5.4 RISK ASSESSMENT

The Suffolk County hazards of concern are presented in Section 5.4 and outlined as follows:

- **Hazard Profile**
  - Description
  - Extent – severity of each hazard
  - Location - geographic area most affected by the hazard
  - Previous Occurrences and Losses
  - Impacts of Climate Change
  - Probability of Future Hazard Events
- **Vulnerability Assessment**
  - Impact to Population
  - Impact to Buildings
  - Impact to Critical Facilities and Lifelines
  - Impact to Economy
  - Impact to Environment
  - Cascading Impacts to Other Hazards
  - Future Changes that may Impact Vulnerability
  - Vulnerability Changes Since 2014

5.4.1 Coastal Erosion

This section provides a hazard profile and vulnerability assessment of the coastal erosion hazard for the Suffolk County HMP.

Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, and probability of future occurrences for the coastal erosion hazard.

Description

Along with flooding, coastal erosion is one of the primary coastal hazards leading to loss of lives or damage to property and infrastructure in damaged coastal areas. Many natural factors affect erosion of the shoreline, including shore and near-shore morphology, shoreline orientation, and the response of these factors to storm frequency and sea level rise. Coastal shorelines change constantly in response to wind, waves, tides, sea level fluctuation, seasonal and climatic variations, human alteration, and other factors that influence the movement of sand and material within a shoreline system.

Coastal erosion is a natural phenomenon that is an endless sediment redistribution process that continually changes beaches, dunes, and bluffs. Waves, currents, wind-driven water, ice, rainwater runoff, and groundwater seepage all move sand, sediment, and water along the coastline. Other contributing factors that can increase coastal erosion of a natural protective feature include length of fetch; wind direction and speed; wavelength, height, and period; nearshore water depth; tidal influence; and overall strength of a storm (NYS DEC 2020).

Coastal erosion can result in significant economic loss through the destruction of buildings, roads, infrastructure, natural resources, and wildlife habitats. Damage often results from an episodic event with the combination of severe storm waves and dune or bluff erosion.

Erosion results in the transfer of sediment from one location to another. The addition of sediment to a location is referred to as accretion. Accretion can be beneficial if it strengthens a shoreline, leading to wider beaches and more material for dune building. However, accretion can also result in the narrowing and shoaling of channels and inlets. This can ultimately lead to a potential increase of coastal flooding risk or lack of safe water access for emergency response boats.

Coastal erosion is typically a sporadic event and most typically associated with another hazard event, such as a hurricane. Additionally, erosion rates are influenced by local geographic features and man-made structures. Although most typically associated with flooding, coastal erosion can also be caused by windstorm events, which can blow beach and dune sand overland into adjacent low-lying marshes, upland habitats, inland bays, and communities. If related to a flood event, erosion is typically seen when extreme rainfall scours and erodes dunes and when inland floodwaters return through the dunes and beach face into the ocean (FEMA 1996).

Human activities can also lead to coastal erosion and intensity the effects of natural processes and speed up the coastal erosion process. This includes construction, shipping, boating, and recreation, which can all increase erosion of sandy beaches, dunes, and bluffs (NYS DEC 2013). Humans contribute to the coastal erosion in several ways:

- By removing vegetation, exposing bare soil to be easily eroded by wind, waves, and precipitation;
- Directing run-off from streets, parking lots, roofs, and other locations over a bluff edge causing it to erode; or
- By construction 'hardened' structures along the shore that block that movement of sand along the coast, reflect wave energy onto adjacent shorelines, or cause deepening of the nearshore area (NYS DEC 2020).

Many development activities damage or alter natural protective features and the protection these features afford the upland area from coastal erosion and storm damage. These activities include the following:

- Building without considering the potential for damage to property or natural protective features;
- Activities which destroy natural protective features such as dunes or bluffs and their vegetation;
- Building structures intended for coastal erosion prevention which may exacerbate coastal erosion conditions on adjacent or nearby properties; and
- Wakes from boats that produce wave action on the shoreline (NYS DEC 2020).

Historically, some of the methods used by municipalities and property owners to stop or slow down coastal erosion or shoreline change have actually exacerbated the problem. Attempting to halt the natural process of erosion with shore parallel or perpendicular structures such as seawalls (groins and jetties) and other hard structures typically worsens the erosion in front of the structure (i.e., walls), prevents or starves any sediment behind the structure (groins) from supplying down-drift properties with sediment, and subjects down-drift beaches to increased erosion. Since most sediment transport associated with erosion and longshore drift has been reduced, some of the state's greatest coastal assets and attractions—beaches, dunes, barrier beaches, salt marshes, and estuaries—are threatened and will slowly disappear as the sediment sources that feed and sustain them are eliminated.

Sandy barrier/bluff coastlines are constantly changing as the result of wind, currents, storms, and sea level rise. Because of this, developed sandy shorelines are often stabilized with hardened structures (seawalls, bulkheads, revetments, rip-rap, gabions, and groins) to protect coastal properties from erosion. While hardened structures typically prove to be beneficial in reducing property damage, the rate of coastal erosion typically increases near stabilization structures. Shore protection structures such as seawalls and revetments typically eliminate natural wave run-up and sand deposition processes and can increase reflected wave action and currents at the waterline.

Increased wave action can cause localized scour in front of structures and prevent settlement of suspended sediment (FEMA 1996). This increased erosion impacts natural habitats, spawning grounds, recreational activity areas, and public access (Frizzera 2011). Suffolk County is home to a number of shoreline structures along the Atlantic Ocean, Long Island Sound, and inland bays, including groins and bulkheads.

To counteract the negative impact of hard structures, alternative forms of shoreline stabilization that provide more natural forms of protection can be used. Along the New York coast, beach nourishment and dune restoration are now the main forms of shoreline protection. The sheltered coastlines in New York consist of tidal marshlands and a few narrow, sandy beaches—all of which naturally migrate inland as the sea level rises. Experts have stated that marshes can keep pace with a 0.1 inch per year (inch/year) rate of sea level rise; however, the state's current rate is approximately 0.12 inch/year, a rate that is predicted to continue increasing (Frizzera 2011, NYSERDA 2014). Currently, bulkheads and revetments are the primary form of shore protection along these tidal areas. As the sea level rises and coastal storms increase in intensity, coastal erosion and requests for additional shoreline stabilization measures are likely to increase (Frizzera 2011).

Erosion can impact beaches, dunes, bluffs, barriers, bays, cliffsides, wetlands, marshes, parks, and other natural landforms and can lead to destructive forces upon nearby manmade structures. One of the major impacts of erosion processes is the permanent breaching or creation of inlets along barrier beaches and islands. An example of this is the creation of the Shinnecock and Moriches Inlets along Suffolk County's South Shore. Impacts associated with new inlets could include (1) increased flooding and erosion on the mainland shoreline due to increased water levels and wave action in the bays, (2) changes in shoaling patterns, water circulation, temperature and salinity that could significantly alter existing bay ecosystems, and (3) disruption of the longshore transport of sand along the ocean shoreline that would result in increased downdrift erosion. It is noted that these stabilized inlets do provide benefits for recreational and commercial navigation, which is the trade-off.

There are a variety of natural- and human-induced factors that influence the erosion process. For example, shoreline orientation and exposure to prevailing winds, open ocean swells and storm surges, and waves all influence erosion rates. Beach composition influences erosion rates as well. For example, a beach composed of a finer sand and silt is easily eroded compared to beaches primarily consisting of course sand, boulders, gravel or large rocks, which are more resistant to erosion. Common contributing factors to coastal erosion include, but are not limited to, the following and further discussed below:

- Impacts from hurricanes and other coastal storms;
- Decreased sediment supplies;
- Storm-induced high water;
- Wave action on inland waters (seiche); and
- Sea level rise

Impacts from Hurricanes and Other Coastal Storms

According to the New York State HMP 2014 update, beaches, dunes, and bluffs are a natural barrier between the ocean and inland communities, ecosystems, and resources. During a strong coastal storm, changes to beaches, dunes, and bluffs can be significant and the results are sometimes catastrophic. The USGS provides scientific support for mitigation planning through observations of beach, dune, and bluff change and models of waves and storm surge in order to identify areas vulnerable to extreme coastal changes. By identifying areas of coastline in New York State that are likely to experience extreme and devastating erosion during a hurricane or coastal storm, it is possible to determine risk levels associated with development in areas where the land shifts and moves with each land-falling storm (NYS DHSES 2013).

Decreased Sediment Supplies

Coastal landforms, such as bluffs, are essential in maintaining a supply of sediment to beaches and dunes. If engineered structures are used to stabilize shorelines, the natural process of erosion is disturbed and decreases the amount of sediment supply. With reduced sediment, the ability of natural protective features (dunes and beaches) to provide prevention from storms and flood control benefits is reduced (NYS DHSES 2013).

Storm-Induced High Water

Coastal storms can occur any time of the year and at varying levels of severity. Natural protective features within coastal erosion hazard areas provide buffering and protection to shorelines from erosion. Dunes and bluffs are effective against storm-induced high water and related wave action (NYS DHSES 2013).

Wave Action on Inland Waters/Seiche

Wave action can cause a surge of water to impact shorelines with great force on inland waterbodies, causing erosion and property damage. This is typically due to a storm system with high winds occurring on a lake (called a seiche) and causes shoreline erosion and property damage (NYS DHSES 2013).

Sea Level Rise

Rising sea levels may have a negative impact on the process that leads to coastal erosion. Studies have shown that an increased sea level attributed to climate change can speed up the natural coastal processes that remove sand and vegetation from protective beaches, dunes, and bluffs. Erosion resulting from sea level rise will lead to more intensive coastal impacts from future storm events (NYS DHSES 2013).

Sea level rise over the next 100 years is expected to contribute significantly to physical changes along open-ocean shorelines. Predicting the form and magnitude of coastal changes is important for understanding the impacts to humans and to the environment (Gutierrez et al. 2007).

For detailed information regarding sea level rise in Suffolk County, see Section 5.4.8 (Flood).

Dune Erosion

The southern shore of Suffolk County is characterized by barrier islands with dune systems. If a storm's surge is large enough, the entire expanse of beach could be flooded, and waves will begin to attack the dunes. Once the dunes have been flattened, infrastructure located adjacent to the beach will become vulnerable to large storm waves. In order to grow dunes, vegetation can be planted; beach grass traps wind-blown sand and roots aid in keeping the sand in place. Not only do dunes act as barriers, like levees, against coastal flooding but they also play an important role in natural beach nourishment. Sediment stored in dunes can replace the sediment that was lost to erosion (NYS Sea Grant 2018).

Washovers are a concern for barrier islands and occur when waves cut away the beach resulting in breaches that connect the ocean water to the bay area. These have occurred on Long Island's barrier system in the past, most notably when Superstorm Sandy opened multiple inlet breaches along Fire Island (NYS Sea Grant 2018).

Bluff Erosion

The north shore of Suffolk County and Montauk is characterized by extensive bluffs which are often impacted by erosion. During heavy rainfall, sand can be washed down the face of the bluff if it is not vegetated, similar to the beach and dune erosion processes just discussed. Storm-related increases in water height can also be detrimental to coastal bluffs. When waves begin to attack the base of the bluff, which is normally protected from wave conditions by a beach, sediment will be removed from the base (i.e., toe) resulting in undercutting and leaving a vertical scarp. This will make the entire bluff unstable due to continual slumping of bluff material from above the eroded toe, which in turn removes the vegetation that provides stability and protective cover, furthering erosion (NYS Sea Grant 2018). This slumping can also result in small landslides on the face of the bluff.

Long Island's coastal bluffs are composed of a wide variety of sediment ranging in grain size from fine silts and clays to large boulders. As the groundwater moves, it loosens and picks up material; erosion will result when the water flows out of the bluff removing sediment with it. The coarser the bluff material, the more easily this can occur. Gullies, which form as a result of surface water flowing down or through the bluff face, indicate groundwater-related problems. In freezing temperatures, the groundwater will become trapped in the bluff and expand as cracks. This separates larger chunks of sediment, which slide down the face (NYS Sea Grant 2018).

Bluffs can be protected with a variety of measures; however, these techniques may also deprive the beach of sediment. Therefore, complete stabilization may result in the reduction of beach size and eventually in its disappearance (NYS Sea Grant 2018).

Extent

Coastal erosion is measured as the rate of change in the position or horizontal displacement of a shoreline over a period of time. Geologists measure the severity of erosion in two ways -- as a rate of linear retreat (feet of shoreline recession per year) and volumetric loss (cubic yards of eroded sediment per linear foot of shoreline frontage per year) (NYC Emergency Management 2019).

Coastal erosion can be rapid or can occur gradually. However, measuring gradual (or long-term) erosion is often difficult, because the extent of natural erosion in a specific shoreline varies significantly from year to year. If choices are made to dredge or nourish beaches along particular parts of the coast, it can be difficult to determine how much beach is being lost or gained through natural processes and how much is being affected by human activities (NYC Emergency Management 2019). Coastal erosion may also be exacerbated by human activities, such as boat wakes, shoreline hardening, and dredging (FEMA 1996). In barrier islands and barrier spits, severe erosion can result in the formation of tidal inlets.

Natural recovery after erosion events can take months or years. If a dune or beach does not recover quickly enough via natural processes, coastal and upland property may be exposed to further damage in subsequent events. Coastal erosion can cause the destruction of buildings and infrastructure (FEMA 1996).

The USGS Coastal Change Hazards Portal hosts a short-term (30 years) change mapper, which displays the rate of average shoreline change on coastal shorelines. The Portal indicates that, over the past 30 years, Suffolk County had various rates shoreline change ranging from -1 meter to 2 meters per year. Figure 5.4.1-1 displays short-term shoreline change rates for Suffolk County's south shore.

Figure 5.4.1-1. Shoreline Change Rates for Suffolk County

Source: USGS 2020

Coastal erosion is measured at a rate of either linear retreat (feet of shoreline recession per year) or volumetric loss (cubic yards of eroded sediment per linear foot of shoreline frontage per year). It is estimated that the coastline of the North East (including New York State) averages an annual erosion rate of approximately 1.18 inches per year (NYS DHSES 2020).

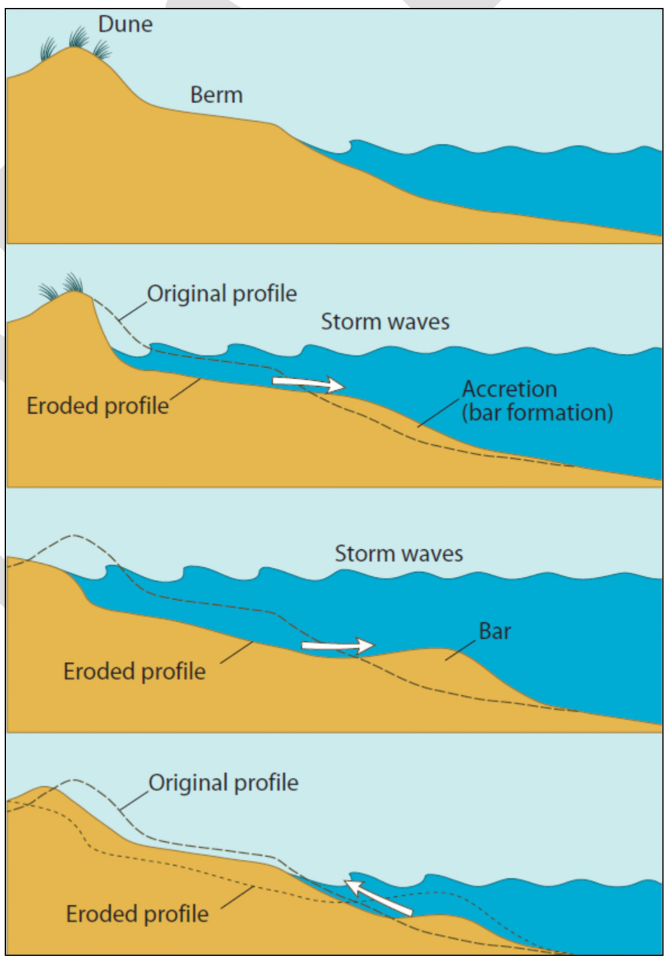
A number of factors determine whether a community exhibits greater long-term erosion or accretion:

- Exposure to high-energy storm waves,
- Sediment size and composition of eroding coastal landforms feeding adjacent beaches,
- Near-shore bathymetric variations which direct wave approach,
- Alongshore variations in wave energy and sediment transport rates,
- Relative sea level rise,
- Frequency and severity of storm events, and
- Human interference with sediment supply (e.g. revetments, seawalls, jetties) (Woods Hole Sea Grant 2003).

