections to include the previous recommendations to reflect the risks, hazards, and vulnerabilities explored in the Getting to Resilience Process**

Public Engagement

- **Update and maintain the Flood Protection Information section of the Borough website and continue to make the link visible and available on the Borough website homepages**
- **Develop a pre-flood plan for public information projects that will be implemented during and after a flood**
- **Develop public presentations about flood zones, flooding risk, building recommendations, etc., to be given annually at public meetings**

Planning Integration

- **Create a detailed mitigation plan for areas that experience repetitive loss**

- Incorporate Sea Level Rise as a hazard in Borough plans
- Consider bolstering the Continuity of Operations Plan

Emergency Response and Recovery

- Work with Ocean County and neighboring municipalities to expand sheltering options
- Expand the Emergency Operations Plan to include more information

Hazard Mitigation and Implementation

- Create a detailed mitigation plan for areas that experience repetitive loss
- Utilize Sea Level Rise and storm surge mapping to identify possible roadways at risk to Sea Level Rise

Barnegat Light Recommendations

In concluding the vulnerability analysis of the Borough of Barnegat Light at the local level, we suggest the evaluation of the following recommendations to aid the community in managing their risk to storm surge and Sea Level Rise impacts:

Action Items related to Storm Surge Projections

- It should remain topmost priority to convey to Borough residents, vacationers and business owners that the safest place in the event of any storm in which local officials declare a Mandatory Evacuation is OFF THE BARRIER ISLAND. There is no location within the Borough of Barnegat Light that is a designated storm shelter.
- Pursue the design of and seek funding opportunities to complete a LBI Regional Stormwater Pump Installation and Drainage Improvement Project.
- Steps should be taken to promote enhancement projects along the sedge areas on Bayview Avenue that will help mitigate anticipated impacts from and Storm Surge.
- Consider raising existing bulkhead heights.
- Promote Living Shoreline projects where feasible along the Bayfront areas.
- Create a coastal conference to provide a means of connecting Borough Officials, Land Use and Construction employees as well as Emergency Management with local business owners and members of the public to discuss recent storm events and exchange knowledge, ideas and experiences to address future coastal hazards.
- Continue to promote the elevation of homes and businesses.

- Continue to prioritize and complete raising all critical infrastructure in the Borough.
- Develop an Outreach Campaign that specifically targets young seasonal tenants, elderly residents with pets and the non-English speaking population.

Action Items related to Sea Level Rise Projections

- Pursue the design of and seek funding opportunities to complete a LBI Regional Stormwater Pump Installation and Drainage Improvement Project.
- Steps should be taken to promote enhancement projects along the wetlands areas on Bayview Avenue that will help mitigate anticipated impacts from Sea Level Rise and Storm Surge.
- Review existing evacuation routes and consider modifications to these routes based on projected Sea Level Rise projections.
- Continue to monitor Sea Level Rise projections on a yearly basis, updating mapping as necessary, to plan for the future of the Borough.
- Conserve coastal land and minimize potential loss through acquisition of contiguous storm-prone properties or those contiguous to adjacent municipally owned land or for the purpose of increasing the Borough's Open and Greenspace.
- Create a coastal conference to provide a means of connecting Borough Officials, Land Use and Construction employees as well as Emergency Management with local business owners and members of the public to discuss recent storm events and exchange knowledge, ideas and experiences to address future coastal hazards.
- Continue to promote the elevation of homes and businesses.
- Continue to prioritize and complete raising all critical infrastructure in the Borough.
- Screen all infrastructure projects for Sea Level Rise impacts.