Long Island is particularly vulnerable to erosion because of the presence of fine-grained sands along the island's shoreline and the island's location facing the ocean in various degrees of orientation opposing the dominant wind and water currents moving up the Atlantic Coast. Suffolk County is surrounded by the Long Island Sound to the north and the Atlantic Ocean to the south; therefore, coastal erosion is an ongoing process along the northern and southern shoreline communities and natural ecosystems (including barrier islands, bays, inlets, beaches and tidal wetlands). Long Island consists of over 1,180 miles of coastline, with Suffolk County consisting of over 980 miles of coastline. Most of Suffolk County has experienced coastal erosion at one time or another, primarily exacerbated by major coastal storms that have directly or indirectly impacted the area. Although there are many contributing factors to coastal erosion, the historical occurrence of coastal storms has been the major contributing factor, permanently changing the landscape of Suffolk County's shorelines, with the creation of inlets (including Shinnecock and Moriches Inlets) as an overall minor to moderate contributor to coastal erosion.

Beaches constantly change from day-to-day, week-to-week, month-to-month, and year-to-year, primarily in response to waves. The size and presence of any part of a beach, at a given time, is influenced by a number of factors: size and direction of the waves, size and shape of sand grains on the beach, the level of water at the time waves strike, and the initial shape of the beach. Waves play a major role in controlling the form, position and size of the beach. Waves are responsible for picking up and moving sand along the coast. The beach responds quickly to changes in wave energy. Very large, choppy waves tend to pick up and remove sand from the beach berm. This lowers the elevation which flattens the beach profile and causes the berm and shoreline to move landward. The material picked up from the waves can move in many directions depending on numerous factors. Most frequent, material is moved offshore and is deposited in a bar during storms. As the bar grows, it causes larger waves to break and dissipate their energy before they reach the landward berm, all which help the beaches protect themselves. In calmer weather, long, gentle waves can pick up much of the sand and bring it back onshore, building up the berm, raising the height of the backshore and moving the beach berm and shoreline back seaward. This creates a cycle where the beach erodes and builds back up in response to wave action. Over the course of a year, beaches can move back and forth by as much as 270 feet (Tanski 2012). Figure 5.4.1-2 illustrates the beach response to waves.

Figure 5.4.1-2. Beach Response to Waves



Source: Tanski 2012

Location

The Long Island region is 191 kilometers long and extends from Montauk, New York at the entrance to Long Island Sound to Breezy Point at the mouth of Raritan Bay. This stretch of coast is dominated by barrier islands in the western and central parts of the region. At Southampton, the barrier system joins the mainland and the elevation of the back beach increases eastward. Tall bluffs are the dominant coastal feature at and near Montauk Point. There are few visible engineering structures east of Westhampton Beach, except for several groins in the East Hampton area and a large riprap seawall at Montauk Point. Numerous rock revetments and bulkheads on individual properties are found throughout. Sand fencing is also present along many portions of this region, as it is used to stabilize dunes. Beginning with jetties at Shinnecock Inlet, there are many littoral interceptors along the Long Island coast, including a groin field at Westhampton and six stabilized inlets (Shinnecock, Moriches, Fire Island, Jones, East Rockaway, and Rockaway) (USGS, 2010).

Suffolk County occupies the central and eastern portions of Long Island, New York. The eastern end of the County is divided into two peninsulas (North Fork and South Fork). It is surrounded by the Atlantic Ocean and the Long Island Sound on three sides, with 980 miles of coastline. Suffolk County has 204 beaches, totaling 34.52 miles (USEPA 2013).

Long-term erosion rates throughout the jurisdictions of Suffolk County vary significantly because of geology and the physical nature of different locations along the shoreline. Although structural and other measures can be taken to reduce the impact or frequency of this hazard, all shorelines in Suffolk County are vulnerable to coastal erosion. The properties most at risk to coastal erosion will be those located within 200 feet of the erodible shoreline and beaches.

Barrier islands are notably prone to large impacts from erosion. Erosion is responsible for the position and shape of most barrier islands, outside of human influence. Longshore transport of eroded sediment can result in the migration of a barrier island or barrier spit, typically with one end of the island or spit lengthening due to accretion.

The Atlantic Ocean coastline of Long Island is designated by NYS DEC as an area that is at risk to coastal erosion from natural and human activities and is therefore regulated. NYS DEC has two programs focused on the protection of coastal erosion: Coastal Erosion Hazard Area (CEHA) permit program and the United States Army Corps of Engineers (USACE) Civil Works Program. The CEHA program regulates and issues permits for activities within a coastal erosion hazard area. DEC works with USACE to study coastal erosion problems along coastlines and to develop coastal erosion solutions. These are usually large-scale projects that impact entire communities (NYS DEC 2020).

NYS prevents and reduces coastal erosion by:

- promoting and preserving the natural protective features such as dunes and bluffs, beaches and near-shore areas of coastal regions;
- restricting or prohibiting activities or development in natural protective feature areas;
- ensuring new construction or structures are a safe distance from areas of active coastal erosion and the impact of coastal storms;
- regulating the placement and construction of coastal erosion protection structures, when justified, to minimize damage to property, natural protective features, and other natural resources;
- restricting development involving public investment in services, facilities, or activities (for example, extending public water supply and sewer services) which are likely to encourage new permanent development in coastal erosion hazard areas;

- requiring publicly financed coastal erosion protection structures intended to minimize coastal erosion damage to be used only where necessary to protect human life or where the public benefits of such structures clearly outweigh the public expenditures;
- encouraging administration of coastal erosion management programs by coastal municipalities and establishing procedural standards for local program implementation and establishing standards for the issuance of coastal erosion management permits (NYS DEC 2020).

Coastal Erosion Hazard Area

Due to the ongoing coastal erosion problems along the New York State coastline, the State Legislature passed the Coastal Erosion Hazard Areas (CEHA) Act (Article 34 of the Environmental Conservation Law [ECL]), establishing the State's coastal policy in August 1981. Under this act:

- Areas prone to coastal erosion are identified.
- Activities in areas subject to coastal erosion are undertaken in such a way that damage to property is minimized, increases in coastal erosion are prevented, and natural protective features are protected. Public actions likely to encourage new development in CEHA should not be undertaken unless the areas are protected by structural or other erosion control projects which could prevent erosion damage during the life of the proposed action.
- Erosion control projects are publicly financed only where needed to protect human life for existing or new development, which absolutely requires a location within a given hazard area.
- Public and private erosion control projects should minimize damage to other human-made property, natural protective features, and other natural resources.

There are 86 coastal communities in New York State that currently fall under CEHA jurisdiction. The law allows local communities to administer their own CEHA program. Of those 86 communities, 44 have been certified by the NYS DEC and have their own CEHA law. The other communities are managed by the NYS DEC. The following list contains the certified CEHA communities and DEC regulated CEHA communities in Suffolk County:

- Babylon, Town of*
- Brookhaven, Town of*
- East Hampton, Town of - DEC Regulated CEHA Community
- East Hampton, Village of*
- Huntington, Town of*
- Islip, Town of - DEC Regulated CEHA Community
- Lloyd Harbor, Village of*
- Nissequogue, Village of - DEC Regulated CEHA Community
- Old Field, Village of*
- Port Jefferson, Village of*
- Quogue, Village of *
- Riverhead, Town of*
- Sagaponack, Village of *
- Saltaire, Village of *
- Shelter Island, Town of - DEC Regulated CEHA Community
- Shoreham, Village of *
- Smithtown, Town of - DEC Regulated CEHA Community
- Southampton, Town of *
- Southampton, Village of *
- Southold, Town of *
- West Hampton Dunes, Village of *
- Westhampton Beach, Village of * (NYS DEC 2020)

**: Certified CEHA community*

As a part of this Act, NYS DEC has developed minimum standards and criteria, 6 NYCRR Part 505 – Coastal Erosion Management, for the statewide regulation of development and other activities within CEHA. Part 505 defines when the Department will administer a regulatory program within identified CEHA and establishes standards for the issuance of coastal erosion management permits by the Department. Procedural requirements are also established for local governments that wish to implement a local program, although local implementation is not required until after the Department has filed CEHA maps for a municipality (NYS DEC 1988). Part 505 establishes two categories of CEHA: (1) Structural Hazard Areas and (2) Natural Protective Features.

- *Structural Hazard Areas* are shorelands, located landward of natural protective features, and have shorelines receding at a long-term average annual recession rate of one foot or more per year. The inland boundary of a structural hazard area is calculated by starting at the landward limit of the fronting natural protective feature and measuring along a line which is perpendicular to the shoreline a horizontal distance which is 40 times the long-term average annual recession rate (NYS DEC 1988).

- *Natural Protective Feature Area (NPFA)s* are a land and/or water area containing natural protective features, the alteration of which might reduce or destroy the protection afforded other lands against erosion or high water, or lower the reserves of sand or other natural materials available to replenish storm losses through natural processes. All NPFAs are delineated as such on CEHA maps (NYS DEC 1988). NYS DEC is in the process of updating these maps.

Both types of areas are depicted on CEHA maps, which depict the landward limit of the Surface Hazard Areas and Natural Protective Features and indicate the recession rate in feet per year where applicable. The NYS DEC commissioner is tasked to review the boundaries of these hazard areas every 10 years and after major coastal storms and revise the maps if the CEHA boundary changed by 25 feet or more (NYS DEC Article 34, Chapter 841). According to Mr. Jay Tanski, Outreach Specialist for Coastal Hazards (SUNY Stonybrook) with the New York Sea Grant, such updates have not been implemented in recent years. Therefore, the 1988 maps are still the most recent regulatory delineations of the CEHA.

The digitized CEHA line and 1,000-foot buffer zone for Suffolk County was provided regional and local erosion rates by Mr. Robert McDonough of the NYS DEC Division of Water, Coastal Erosion Management Unit in June 2007. Figures 5.4.1-3 through 5.4.1-5 illustrate the digitized line. CEHA jurisdiction extends 1,000 feet seaward of the mean low water level or to a depth of 15 feet, whichever is greater. The 1,000-foot buffer on the seaward side of the CEHA or NPFA landward limit line has been placed as a reminder of the seaward limit of the nearshore area which is regulated as a Natural Protective Feature. As explained by Mr. McDonough, the CEHA maps filed with the municipality are the official documents containing the legally defined NPFA and SHA boundary lines and should be referred to when considering areas subject to the coastal erosion hazard.

The NYS DEC is currently evaluating and revising the CEHA boundaries. NYS DEC is required to review the CEHA boundaries every 10 years.

Figure 5.4.1-3. NYS DEC Coastal Erosion Hazard Areas Line for Suffolk County West

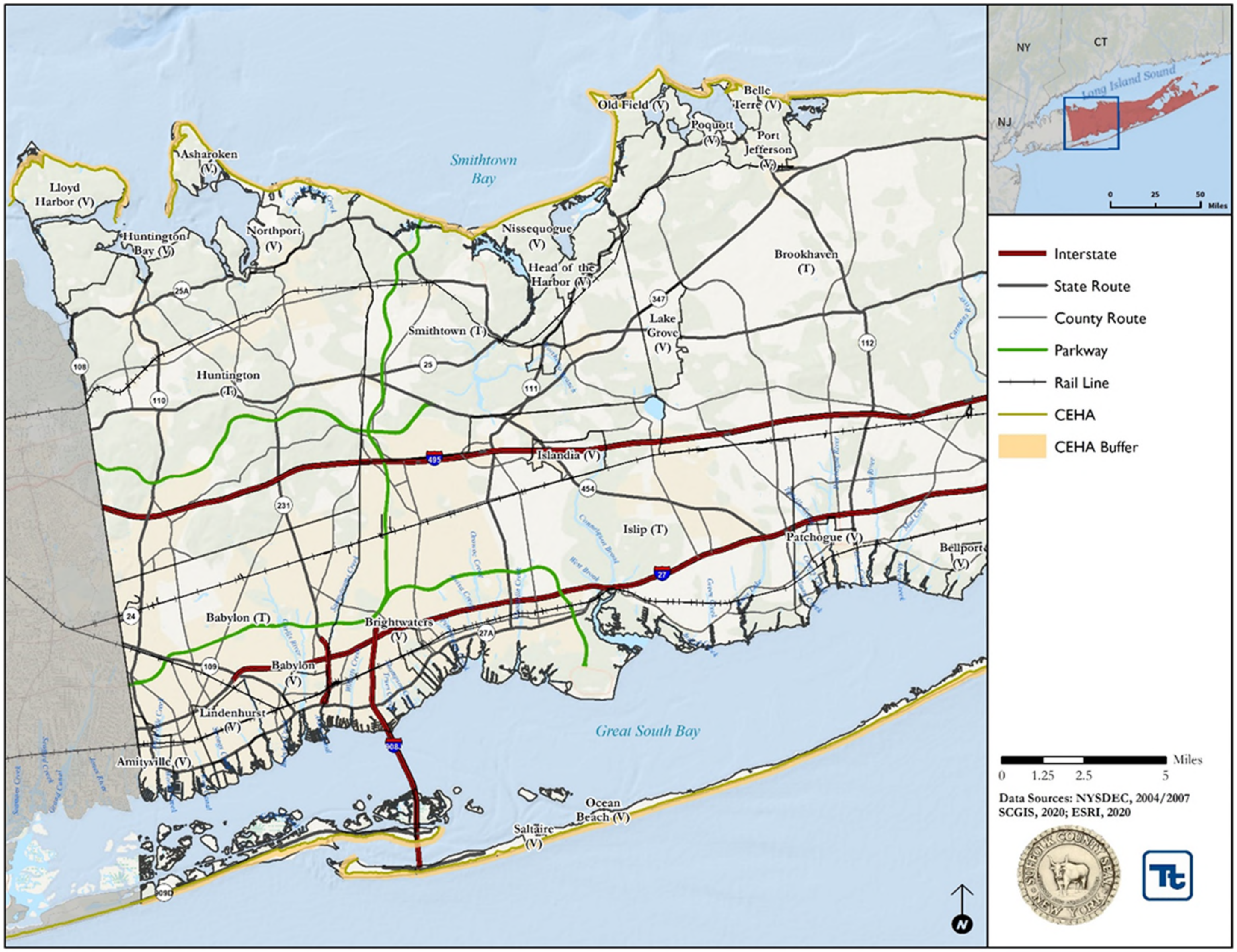


Figure 5.4.1-4. NYS DEC Coastal Erosion Hazard Areas Line for Suffolk County – Central

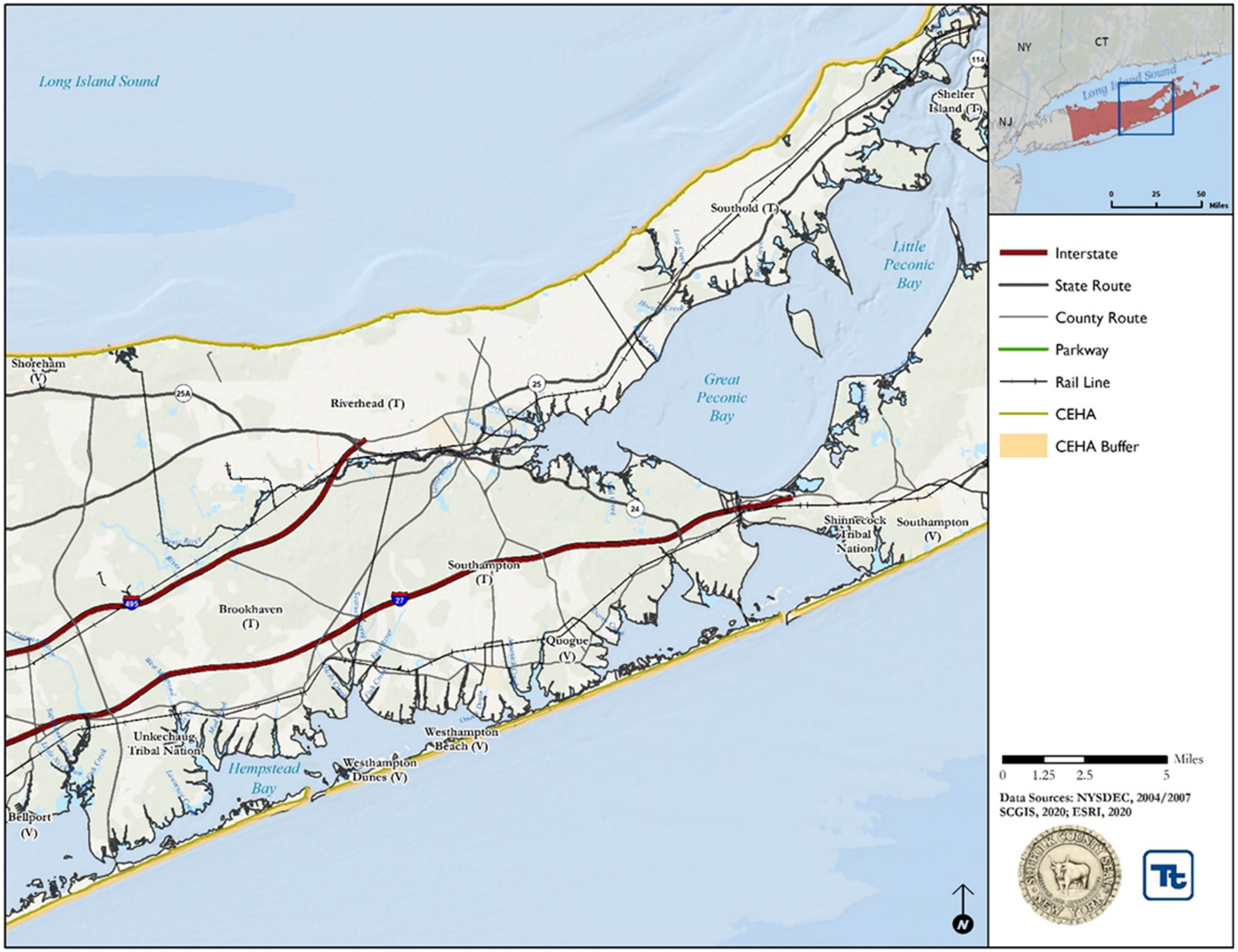
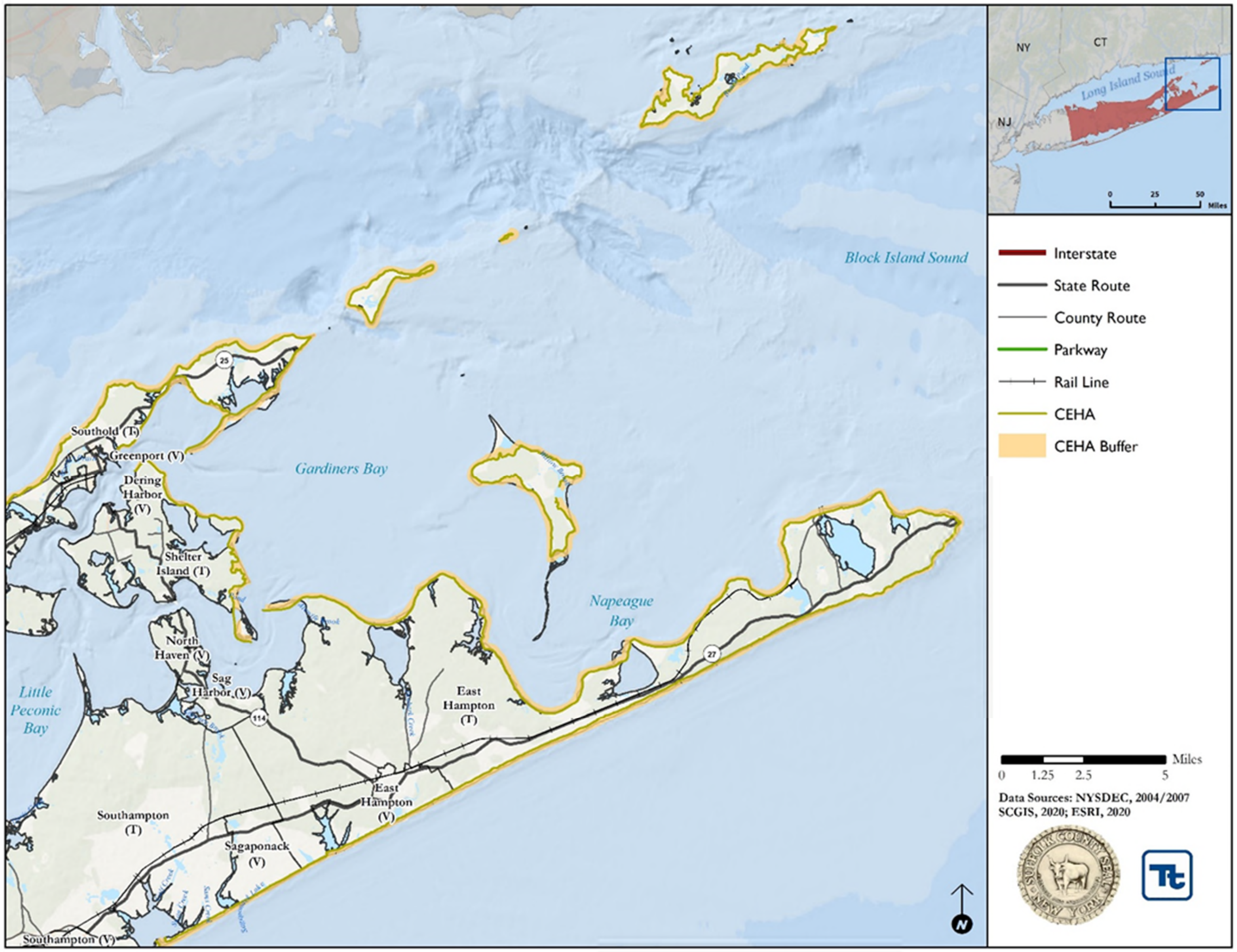


Figure 5.4.1-5. NYS DEC Coastal Erosion Hazard Areas Line for Suffolk County – East



To better understand the County's risk to coastal erosion, the CEHA 98-foot buffer and coastal risk 'moderate', 'high', and 'extreme' hazard areas can be viewed in Figure 5.4.1-6 through Figure 5.4.1-8.

Figure 5.4.1-6. Coastal Risk Assessment Areas - West

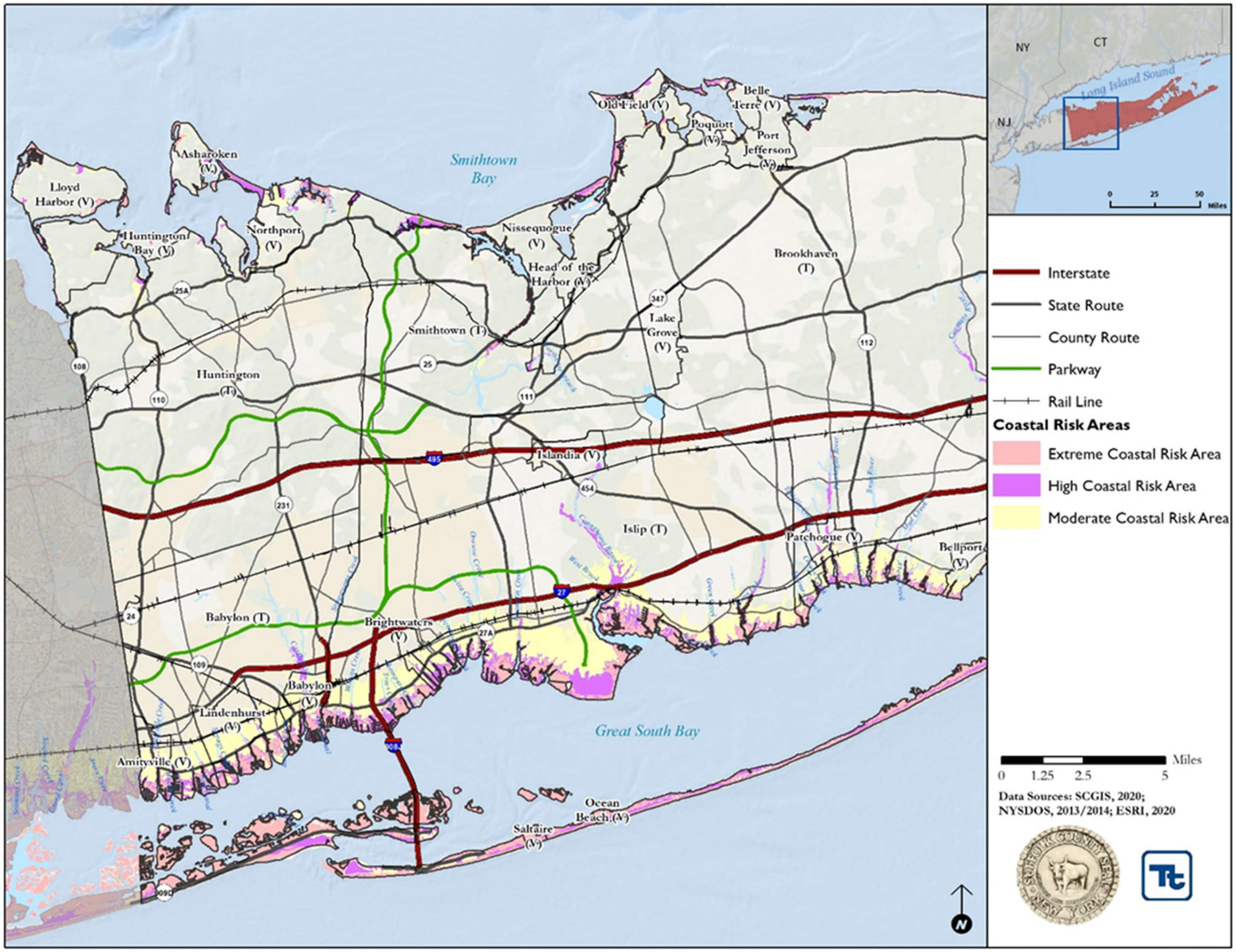


Figure 5.4.1-7. Coastal Risk Assessment Areas - Central

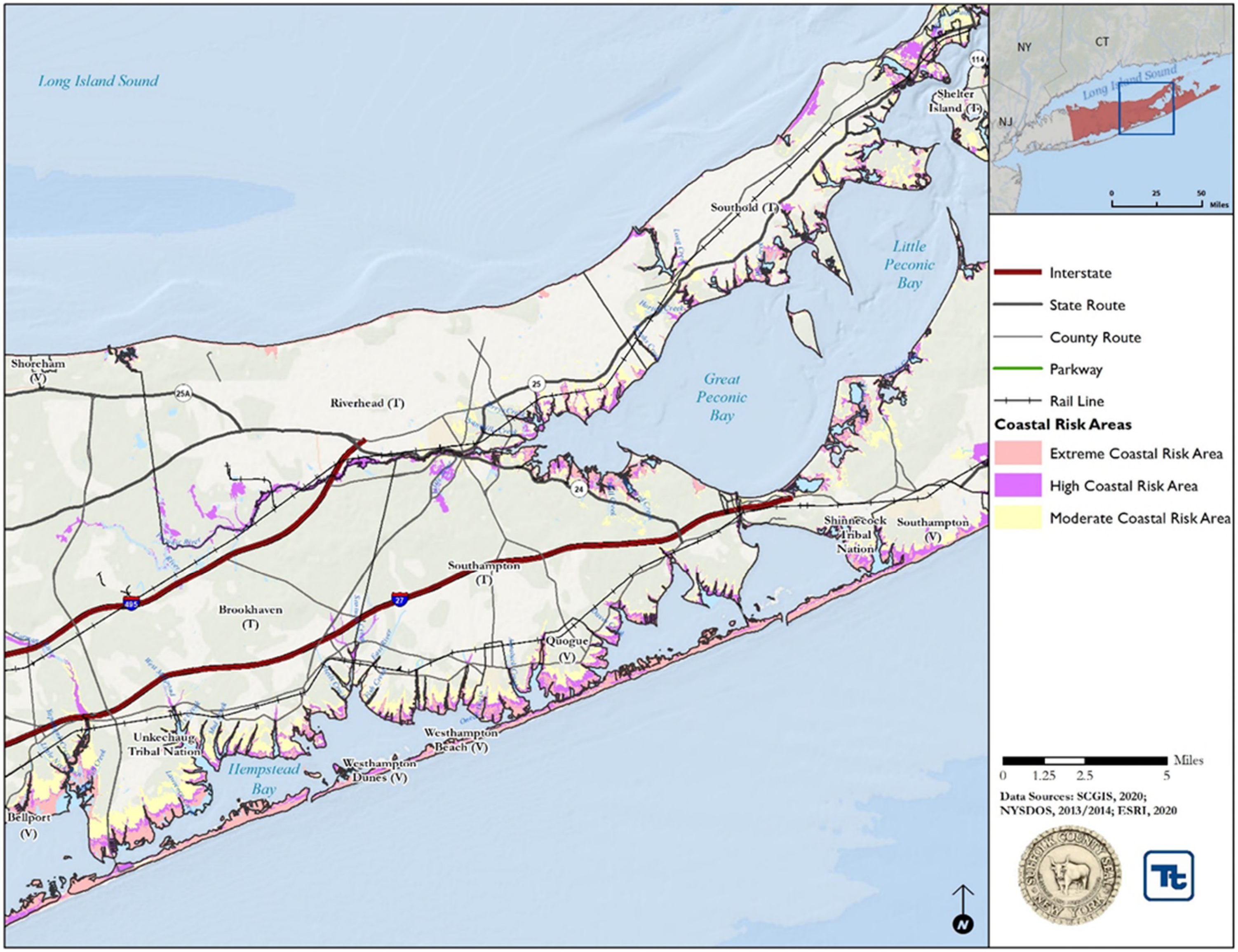
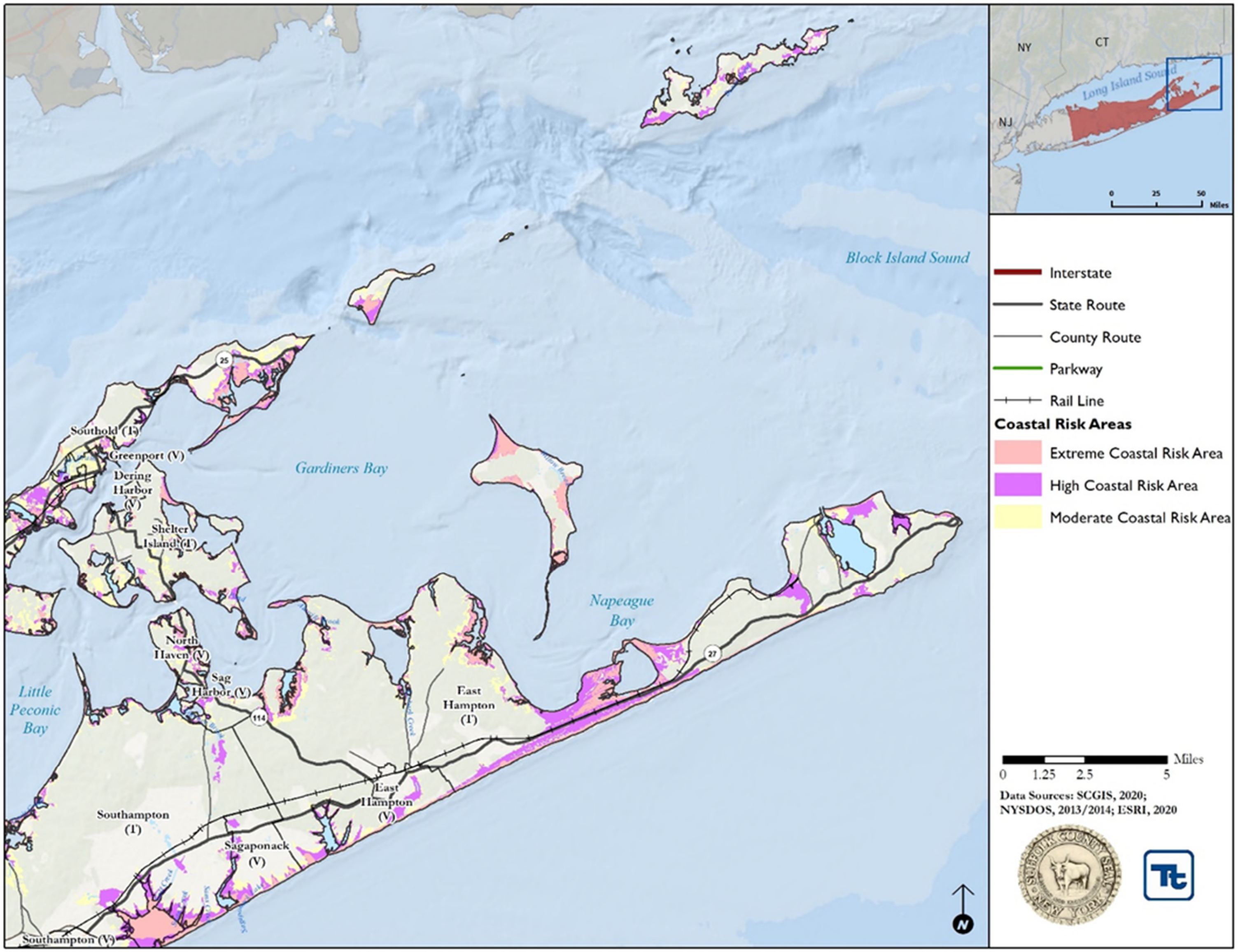


Figure 5.4.1-8. Coastal Risk Assessment Areas - East



Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences of coastal erosion throughout Suffolk County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP. The NYS Hazard Mitigation Plan notes that historically, there has been a lack of objective, isolated coastal erosion data (NYS HMP 2019).

Although many factors contribute to the natural coastal erosion of Suffolk County shorelines; historical hurricanes, tropical storms and Nor'Easter events have significantly increased coastal erosion processes throughout Suffolk County. Because Suffolk County is primarily surrounded by coastal waters, most tropical and extra-tropical events that commonly occur within the area result in significant losses and temporary or permanent changes to the County's shorelines. The Long Island shorelines have historically experienced coastal erosion and related storm damage. Details regarding Nor'Easter and Hurricane events that have impacted Suffolk County are presented earlier in Section 5.4.10 and Section 5.4.12, respectively.

FEMA Major Disasters and Emergency Declarations

Between 1954 and 2020, New York State and Suffolk County were not included in any Federal Emergency Management Agency (FEMA) declared coastal erosion specific disasters (DR) or emergency declarations (EM). However, Suffolk County has been included in numerous declarations that involved hurricanes, coastal storms, and coastal floods. For more information on these declarations, refer to Section 5.4.8 (Flood), Section 5.4.10 (Hurricane), and Section 5.4.12 (Nor'Easter).

For this 2020 HMP, known coastal erosion events that have impacted Suffolk County between 2013 and 2020 are identified. For events prior to 2014, refer to Appendix E.

Table 5.4.1-1. Coastal Erosion Events in Suffolk County, 2013 to 2020

Dates of Event	Event Type	FEMA Declaration Number	Suffolk County Designated?	Location	Losses / Impacts
January 10, 2016	High Surf	N/A	N/A	Southwest Suffolk, Northeast Suffolk	Strong high pressure over Southeast Canada and low pressure drifting off the Mid Atlantic coast resulted in 2 days of persistent northeast winds Jan 8th and 9th. This was followed by 12 to 18 hours of east to southeast winds of 15 to 20 mph with gusts to 30 to 35 mph leading into high tides on Jan 10th. The resultant surge combined with high astronomical tides, resulted in widespread minor to moderate coastal flooding along southern and western coastal areas of Long Island and New York City on the morning of January 10th. Gilgo Beach in Babylon experienced moderate erosion with the east wind ledge of sand being removed during the morning high tide of January 10th. Orient Beach State Park experienced moderate erosion along the Gardiners Bay shoreline during high tide due to waves and strong east winds.
January 23-24, 2016	High Surf	N/A	N/A	Southeast Suffolk, Southwest Suffolk, Northeast Suffolk	Low pressure developed along the southern mid-Atlantic coast on the evening of the 23rd and then rapidly intensified as it slowly tracked northeast, south of Long Island, through the night of the 24th. The resulting surge from 36 hours of gale to storm force north to northeast winds, combined with high astronomical tides, resulted in widespread minor to moderate coastal flooding for three consecutive tidal cycles the morning of the 23d into the morning of the 24th along the southern coastal areas of Long Island. Areas of minor to localized moderate coastal flooding occurred along Long Island Sound and East End portions of Long Island during this time period as well. In addition, widespread dune toe erosion and localized wash overs were reported along the Atlantic Ocean facing beaches of Long Island. Fire Island was especially hard hit. A truck was inundated, and half buried in sand at Scott Cameron Beach on Dune Road in Bridgehampton due to the high surf and water levels. The truck was discovered the morning of the 24th after high tide. At Gilgo Beach, heavy beach erosion was reported with some dune damage. At Robert Moses State Park in Babylon, NY, beach flooding occurred to the dune lines on the ocean fronts. The surf was very rough. The emergency manager estimated 8-12-foot waves, although with the white out, the view of the ocean was limited. At Robbins Rest on Fire Island, significant beach erosion was reported with localized wash overs. At Captree State Park in Bay Shore, NY, bordered by the Fire Island Inlet and State Boat Channel, erosion was experienced during high tides on the east side of the shoreline. Along the Gardiner's Bay shoreline along the Entrance Drive of Orient Beach State Park, moderate erosion and sand scouring occurred on the west side of jetties and on south facing dunes.

Dates of Event	Event Type	FEMA Declaration Number	Suffolk County Designated?	Location	Losses / Impacts
September 3-6, 2016	High Surf	N/A	N/A	Southeast Suffolk, Northeast Suffolk, Southwest Suffolk	Slow moving tropical cyclone Hermine caused several days of 8 to 12 feet of surf breaking on Atlantic Ocean shorelines. The surf on top of storm tide September 3rd through the 6th caused significant beach erosion on Long Island ocean beaches. Hither Hills State Park had a significant amount of erosion, with an initial estimate of 30 feet of shoreline lost. At Orient Point State Park, moderate erosion was experienced along the Gardiners Bay Shoreline, with some loss of boulders. Otherwise only minor flooding occurred at the park. Moderate beach erosion was also reported at Wildwood State Park on the north shore of the Town of Riverhead. Robert Moses State Park sustained substantial erosion mostly beginning September 3rd Saturday night and continuing until Monday night. The worst erosion came Sunday night into Monday on the fifth of September. During that time, beach flooding, in some cases up to the dune lines, was experienced throughout the length of the ocean front. Specifically, significant beach erosion occurred at Robert Moses State Park on the west side from the Water Tower towards Field 2. An initial rough estimate of 60-90 feet of shoreline was lost. Additionally, Gilgo Beach within the Town of Babylon jurisdiction, suffered substantial beach erosion. There was a moderate loss of sand along Gilgo Beach with one area west of the Gilgo underpass experiencing a 6-foot scarp along 200 feet of beach, leaving little beach.
September 19-20, 2017	High Surf	N/A	N/A	Southeast Suffolk, Southwest Suffolk,	Tropical cyclone Jose tracked north and east along the Mid Atlantic coast Tuesday September 19th, eventually passing about 150 to 200 miles southeast of Montauk Point Tuesday night into Wednesday morning. Generally, 1 to 2 feet of surge was observed during the Tuesday Night and Wednesday morning high tides, resulting in minor to isolated moderate flooding thresholds being exceeded along the southern bays and Atlantic shore front communities of NYC and Long Island. The elevated water levels combined with incoming energetic swells from Jose, also brought surf of 7 to 13 feet. This caused widespread beachfront flooding, dune erosion, and localized wash overs. At Hither Hills in Montauk, the entire beachfront experienced minor to moderate flooding with waves eroding the base of the dunes during the Tuesday morning through Wednesday morning high tides. At Robert Moses, minor to moderate flooding and beach erosion were observed during the Tuesday morning to Wednesday morning high tides. Gilgo Beach had water up to the dunes during the Tuesday morning to Wednesday morning high tides, causing moderate erosion with a strong littoral drift. A wash over cutting from ocean to bay occurred through the Otis Pike High Dune Wilderness Area just west of Smith Point on Fire Island during the Tuesday Night and Wednesday morning high tides. Orient Point State Park had

Dates of Event	Event Type	FEMA Declaration Number	Suffolk County Designated?	Location	Losses / Impacts
					moderate erosion along the Gardiners Bay shoreline due to high wave action during times of high tide Sunday Night and Monday Morning.
April 15-16, 2018	High Surf	N/A	N/A	Northwest Suffolk, Southwest Suffolk	A slow-moving frontal system brought heavy rain and easterly gale winds to the region during the times of high tide Monday morning into early Monday afternoon. Although waters levels only reached minor flood thresholds along lower NY Harbor and Long Island, heavy rains Monday morning across overwhelmed drainages caused widespread flash flooding across the region. Additionally, 5 to 8 ft breaking waves and elevated water levels resulted in minor to moderate erosion along the beachfront. Robert Moses and Captree suffered moderate beach erosion during the Monday morning high tidal cycle. The strong easterly winds eroded the beach at Robert Moses leaving cuts and pulling sand offshore. The sand recently placed on Captree's east side was also eroded.
October 10 and 17, 2019	Coastal Erosion	N/A	N/A	Robert Moses State Park through Shinnecock Inlet	Back to back coastal storms resulted in significant coastal erosion along Suffolk County's south shore. Dune Road experienced overwash, resulting in damage to a commercial dock and several businesses. Dunes were heavily damaged, but no full breeches occurred. Suffolk County supported impacted towns with response and cleanup.

Source: NOAA-NCEI 2020; FEMA 2020; Suffolk County Department of Public Works 2020

Note:

DR	*Federal Disaster Declaration*
EM	*Federal Emergency Declaration*
FEMA	*Federal Emergency Management Agency*
IA	*Individual Assistance*
NA	*Not Available*
NOAA-NCDC	*National Oceanic Atmospheric Administration – National Climate Data Center*
NWS	*National Weather Service*
NYSDPC	*New York State Disaster Preparedness Commission*
PA	*Public Assistance*

Hurricane Sandy

Hurricane Sandy's landfall affected the coastlines over a broad swatch of mid-Atlantic and northeastern states. The effects from this storm included breaching, overwash, and erosion of the barrier islands along the coast. The following figures show different areas of Suffolk County pre- and post-Sandy.

Figure 5.4.1-9 shows aerial photographs of Bridgehampton (Town of Southampton), looking northwest across the south shore of Long Island towards Mecox Bay. This is a very narrow area and periodically opens during large storms. Large volumes of material were transported into Mecox Bay when it breached during Hurricane sandy. One week after the storm, the breach was being closed by mechanical means. The yellow arrow in each image points to the same feature.

Figure 5.4.1-9 Bridgehampton, New York

Source: USGS, 2013

Figure 5.4.1-10 shows aerial photographs of Cupsogue Beach (Village of Westhampton Beach) looking northwest across West Hampton towards Moriches Beach. The breach that formed during Hurricane Sandy is just east of Moriches Inlet, which was formed during a Nor'Easter in 1931 and was stabilized in the 1950s. The yellow arrow points to the same feature.

Figure 5.4.1-10. Cupsogue Beach, New York

Source: USGS, 2013

Figure 5.4.1-11 is an aerial photograph of Pelican Island and Fire Island looking northwest across Fire Island towards Great South Bay. This location is within Fire Island National Seashore, near Old Inlet. It is a very narrow portion of the Island that has experienced breaching in previous large storms. The island breached during Hurricane Sandy, creating a new inlet. Despite the breach, the fishing shack (yellow arrow) remained standing.

Figure 5.4.1-11. Pelican Island and Fire Island, New York

Source: USGS, 2013

Figure 5.4.1-12 is an aerial of Ocean Bay Park, Fire Island looking northwest across Fire Island towards Great South Bay. Overwash from the beach and narrow dunes carried sand inland towards the interior and bayside of the island, and numerous homes were destroyed or severely damaged. The yellow arrow points to the same feature in each photograph.

Figure 5.4.1-12. Ocean Bay Park, Fire Island, New York

Source: USGS, 2013

As stated in the 2014 NYS HMP, beginning with Hurricane Irene in 2011 and Hurricane Sandy in 2012, Fire Island in Suffolk County has experienced above average erosion rates and is considered one of the most vulnerable beaches in the State. Some of the most significant coastal erosion that resulted from Hurricane Sandy was found on Fire Island (Figure 5.4.1-13).

Figure 5.4.1-13. Fire Island Coastal Erosion Survey (USGS) After Hurricane Sandy

Source: NYS HMP, 2014

a leveled beaches, scarped dunes
b damaged homes in Davis Park
c leveled dunes, overwash sheets by the lighthouse
d breach at Old Inlet

Recent Beach Nourishment Activities

To counteract the effects of natural erosion, as well as to prevent storms from devastating beachfront communities, the County has worked with the federal government on beach nourishment projects throughout the County.

In NYS, Coastal Storm Risk Reduction Projects are constructed through a three-way partnership. The USACE is the federal partner, NYS DEC is known as the "Non-Federal Sponsor" and the local municipality is the project's Local Sponsor. These projects are typically cost-shared between the three parties (Federal, State, and local), but under certain circumstances, the federal government may undertake these projects at a 100 percent Federal expense (NYS DEC 2019).

- *Fire Island Inlet and Shores Westerly to Jones Inlet* – The last maintenance dredging cycle was completed in the Winter 2013-14 after Hurricane Sandy with the placement of approximately 2.3 million CY along the critical erosion areas at Gilgo Beach and Tobay Beach. Dredging and placement at Gilgo Beach was completed on March 26, 2008. The previous maintenance dredging cycle was completed in March of 2008 and removed approximately 620,000 CY. STATUS: During FY18, the project was in caretaker status includes monitoring of the channel shoaling conditions, coordination with the users and stakeholders including the USCG; and the monitoring of piping plovers working with the US Fish and Wildlife Service (USACE 2018).

- *Fire Island Inlet to Montauk Point Reformulation Study* – The goal of the Reformulation Study is to identify storm risk management within the overall study area. All efforts, in cooperation between the Corps, State of New York and Department of the Interior, are currently focused on finalization of the Final General Reformulation Report and Final Environmental Impact Statement, which will make the final recommendations for project features. This effort is being completed at 100% Federal expense and was submitted for higher approval on October 23, 2019. After final report approvals, including a Chief's Report (expected April 2020), a Project Partnership Agreement would need to be executed with the State of New York, allowing for initial construction of the various recommended FIMP project features at 100% Federal expense (USACE 2020).

    - *Breach Contingency Plan* – Provided a mechanism for rapid breach closure of the barrier islands through the 83-mile project area. A Breach Contingency Plan was approved in February 1996. Under the approved Project Cooperation Agreement, the Corps was authorized to execute specific PPA’s with the State of New York in order to close breaches immediately after coastal storms. The Sandy storm event of October 2012 resulted in damages to Long Island's barrier beaches. This event breached the barrier island in several locations on Long Island, specifically at Cupsogue County Park and Smith Point County Park, leaving the area vulnerable to significant damages. On November 2, 2012, the State of New York formally requested emergency assistance from the Corps to activate the Breach Contingency Plan. Emergency contract actions were issued for both areas. The Cupsogue breach was closed on November 27, 2012, and the Smith Point breach was closed on December 7, 2012. Sandy also caused a third breach within the Fire Island Wilderness Area (Old Inlet area). This breach is currently open, with ongoing monitoring by NPS underway to determine if the breach will close naturally or if it will be necessary to close the breach via a contract action (USACE 2020).

    - *Westhampton Interim Project* – Provides interim protection to the Westhampton Beach area west of Groin 15 and affected mainland communities north of Moriches Bay. The project provides for a protective beach berm and dune, tapering of existing groins 14 & 15, and construction of an intermediate groin (14a). The project also includes periodic nourishment as necessary to ensure the integrity of the project design, for up to 30 years (thru 2027). Beachfill for this interim project also includes placement within the existing groin field to fill the groin compartments and encourage sand transport to the areas west of groin 15. Initial construction was completed in December 1997 at an approximate cost of $20 million. The project has performed better than anticipated in terms of anticipated cost, project performance and beneficial environmental impacts. The first renourishment effort was completed in February 2001 ($5 million). The second renourishment effort was completed in December 2004 ($4.5 million). A portion of the third renourishment effort was completed in February 2009 ($9.5 million). In response to 2012 Sandy damages, P.L. 113-2, the Disaster Relief Appropriations Act of 2013 funded construction for restoration of this project to its original design template at 100% Federal cost. This construction contract was completed October 2015. The project’s fourth beachfill renourishment contract was awarded on 30 September 2019 to Weeks Marine Inc. for $22.3M. An estimated contract quantity is 1.2M cubic yard of sand based on survey performed on February 2019. The contractor started construction on 26 November 2019 and expected to complete in mid-February 2020 depending on weather conditions. Required coastal and environmental monitoring efforts continue every year within the Westhampton project area (USACE 2020).

- *West of Shinnecock Interim Project* – Provided interim protection to the area immediately west of Shinnecock Inlet up to 4,000 feet westerly, which is a potential breach area. The project was intended to provide protection until implementation of Reformulation Study recommendations. This interim project consisted of initial beachfill placement, with 2 anticipated renourishments, for a period not to exceed 6 years (thru 2011). The placement of sand in this area enabled future maintenance dredging of Shinnecock Inlet to bypass sand past the influence of the inlet. Initial beach fill placement was completed in March 2005 at an approximate cost of $4.3 million. No renourishment efforts were ever completed due to lack of funds. This Interim project is considered complete, until a new recommendation is made by the Reformulation Study, or a new decision document is prepared which would approve the extension of interim nourishment efforts. An emergency contract for P.L. 84-99 rehabilitation of this project, which was damaged by both the Irene and Sandy events, was completed by the Corps in January 2013, placing approximately 300k cy of sand west of the inlet to repair the project to pre-storm conditions. In conjunction with this contract, a Memorandum of Agreement was executed between the Corps and NYS for placement of an additional 124k cy of material at Tiana beach. In response to 2012 Sandy damages, P.L. 113-2, the Disaster Relief Appropriations Act of 2013 funded the construction for restoration of this project to its original design template at 100% Federal cost. This work was completed March 2014, placing an additional 450k cy of sand in the project area (USACE 2020).

- *Post-Sandy One-Time Stabilization Efforts* - The Corps and State of New York developed one-time stabilization plans along the Fire Island barrier island and at Downtown Montauk. These stabilization efforts were one-time placement projects and include no nourishment cycles. The efforts are meant to provide storm management until the implementation and construction of final recommendations of the overall FIMP Reformulation Study (USACE 2020).

- *Downtown Montauk Stabilization* - The Downtown Montauk Stabilization Project consists of a one-time construction of reinforced dune with geotextile bags. The Project Partnership Agreement was executed with the State of New York in March 2015. The project was completed and turned over to the sponsor for operation and maintenance in May 2017 (USACE 2020).

- *Fire Island Stabilization* - The Fire Island Stabilization Project consists of a one-time sand placement along Fire Island, from Robert Moses State Park to Smith Point County Park. The Fire Island Stabilization HSLRR and EA were approved July 2014, with a Project Partnership Agreement executed with the State of New York in August 2014. The first construction contract at Smith Point County Park was completed April 2016. The second construction contract at Robert Moses State Park through Saltaire was completed July 2016. The third construction contract at Fair Harbor through Seaview was completed November 2017. The remaining contracts focus on the Fire Island communities from Ocean Bay Park through Davis Park. The site preparation contracts for demolitions and relocations in Ocean Bay Park through Davis Park are substantially complete as of July 2019. The final beachfill contract of the FIMI project located at Ocean Bay Park through Davis Park is awarded to Weeks Marine and is currently under construction. The Project's final contract for relocation of the Ocean Beach water utility is currently in design with expected award in early 2020 (USACE 2020).

Probability of Future Occurrences

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, wave angles, climate changes, and human causes such as development, removal of vegetation, runoff from development, and impacts of hard structures in the coastal zone (NYS DEC 2020). 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. For information on the probability of coastal storms, refer to the Hurricane (Section 5.4.10) and Nor'Easter (Section 5.4.12) hazard profiles.

In Section 5.3, the identified hazards of concern for Suffolk County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Steering and Planning Committees, the probability of occurrence for coastal erosion in the County is considered 'frequent'.

Climate Change Impacts

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2014).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Suffolk County is part of Region 4, New York City and Long Island. Some of the issues in this region, affected by climate change, include: the area contains the highest population density in the State; sea level rise and storm surge increase coastal flooding, erosion, and wetland loss; challenges for water supply and wastewater treatment; increase in heat-related deaths; illnesses related to air quality increase; and higher summer energy demand stresses the energy system (NYSERDA 2014).

Sea level rise projections for Montauk Point in the middle range estimate (25th to 75th percentile) suggest four to eight inches of rise by the 2020s; 11 to 21 inches by the 2050s; and 18 to 39 inches by the 2080s (based on the 2000-2004 baseline). Scenarios in the high estimate suggest 10 inches by the 2020s; 30 inches by the 2050s; and 58 inches by the 2080s. As decades progress, the expansion of the range is driven by uncertainty in land-based ice mass change, ocean thermal expansion, and regional ocean dynamics (NYSERDA 2014).

Accelerated sea level rise will tend to exacerbate barrier island erosion issues. At low-to-moderate increase in the rates of rise, the effects of sea level rise will still be of lesser magnitude than storm events and disruptions of the longshore sediment transport. At the most extreme rates of increased rate of rise, the barrier islands may not be able to maintain themselves if sea level rise outpaces the ability of the system to supply sediment naturally; thus, exposing the bay and mainland shoreline to more oceanic conditions as the barrier disappears (NYSERDA 2011).

According to NOAA, sea level rise can amplify factors that currently contribute to coastal flooding: high tides, storm surge, high waves, and high runoff from rivers and creeks. Other secondary hazards that could occur along the Mid-Atlantic coast in response to sea level rise include:

- *Bluff and upland erosion* – Shorelines composed of older geologic units that form headland regions of the coast will retreat landward with rising sea level. As sea level rises, the uplands are eroded, and sandy materials are incorporated into the beach and dune systems along the shore and adjacent compartments (Gutierrez et al. 2007).
- *Overwash, inlet processes, shoreline retreat, and barrier island narrowing* – As sea level rise occurs, storm overwash will become more likely. Tidal inlet formation and migration will become important components of future shoreline changes. Barrier islands are subject to inlet formation by storms. If the storm surge produces channels that extend below sea level, an inlet may persist after the storm. The combination of rising sea level and stronger storms can create the potential to accelerate shoreline retreat in many locations. Assessments of shoreline change on barrier islands have shown that barrier island narrowing has been observed on some islands over the last 100 years (Gutierrez et al. 2007).

Impacts of climate change can lead to shoreline erosion, coastal flooding, and water pollution; affecting man-made coastal infrastructures and coastal ecosystems. Coastal areas may be impacted by climate change in different ways. These areas are sensitive to sea level rise, changes in the frequency and intensity of storms, increase in precipitation, and warmer ocean temperatures (USEPA 2017). Temperatures are predicted to increase in Suffolk County, which lead to an increase in intensity and frequency of severe storm. This increase may lead to more weather patterns that cause coastal erosion events.

Vulnerability Assessment

The County's proximity to water, along with a growing population, lays the foundation for Suffolk County's vulnerability to coastal erosion events, both in terms of exposure to and the potential impacts from hazard events. Since Suffolk County is a coastal peninsula bordered by Smithtown Bay and Long Island Sound to the north, the Great South Bay and Hempstead Bay to the south, and the Great Peconic Bay and Little Peconic Bay to the east, this County and its resources are vulnerable all around its perimeter (refer to Figure 5.4.1-14 through Figure 5.4.1-16).

To better understand the County's risk to coastal erosion, the CEHA 98-foot buffer and coastal risk 'moderate', 'high', and 'extreme' hazard areas was considered and used for this analysis. As noted in Section 5.1 (Methodology and Tools), CEHA boundary does not account for coastal erosion hazards for bay-front communities like the Village of Bellport, because the data does not cover areas that are not adjacent to the Atlantic Ocean or Long Island Sound. Refer to Section 5.1 for additional details on the methodology used to assess coastal erosion risk.

Figure 5.4.1-14. Coastal Risk Assessment Areas - West

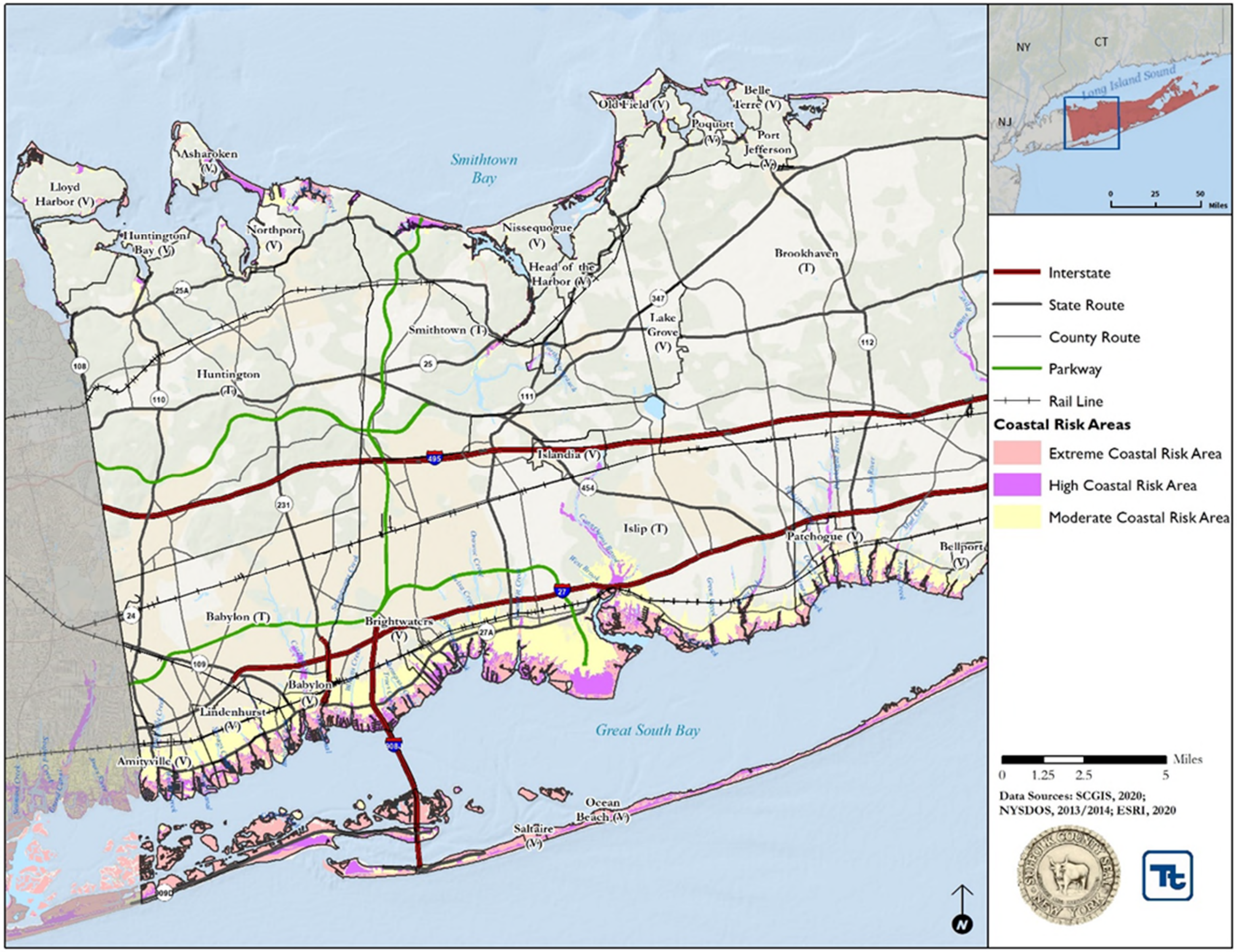


Figure 5.4.1-15. Coastal Risk Assessment Areas - Central

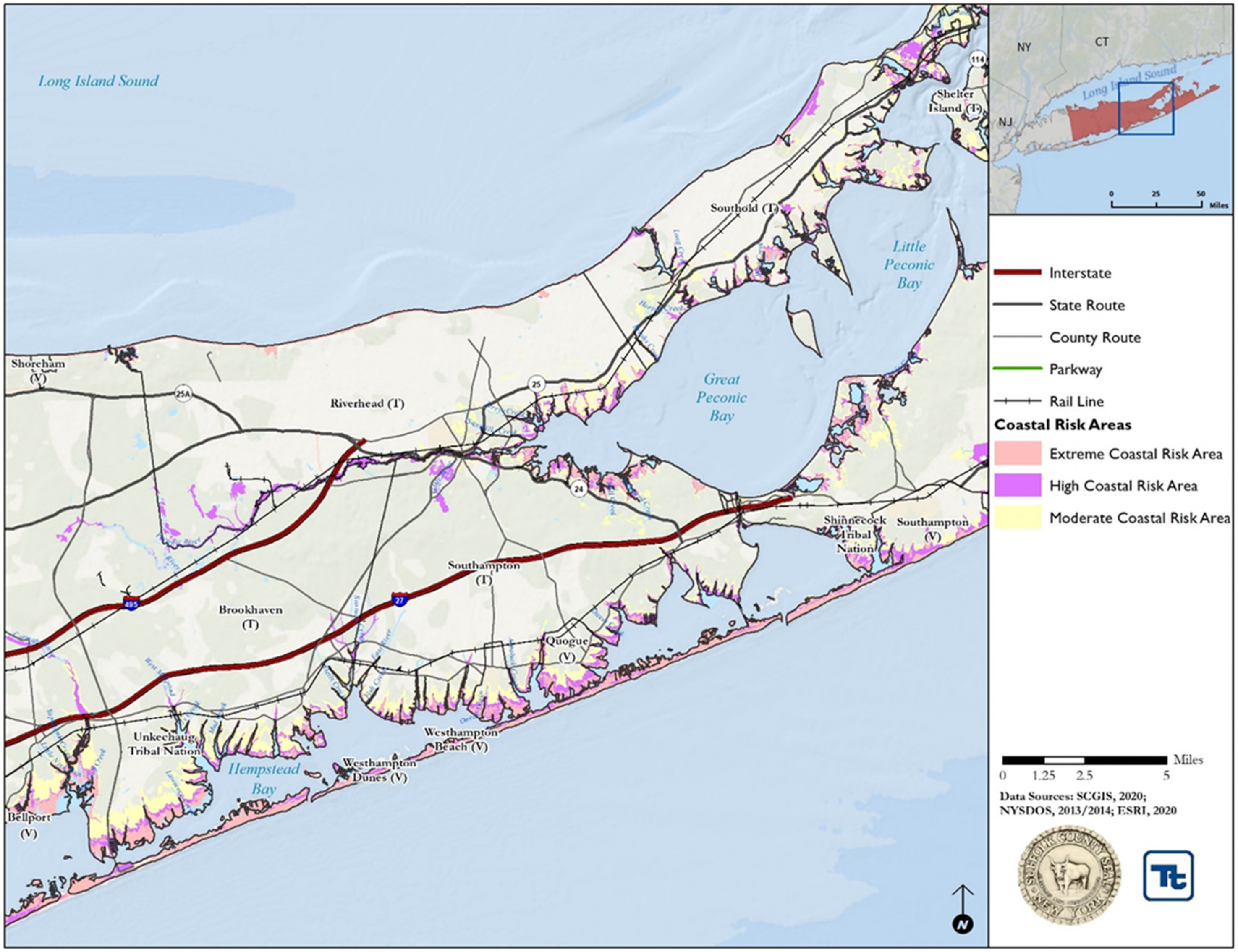
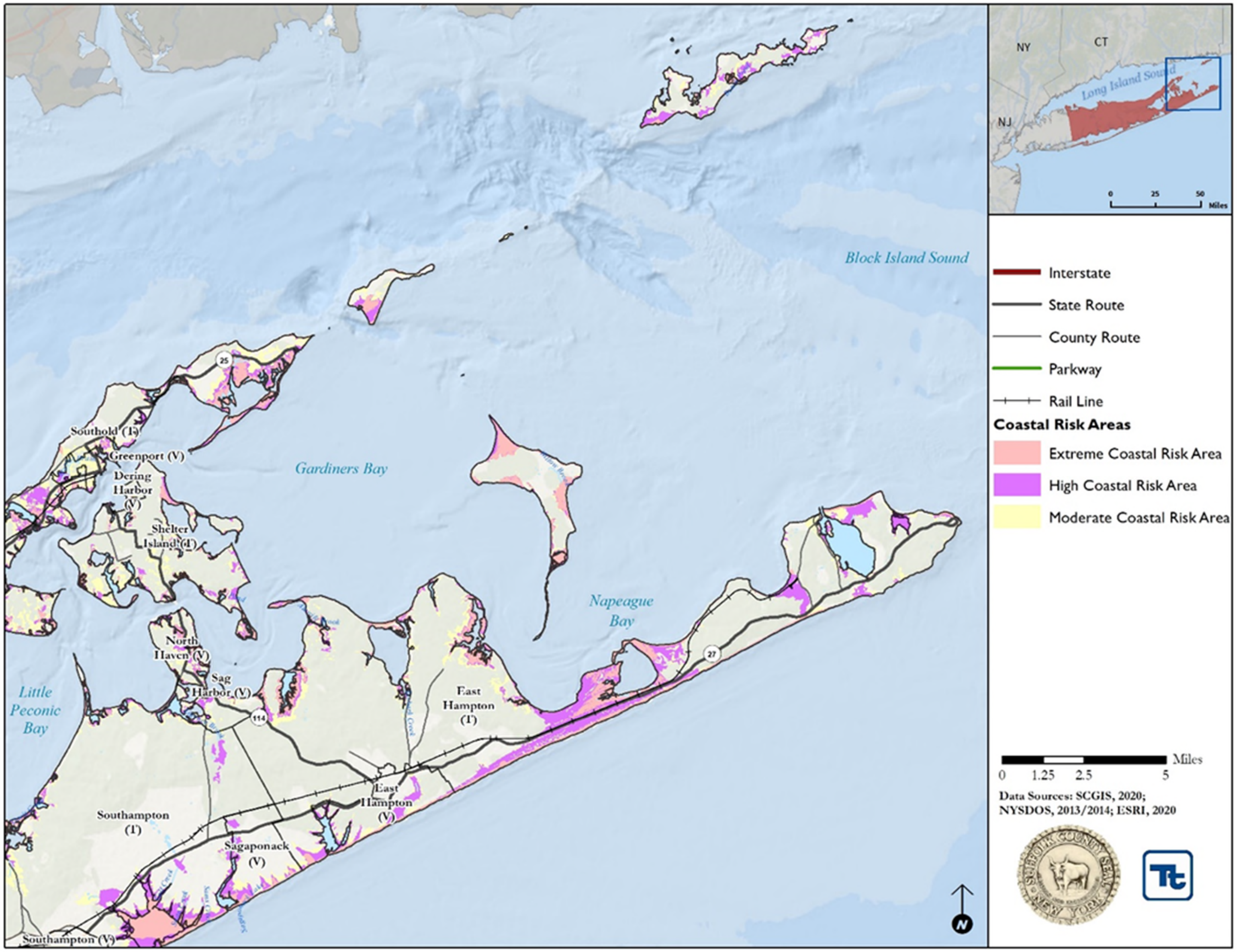


Figure 5.4.1-16. Coastal Risk Assessment Areas - East



Impact on Life, Health and Safety

To estimate population exposed and vulnerable to the coastal erosion hazard areas, a spatial analysis was conducted. Table 5.4.1-2 lists the estimated population located within the CEHA buffer and Coastal Risk Area boundaries by jurisdiction. Overall, 129,838 people live within the moderate coastal risk hazard area, 34,959 people live within the high coastal risk hazard area, and 31,157 people live within the extreme coastal risk hazard area. The same analysis was performed for the coastal erosion hazard buffer and it was estimated that 6,996 people live in the coastal erosion hazard area. The Town of Islip has the greatest number of persons living within the designated coastal risk areas and the Town of Brookhaven has the greatest number of persons living within the CEHA Buffer.

Table 5.4.1-2. Approximate Population in the Coastal Erosion Hazard Areas

Jurisdiction	Total Population American Community Survey 2018 5-Year Estimates (2014-2018)	CEHA with Buffer	% Total	NYSDOS Coastal Risk Areas					
				Moderate	% Total	High	% Total	Extreme	% Total
Amityville (V)	9,452	0	0.0%	3,954	41.8%	894	9.5%	1,705	18.0%
Asharoken (V)	443	107	24.2%	29	6.5%	201	45.4%	84	19.0%
Babylon (T)	162,968	425	0.3%	16,605	10.2%	4,478	2.7%	6,974	4.3%
Babylon (V)	12,089	0	0.0%	7,164	59.3%	1,110	9.2%	2,498	20.7%
Belle Terre (V)	681	27	3.9%	0	0.0%	0	0.0%	9	1.3%
Bellport (V)	2,008	0	0.0%	197	9.8%	20	1.0%	27	1.4%
Brightwaters (V)	3,069	0	0.0%	686	22.3%	276	9.0%	56	1.8%
Brookhaven (T)	448,342	2,089	0.5%	22,392	5.0%	8,509	1.9%	5,553	1.2%
Dering Harbor (V)	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
East Hampton (T)	18,685	592	3.2%	1,291	6.9%	1,131	6.1%	255	1.4%
East Hampton (V)	1,034	26	2.5%	50	4.8%	21	2.0%	25	2.4%
Greenport (V)	1,945	0	0.0%	1,152	59.2%	103	5.3%	61	3.2%
Head of the Harbor (V)	1,463	0	0.0%	9	0.6%	3	0.2%	0	0.0%
Huntington (T)	189,840	466	0.2%	1,104	0.6%	184	0.1%	155	0.1%
Huntington Bay (V)	1,366	0	0.0%	179	13.1%	48	3.5%	2	0.2%
Islandia (V)	3,345	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Islip (T)	326,416	792	0.2%	44,937	13.8%	9,025	2.8%	7,599	2.3%
Lake Grove (V)	11,130	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Lindenhurst (V)	27,053	0	0.0%	11,064	40.9%	915	3.4%	3,210	11.9%
Lloyd Harbor (V)	3,676	30	0.8%	101	2.7%	9	0.2%	0	0.0%
Nissequogue (V)	1,574	34	2.2%	45	2.9%	66	4.2%	40	2.5%
North Haven (V)	919	0	0.0%	281	30.6%	32	3.5%	1	0.1%
Northport (V)	7,348	0	0.0%	151	2.0%	3	0.0%	29	0.4%
Ocean Beach (V)	24	2	6.4%	0	0.6%	6	25.2%	18	74.2%
Old Field (V)	812	66	8.2%	117	14.4%	15	1.9%	7	0.8%
Patchogue (V)	12,398	0	0.0%	4,531	36.5%	1,147	9.3%	539	4.3%
Poquott (V)	992	0	0.0%	34	3.4%	0	0.0%	13	1.3%
Port Jefferson (V)	7,871	50	0.6%	161	2.1%	11	0.1%	0	0.0%

Jurisdiction	Total Population American Community Survey 2018 5-Year Estimates (2014-2018)	CEHA with Buffer	% Total	NYSDOS Coastal Risk Areas					
				Moderate	% Total	High	% Total	Extreme	% Total
Quogue (V)	803	44	5.5%	164	20.4%	145	18.1%	74	9.2%
Riverhead (T)	33,625	623	1.9%	2,180	6.5%	798	2.4%	391	1.2%
Sag Harbor (V)	2,184	0	0.0%	355	16.3%	147	6.7%	6	0.3%
Sagaponack (V)	260	14	5.4%	27	10.3%	21	8.1%	10	3.7%
Saltaire (V)	8	1	14.7%	0	0.0%	1	14.4%	7	85.6%
Shelter Island (T)	2,744	57	2.1%	429	15.7%	45	1.6%	10	0.4%
Shoreham (V)	437	17	3.8%	0	0.0%	0	0.0%	0	0.0%
Smithtown (T)	112,224	37	0.0%	182	0.2%	24	0.0%	13	0.0%
Southampton (T)	51,008	278	0.5%	5,739	11.3%	3,493	6.8%	1,026	2.0%
Southampton (V)	3,263	121	3.7%	193	5.9%	176	5.4%	73	2.2%
Southold (T)	20,202	907	4.5%	3,788	18.8%	1,378	6.8%	306	1.5%
Village of the Branch (V)	1,770	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Westhampton Dunes (V)	69	27	39.5%	1	0.7%	34	49.3%	35	50.0%
Westhampton Beach (V)	1,653	164	9.9%	234	14.2%	375	20.3%	336	22.7%
Shinnecock Tribal Nation	662	0	0.0%	187	28.3%	72	0.3%	2	10.8%
Unkechaug Tribal Nation	324	0	0.0%	126	38.9%	41	2.1%	7	12.5%
Suffolk County	**1,488,179**	**6,996**	**0.5%**	**129,838**	**8.7%**	**34,959**	**2.1%**	**31,157**	**2.3%**

Source: NYS DEC, 2004/2007; NYSDOS, 2013/2014; American Community Survey 5-year Estimate, 2018
Note (1): These population estimates do not include the increase in seasonal population along the coast.
Note (2): The populations are reported as in each zone, not cumulative.

Socially vulnerable populations (e.g., low-income populations, persons with disabilities, and the elderly) in Suffolk County may be at the greatest risk of impacts from coastal erosion. Within the County, there are 104,660 persons living in poverty and 13,147 persons with disabilities. The cost of interventions to protect properties from coastal erosion risk may financially stress lower- or middle-income residents, particularly those living in poverty. Furthermore, people with disabilities and functional needs may also face similar issues to lower-income households. Relocating may be difficult because of the expenses and the availability of accessible housing or the time needed to make housing accessible. Structural improvements may not be possible because doing so could render the housing inaccessible (NYC Emergency Management 2019).

Research has also shown that some populations may experience exacerbated impacts and prolonged recovery if/when impacted. This is due to many factors including their physical and financial ability to react or respond during a hazard. The population over the age of 65 is also more vulnerable and, physically, they may have more difficulty evacuating. They may require extra time or outside assistance during evacuations and are more likely to seek or need medical attention which may not be available due to isolation during a storm event. Population estimates for the County indicate that there are 239,285 persons over 65 currently living in Suffolk County.

Furthermore, the CDC 2016 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Suffolk County's overall score is 0.2318, indicating that in general its communities have low vulnerability (CDC 2016). However, the CDC shows that areas more vulnerable to housing and transportation needs are along the border of the County, i.e., areas most vulnerable to coastal erosion, which may impact the coastal community's ability to respond to or be protected from coastal erosion hazard events.

As discussed above, there are limitations with the application of the CEHA data set for assessing vulnerability. Communities along inland bays like the Shinnecock Bay and the Great South Bay may be vulnerable to coastal erosion hazard but are not assessed based upon the limitation to the data layer's extent.

Impact on General Building Stock

Exposure to coastal erosion hazard areas includes those buildings located in the CEHA buffer and coastal risk areas. Potential damage is the modeled loss that could occur to the exposed inventory measured by the structural and content replacement cost value. There are an estimated 3,873 structures located in the CEHA buffer with a replacement cost value of approximately $7 billion (less than 1-percent of the total replacement cost value in the County). Additionally, there are 47,473 buildings with replacement costs of approximately $77.8 billion (9-percent of total replacement cost value) built in the moderate coastal risk area, 15,086 buildings with replacement costs of approximately $24 billion (2.8-percent of total replacement cost value) built in the high coastal risk area, and 12,517 buildings with replacement costs of approximately $14.7 billion (1.7-percent of total replacement cost value) built in the extreme coastal risk area. Refer to Table 5.4.1-3 through Table 5.4.1-6 for a summary of these potential losses by jurisdiction.

It is important to note that these estimates are considered high because coastal erosion generally occurs in increments of inches to feet per year along the coastline, with the exception of large-scale events, and may not necessarily occur across the entire coastal resource area at the same time.

Table 5.4.1-3. Building Exposure to the Coastal Erosion Hazard Areas - CEHA Buffer

Jurisdiction	Total Number of Buildings	Total RCV	CEHA (with buffer)			
			Count	% Total	Total RCV	% Total
Amityville (V)	4,161	$5,519,611,238	0	0.0%	$0	0.0%
Asharoken (V)	321	$379,192,198	76	23.7%	$79,760,805	21.0%
Babylon (T)	51,514	$82,740,965,827	137	0.3%	$141,452,948	0.2%
Babylon (V)	4,957	$6,110,029,951	0	0.0%	$0	0.0%
Belle Terre (V)	316	$680,761,603	13	4.1%	$39,128,129	5.7%
Bellport (V)	1,206	$2,358,752,934	0	0.0%	$0	0.0%
Brightwaters (V)	1,162	$1,932,120,865	0	0.0%	$0	0.0%
Brookhaven (T)	154,866	$221,811,756,528	706	0.5%	$791,994,734	0.4%
Dering Harbor (V)	41	$88,595,797	0	0.0%	$0	0.0%
East Hampton (T)	18,243	$26,516,571,402	597	3.3%	$1,117,080,641	4.2%
East Hampton (V)	1,938	$5,002,346,911	56	2.9%	$207,852,122	4.2%
Greenport (V)	982	$1,316,147,268	0	0.0%	$0	0.0%
Head of the Harbor (V)	527	$1,052,509,872	0	0.0%	$0	0.0%
Huntington (T)	62,226	$82,709,382,979	154	0.2%	$142,165,762	0.2%
Huntington Bay (V)	593	$642,162,208	0	0.0%	$0	0.0%
Islandia (V)	1,039	$4,798,220,611	0	0.0%	$0	0.0%
Islip (T)	86,764	$157,009,867,271	200	0.2%	$158,453,995	0.1%
Lake Grove (V)	3,693	$4,999,176,933	0	0.0%	$0	0.0%
Lindenhurst (V)	9,387	$9,110,586,538	0	0.0%	$0	0.0%
Lloyd Harbor (V)	1,301	$2,057,808,899	11	0.8%	$20,545,017	1.0%
Nissequogue (V)	638	$1,430,093,283	20	3.1%	$43,851,140	3.1%
North Haven (V)	772	$2,221,433,929	0	0.0%	$0	0.0%
Northport (V)	2,702	$2,610,724,998	0	0.0%	$0	0.0%
Ocean Beach (V)	530	$483,689,958	35	6.6%	$34,638,195	7.2%
Old Field (V)	391	$967,667,970	44	11.3%	$107,056,485	11.1%
Patchogue (V)	3,900	$11,533,289,631	0	0.0%	$0	0.0%
Poquott (V)	379	$540,263,069	0	0.0%	$0	0.0%
Port Jefferson (V)	3,133	$10,546,648,033	19	0.6%	$80,239,417	0.8%
Quogue (V)	1,785	$5,371,998,365	109	6.1%	$405,054,032	7.5%
Riverhead (T)	16,853	$27,561,801,284	257	1.5%	$183,585,161	0.7%
Sag Harbor (V)	1,887	$3,157,033,580	0	0.0%	$0	0.0%

Jurisdiction	Total Number of Buildings	Total RCV	CEHA (with buffer)			
			Count	% Total	Total RCV	% Total
Sagaponack (V)	908	$3,548,811,980	44	4.8%	$145,671,974	4.1%
Saltaire (V)	399	$406,571,331	57	14.3%	$59,864,428	14.7%
Shelter Island (T)	2,729	$3,894,434,021	51	1.9%	$82,123,605	2.1%
Shoreham (V)	216	$381,052,410	9	4.2%	$31,595,446	8.3%
Smithtown (T)	35,517	$62,086,530,012	28	0.1%	$59,791,152	0.1%
Southampton (T)	33,290	$69,558,169,929	184	0.6%	$784,176,142	1.1%
Southampton (V)	3,500	$13,027,590,722	141	4.0%	$799,265,184	6.1%
Southold (T)	15,123	$17,842,698,534	628	4.2%	$625,483,374	3.5%
Village of the Branch (V)	624	$1,414,333,647	0	0.0%	$0	0.0%
Westhampton Dunes (V)	279	$766,363,715	110	39.4%	$319,469,820	41.7%
Westhampton Beach (V)	1,965	$5,590,458,778	187	9.5%	$599,021,669	10.7%
Shinnecock Tribal Nation	378	$155,005,274	0	0.0%	$0	0.0%
Unkechaug Tribal Nation	144	$55,549,783	0	0.0%	$0	0.0%
Suffolk County (Total)	**533,279**	**$861,988,782,069**	**3,873**	**0.7%**	**$7,059,321,375**	**0.8%**

Source: NYS DEC, 2004/2007; NYSDOS, 2013/2014; RS Means 2019; Suffolk County GIS 2020; Microsoft, 2018, Open Street Map, 2019; Suffolk County Real Property Tax Service, 2020
Notes: RCV = Total replacement cost value (structure and contents)

Table 5.4.1-4. Building Exposure to the Coastal Erosion Hazard Areas - Moderate Coastal Risk Area

Jurisdiction	Total Number of Buildings	Total RCV	Coastal Risk Area - Moderate			
			Count	% Total	Total RCV	% Total
Amityville (V)	4,161	$5,519,611,238	1,679	40.4%	$1,898,923,775	34.4%
Asharoken (V)	321	$379,192,198	21	6.5%	$29,162,336	7.7%
Babylon (T)	51,514	$82,740,965,827	5,144	10.0%	$7,796,927,515	9.4%
Babylon (V)	4,957	$6,110,029,951	3,003	60.6%	$4,417,126,082	72.3%
Belle Terre (V)	316	$680,761,603	0	0.0%	$0	0.0%
Bellport (V)	1,206	$2,358,752,934	112	9.3%	$219,695,798	9.3%
Brightwaters (V)	1,162	$1,932,120,865	251	21.6%	$537,135,403	27.8%
Brookhaven (T)	154,866	$221,811,756,528	7,528	4.9%	$7,638,165,024	3.4%
Dering Harbor (V)	41	$88,595,797	5	12.2%	$11,671,391	13.2%
East Hampton (T)	18,243	$26,516,571,402	1,324	7.3%	$2,017,738,532	7.6%
East Hampton (V)	1,938	$5,002,346,911	88	4.5%	$230,958,231	4.6%
Greenport (V)	982	$1,316,147,268	588	59.9%	$833,599,532	63.3%
Head of the Harbor (V)	527	$1,052,509,872	3	0.6%	$3,865,424	0.4%
Huntington (T)	62,226	$82,709,382,979	507	0.8%	$1,430,473,265	1.7%
Huntington Bay (V)	593	$642,162,208	77	13.0%	$84,856,960	13.2%
Islandia (V)	1,039	$4,798,220,611	0	0.0%	$0	0.0%
Islip (T)	86,764	$157,009,867,271	12,196	14.1%	$24,775,022,891	15.8%
Lake Grove (V)	3,693	$4,999,176,933	0	0.0%	$0	0.0%
Lindenhurst (V)	9,387	$9,110,586,538	3,851	41.0%	$3,467,964,679	38.1%
Lloyd Harbor (V)	1,301	$2,057,808,899	37	2.8%	$52,205,339	2.5%
Nissequogue (V)	638	$1,430,093,283	17	2.7%	$25,835,133	1.8%
North Haven (V)	772	$2,221,433,929	240	31.1%	$693,589,868	31.2%
Northport (V)	2,702	$2,610,724,998	85	3.1%	$219,894,216	8.4%
Ocean Beach (V)	530	$483,689,958	3	0.6%	$1,002,300	0.2%
Old Field (V)	391	$967,667,970	58	14.8%	$167,674,261	17.3%
Patchogue (V)	3,900	$11,533,289,631	1,351	34.6%	$2,214,975,717	19.2%
Poquott (V)	379	$540,263,069	13	3.4%	$22,424,049	4.2%
Port Jefferson (V)	3,133	$10,546,648,033	144	4.6%	$2,829,317,138	26.8%
Quogue (V)	1,785	$5,371,998,365	381	21.3%	$1,383,309,573	25.8%
Riverhead (T)	16,853	$27,561,801,284	1,003	6.0%	$965,362,893	3.5%
Sag Harbor (V)	1,887	$3,157,033,580	321	17.0%	$705,662,417	22.4%
Sagaponack (V)	908	$3,548,811,980	97	10.7%	$440,903,036	12.4%
Saltaire (V)	399	$406,571,331	0	0.0%	$0	0.0%

Jurisdiction	Total Number of Buildings	Total RCV	Coastal Risk Area - Moderate			
			Count	% Total	Total RCV	% Total
Shelter Island (T)	2,729	$3,894,434,021	399	14.6%	$524,121,001	13.5%
Shoreham (V)	216	$381,052,410	0	0.0%	$0	0.0%
Smithtown (T)	35,517	$62,086,530,012	68	0.2%	$75,515,785	0.1%
Southampton (T)	33,290	$69,558,169,929	3,580	10.8%	$7,274,734,881	10.5%
Southampton (V)	3,500	$13,027,590,722	197	5.6%	$1,039,441,905	8.0%
Southold (T)	15,123	$17,842,698,534	2,627	17.4%	$2,616,779,266	14.7%
Village of the Branch (V)	624	$1,414,333,647	0	0.0%	$0	0.0%
Westhampton Dunes (V)	279	$766,363,715	2	0.7%	$4,813,800	0.6%
Westhampton Beach (V)	1,965	$5,590,458,778	310	15.8%	$1,090,084,294	19.5%
Shinnecock Tribal Nation	378	$155,005,274	107	28.3%	$43,910,131	28.3%
Unkechaug Tribal Nation	144	$55,549,783	56	38.9%	$21,490,459	38.7%
Suffolk County (Total)	**533,279**	**$861,988,782,069**	**47,473**	**8.9%**	**$77,806,334,299**	**9.0%**

Source: NYS DEC, 2004/2007; NYSDOS, 2013/2014; RS Means 2019; Suffolk County GIS 2020; Microsoft, 2018, Open Street Map, 2019; Suffolk County Real Property Tax Service, 2020

Notes: RCV = Total replacement cost value (structure and contents)

Table 5.4.1-5. Building Exposure to the Coastal Erosion Hazard Areas - High Coastal Risk Area

Jurisdiction	Total Number of Buildings	Total RCV	Coastal Risk Area - High			
			Count	% Total	Total RCV	% Total
Amityville (V)	4,161	$5,519,611,238	364	8.7%	$297,076,222	5.4%
Asharoken (V)	321	$379,192,198	141	43.9%	$149,486,802	39.4%
Babylon (T)	51,514	$82,740,965,827	1,349	2.6%	$937,794,998	1.1%
Babylon (V)	4,957	$6,110,029,951	444	9.0%	$518,066,238	8.5%
Belle Terre (V)	316	$680,761,603	0	0.0%	$0	0.0%
Bellport (V)	1,206	$2,358,752,934	11	0.9%	$27,604,500	1.2%
Brightwaters (V)	1,162	$1,932,120,865	105	9.0%	$236,242,963	12.2%
Brookhaven (T)	154,866	$221,811,756,528	2,881	1.9%	$2,755,472,152	1.2%
Dering Harbor (V)	41	$88,595,797	0	0.0%	$0	0.0%
East Hampton (T)	18,243	$26,516,571,402	1,126	6.2%	$1,422,102,897	5.4%
East Hampton (V)	1,938	$5,002,346,911	40	2.1%	$75,801,086	1.5%
Greenport (V)	982	$1,316,147,268	69	7.0%	$185,785,351	14.1%
Head of the Harbor (V)	527	$1,052,509,872	1	0.2%	$1,110,000	0.1%
Huntington (T)	62,226	$82,709,382,979	100	0.2%	$183,693,436	0.2%
Huntington Bay (V)	593	$642,162,208	26	4.4%	$27,935,657	4.4%
Islandia (V)	1,039	$4,798,220,611	0	0.0%	$0	0.0%
Islip (T)	86,764	$157,009,867,271	2,477	2.9%	$4,068,910,605	2.6%
Lake Grove (V)	3,693	$4,999,176,933	0	0.0%	$0	0.0%
Lindenhurst (V)	9,387	$9,110,586,538	312	3.3%	$404,403,968	4.4%
Lloyd Harbor (V)	1,301	$2,057,808,899	9	0.7%	$21,869,048	1.1%
Nissequogue (V)	638	$1,430,093,283	29	4.5%	$41,547,411	2.9%
North Haven (V)	772	$2,221,433,929	27	3.5%	$64,850,611	2.9%
Northport (V)	2,702	$2,610,724,998	8	0.3%	$17,086,069	0.7%
Ocean Beach (V)	530	$483,689,958	125	23.6%	$90,842,938	18.8%
Old Field (V)	391	$967,667,970	10	2.6%	$24,771,342	2.6%
Patchogue (V)	3,900	$11,533,289,631	334	8.6%	$523,450,296	4.5%
Poquott (V)	379	$540,263,069	0	0.0%	$0	0.0%
Port Jefferson (V)	3,133	$10,546,648,033	36	1.1%	$765,157,896	7.3%
Quogue (V)	1,785	$5,371,998,365	300	16.8%	$1,078,179,258	20.1%
Riverhead (T)	16,853	$27,561,801,284	360	2.1%	$424,546,447	1.5%
Sag Harbor (V)	1,887	$3,157,033,580	150	7.9%	$368,679,584	11.7%
Sagaponack (V)	908	$3,548,811,980	70	7.7%	$243,222,848	6.9%
Saltaire (V)	399	$406,571,331	59	14.8%	$63,461,106	15.6%
Shelter Island (T)	2,729	$3,894,434,021	55	2.0%	$143,513,783	3.7%
Shoreham (V)	216	$381,052,410	0	0.0%	$0	0.0%

Jurisdiction	Total Number of Buildings	Total RCV	Coastal Risk Area - High			
			Count	% Total	Total RCV	% Total
Smithtown (T)	35,517	$62,086,530,012	11	0.0%	$32,031,209	0.1%
Southampton (T)	33,290	$69,558,169,929	2,219	6.7%	$4,787,367,997	6.9%
Southampton (V)	3,500	$13,027,590,722	185	5.3%	$1,101,999,685	8.5%
Southold (T)	15,123	$17,842,698,534	1,047	6.9%	$1,225,409,208	6.9%
Village of the Branch (V)	624	$1,414,333,647	0	0.0%	$0	0.0%
Westhampton Dunes (V)	279	$766,363,715	138	49.5%	$406,790,237	53.1%
Westhampton Beach (V)	1,965	$5,590,458,778	409	20.8%	$1,326,744,835	23.7%
Shinnecock Tribal Nation	378	$155,005,274	41	10.8%	$13,729,992	8.9%
Unkechaug Tribal Nation	144	$55,549,783	18	12.5%	$5,705,945	10.3%
Suffolk County (Total)	**533,279**	**$861,988,782,069**	**15,086**	**2.8%**	**$24,062,444,619**	**2.8%**

Source: NYS DEC, 2004/2007; NYSDOS, 2013/2014; RS Means 2019; Suffolk County GIS 2020; Microsoft, 2018, Open Street Map, 2019; Suffolk County Real Property Tax Service, 2020
Notes: RCV = Total replacement cost value (structure and contents)

Table 5.4.1-6. Building Exposure to the Coastal Erosion Hazard Areas - Extreme Coastal Risk Area

Jurisdiction	Total Number of Buildings	Total RCV	Coastal Risk Area - Extreme			
			Count	% Total	Total RCV	% Total
Amityville (V)	4,161	$5,519,611,238	718	17.3%	$544,484,174	9.9%
Asharoken (V)	321	$379,192,198	58	18.1%	$48,981,600	12.9%
Babylon (T)	51,514	$82,740,965,827	2,087	4.1%	$1,386,273,618	1.7%
Babylon (V)	4,957	$6,110,029,951	997	20.1%	$796,930,644	13.0%
Belle Terre (V)	316	$680,761,603	4	1.3%	$8,579,400	1.3%
Bellport (V)	1,206	$2,358,752,934	20	1.7%	$27,640,734	1.2%
Brightwaters (V)	1,162	$1,932,120,865	20	1.7%	$34,725,857	1.8%
Brookhaven (T)	154,866	$221,811,756,528	1,943	1.3%	$1,962,267,343	0.9%
Dering Harbor (V)	41	$88,595,797	0	0.0%	$0	0.0%
East Hampton (T)	18,243	$26,516,571,402	267	1.5%	$439,507,482	1.7%
East Hampton (V)	1,938	$5,002,346,911	53	2.7%	$177,119,472	3.5%
Greenport (V)	982	$1,316,147,268	33	3.4%	$48,016,755	3.6%
Head of the Harbor (V)	527	$1,052,509,872	0	0.0%	$0	0.0%
Huntington (T)	62,226	$82,709,382,979	70	0.1%	$64,576,721	0.1%
Huntington Bay (V)	593	$642,162,208	7	1.2%	$21,591,931	3.4%
Islandia (V)	1,039	$4,798,220,611	0	0.0%	$0	0.0%
Islip (T)	86,764	$157,009,867,271	2,246	2.6%	$3,153,985,811	2.0%
Lake Grove (V)	3,693	$4,999,176,933	0	0.0%	$0	0.0%
Lindenhurst (V)	9,387	$9,110,586,538	1,100	11.7%	$739,954,526	8.1%
Lloyd Harbor (V)	1,301	$2,057,808,899	8	0.6%	$21,075,622	1.0%
Nissequogue (V)	638	$1,430,093,283	21	3.3%	$31,857,388	2.2%
North Haven (V)	772	$2,221,433,929	1	0.1%	$660,881	0.0%
Northport (V)	2,702	$2,610,724,998	11	0.4%	$10,083,922	0.4%
Ocean Beach (V)	530	$483,689,958	402	75.8%	$391,844,720	81.0%
Old Field (V)	391	$967,667,970	7	1.8%	$12,945,954	1.3%
Patchogue (V)	3,900	$11,533,289,631	186	4.8%	$211,412,260	1.8%
Poquott (V)	379	$540,263,069	5	1.3%	$960,284	0.2%
Port Jefferson (V)	3,133	$10,546,648,033	6	0.2%	$2,132,338	0.0%
Quogue (V)	1,785	$5,371,998,365	166	9.3%	$560,181,847	10.4%
Riverhead (T)	16,853	$27,561,801,284	162	1.0%	$121,466,263	0.4%
Sag Harbor (V)	1,887	$3,157,033,580	7	0.4%	$7,357,879	0.2%
Sagaponack (V)	908	$3,548,811,980	33	3.6%	$84,980,062	2.4%
Saltaire (V)	399	$406,571,331	340	85.2%	$343,110,225	84.4%
Shelter Island (T)	2,729	$3,894,434,021	17	0.6%	$34,086,832	0.9%
Shoreham (V)	216	$381,052,410	0	0.0%	$0	0.0%

Jurisdiction	Total Number of Buildings	Total RCV	Coastal Risk Area - Extreme			
			Count	% Total	Total RCV	% Total
Smithtown (T)	35,517	$62,086,530,012	11	0.0%	$29,719,886	0.0%
Southampton (T)	33,290	$69,558,169,929	664	2.0%	$1,538,991,557	2.2%
Southampton (V)	3,500	$13,027,590,722	85	2.4%	$392,783,331	3.0%
Southold (T)	15,123	$17,842,698,534	253	1.7%	$240,472,206	1.3%
Village of the Branch (V)	624	$1,414,333,647	0	0.0%	$0	0.0%
Westhampton Dunes (V)	279	$766,363,715	139	49.8%	$354,759,678	46.3%
Westhampton Beach (V)	1,965	$5,590,458,778	366	18.6%	$925,775,007	16.6%
Shinnecock Tribal Nation	378	$155,005,274	1	0.3%	$77,388	0.0%
Unkechaug Tribal Nation	144	$55,549,783	3	2.1%	$1,009,804	1.8%
Suffolk County (Total)	**533,279**	**$861,988,782,069**	**12,517**	**2.3%**	**$14,772,381,406**	**1.7%**

Source: NYS DEC, 2004/2007; NYSDOS, 2013/2014; RS Means 2019; Suffolk County GIS 2020; Microsoft, 2018, Open Street Map, 2019; Suffolk County Real Property Tax Service, 2020

Notes: RCV = Total replacement cost value (structure and contents)

Impact on Critical Facilities

It is important to determine the critical facilities and infrastructure that may be at risk to coastal erosion impacts, and who may be impacted should damage occur. Coastal erosion can degrade the surrounding infrastructure and utility lines, depending on their location on the property. Critical services may be postponed due to direct damage or if transportation corridors that connect these facilities to the community are damaged due to coastal erosion impacts. Roads that are damaged may even isolate residents and can prevent access throughout the planning area to many service providers needing to reach vulnerable populations or to make repairs.

Critical facility exposure to these coastal erosion hazard areas was examined. If the critical facility is built within the coastal erosion hazard area, it is considered exposed. Furthermore, these critical facilities may also be considered a lifeline facility according to FEMA's guidelines. These categories include communication; energy; food, water, and shelter; health and medical; safety and security; and transportation. Therefore, the analysis reviewed the number of critical facilities, thus the number of lifelines, per jurisdiction that are built within these hazard areas.

Coastal erosion can severely impact Suffolk County's roads and infrastructure, including the ability of communities to evacuate during coastal hazard events. There are 270 miles of local, State, major highway, and County roads that lie within the extreme coastal erosion risk area and are vulnerable to coastal erosion (refer to Figure 5.4.1-17 through Figure 5.4.1-19). There are an estimated 2.7 miles of the exposed transportation routes classified by DOT as major evacuation routes. Major highways at risk include portions of the RMC Inlet Bridge, Robert Moses Causeway, and Sunrise Highway. Interruptions in evacuation routes can simultaneously cause disruption to services provided by critical facilities within the County. Not only can flooded or breached roadways isolate these facilities from the community, they are also at risk of becoming structurally damaged due to flood and erosion exposure. Additionally, 17 major transportation critical facilities are built within the extreme coastal risk area, 7 of which are located in the Town of Islip. These transportation critical facilities range from bridges, ferries, and terminals, which may be considered major corridors for essential services and economic activity in the County within its coastal communities.

Figure 5.4.1-17. Evacuation Routes in Suffolk County – West

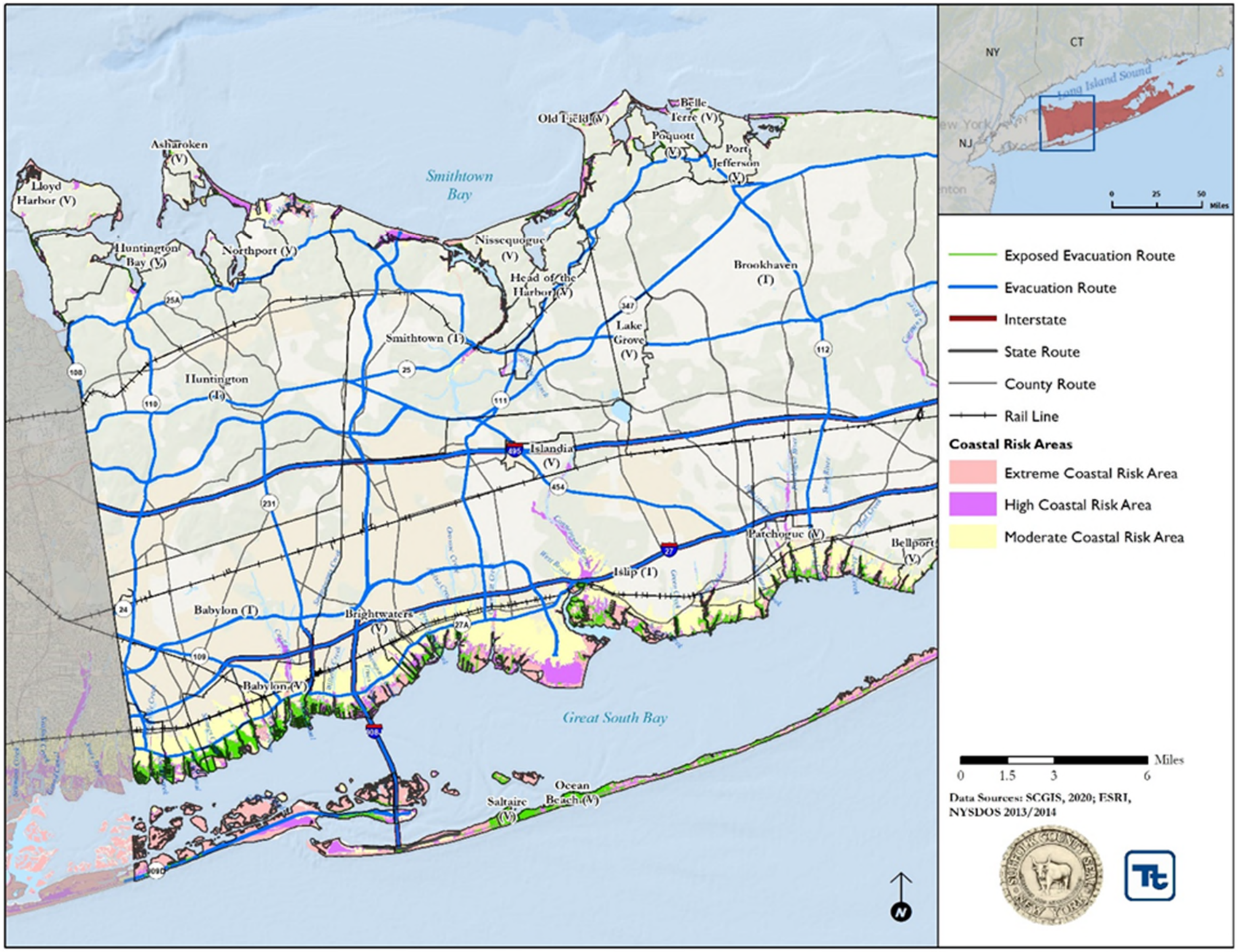


Figure 5.4.1-18. Evacuation Routes in Suffolk County – Central

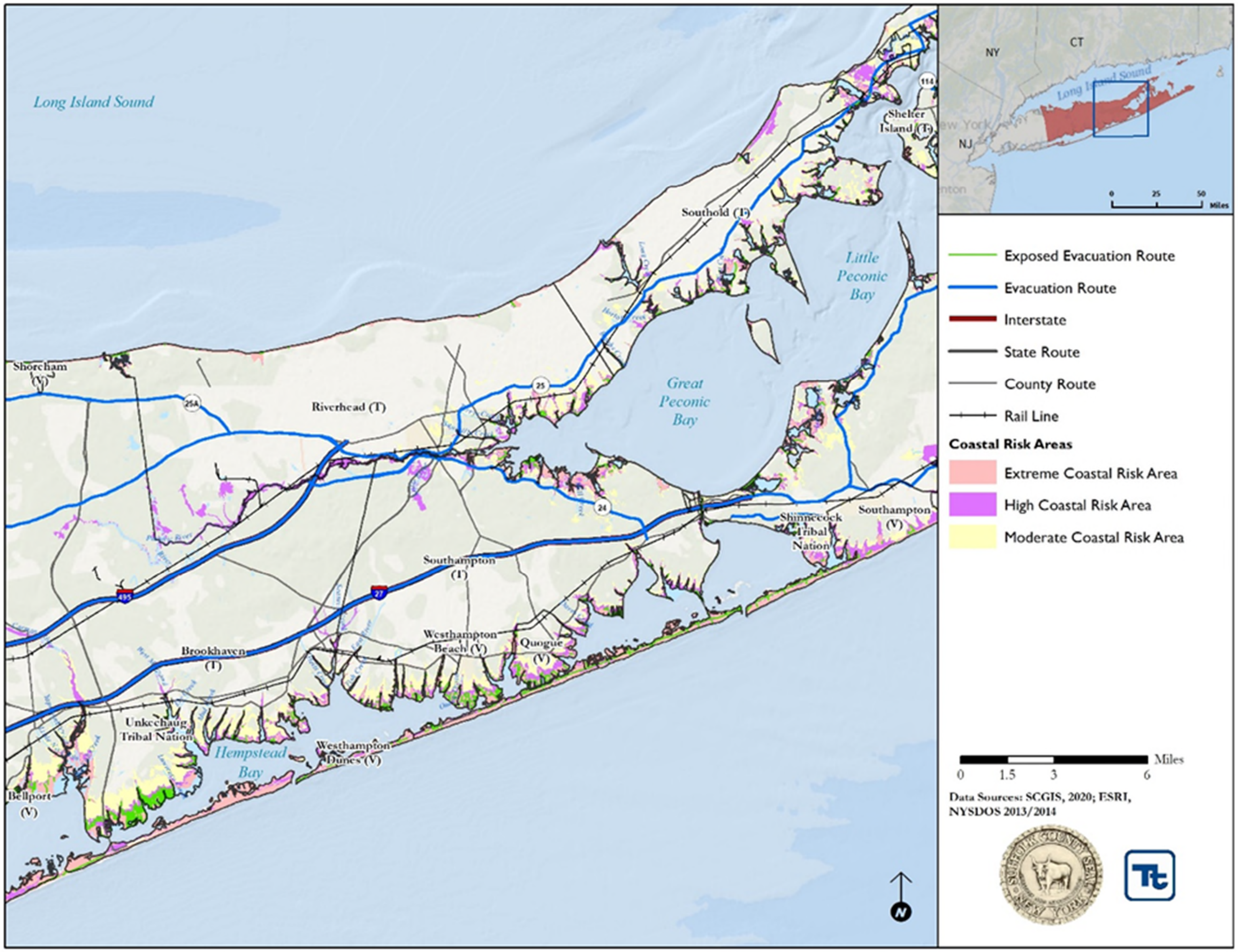


Figure 5.4.1-19. Evacuation Routes in Suffolk County – East

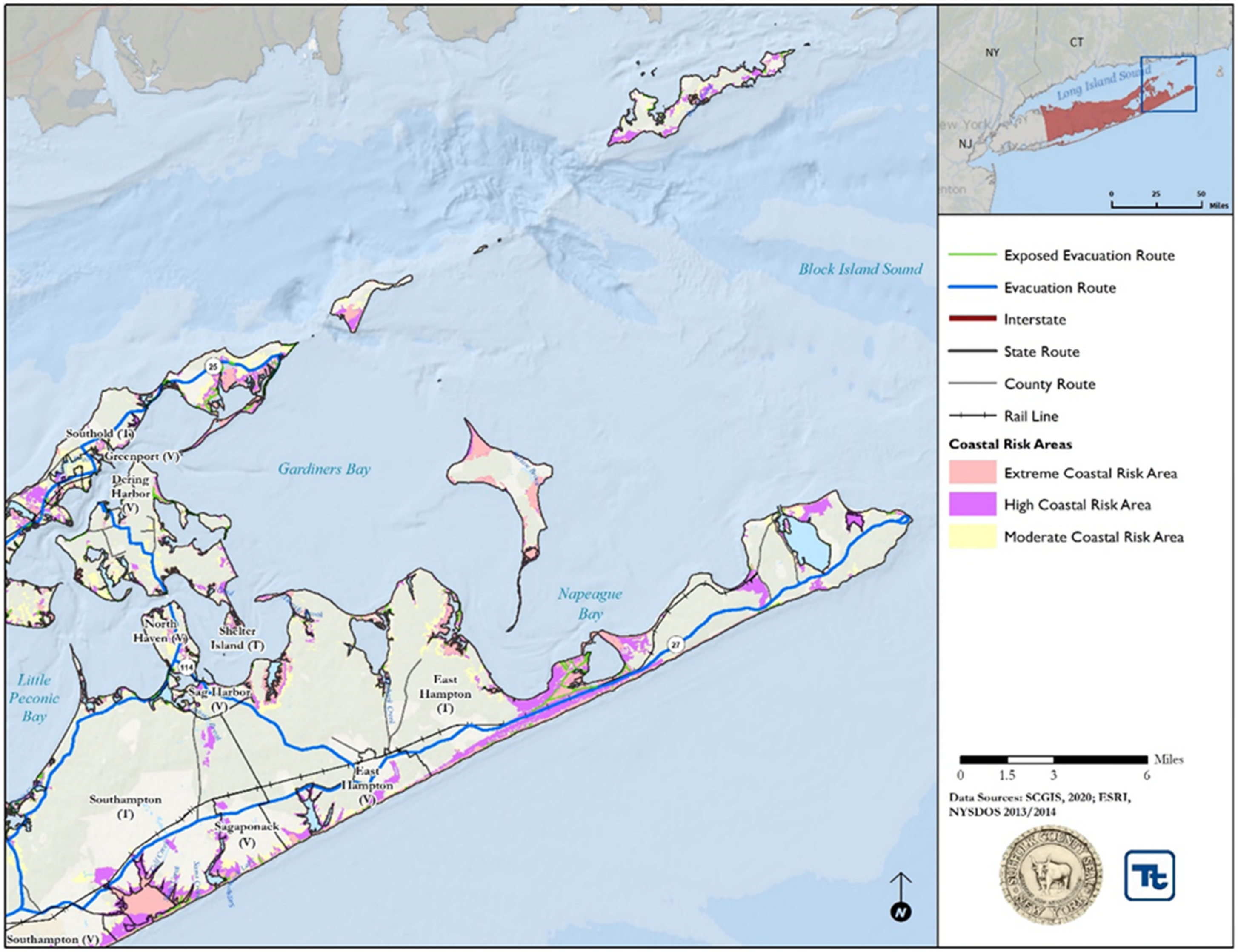


Table 5.4.1-4 and Table 5.4.1-5 summarize the number of critical facilities and lifelines at risk of coastal erosion per jurisdiction, and are summarized by each FEMA lifeline category, respectively.

Table 5.4.1-7. Critical Facilities and Lifelines Located in the CEHA Buffer and Coastal Risk Hazard Areas

Jurisdiction	Total CFs	Total Lifelines	CEHA Buffer (CF)	CEHA Buffer (Lifelines)	Moderate CRA (CF)	Moderate CRA (Lifelines)	High CRA (CF)	High CRA (Lifelines)	Extreme CRA (CF)	Extreme CRA (Lifelines)
Amityville (V)	85	62	0	0	18	12	3	2	1	1
Asharoken (V)	4	3	1	1	0	0	3	2	0	0
Babylon (T)	1,029	741	1	0	92	69	6	2	8	6
Babylon (V)	93	64	0	0	84	57	2	2	2	2
Belle Terre (V)	6	5	0	0	0	0	0	0	0	0
Bellport (V)	35	25	0	0	1	1	0	0	0	0
Brightwaters (V)	14	11	0	0	3	2	1	1	1	1
Brookhaven (T)	2,798	2,272	4	4	87	68	22	19	13	11
Dering Harbor (V)	2	2	0	0	0	0	0	0	0	0
East Hampton (T)	234	204	0	0	14	12	10	8	1	1
East Hampton (V)	37	23	0	0	1	1	1	1	0	0
Greenport (V)	33	20	0	0	14	8	5	5	0	0
Head of the Harbor (V)	11	9	0	0	0	0	0	0	0	0
Huntington (T)	961	664	1	0	26	21	4	4	0	0
Huntington Bay (V)	2	2	0	0	0	0	0	0	0	0
Islandia (V)	70	62	0	0	0	0	0	0	0	0
Islip (T)	2,275	1,740	1	1	316	237	29	26	27	27
Lake Grove (V)	50	38	0	0	0	0	0	0	0	0
Lindenhurst (V)	104	62	0	0	42	24	1	1	2	1
Lloyd Harbor (V)	16	12	0	0	0	0	1	1	0	0
Nissequogue (V)	7	4	0	0	0	0	0	0	0	0
North Haven (V)	3	1	0	0	2	1	0	0	0	0
Northport (V)	40	24	0	0	3	1	1	1	0	0
Ocean Beach (V)	5	4	0	0	0	0	0	0	5	4
Old Field (V)	4	3	1	1	0	0	0	0	0	0
Patchogue (V)	92	63	0	0	18	14	6	5	4	4
Poquott (V)	2	2	0	0	0	0	0	0	0	0
Port Jefferson (V)	95	71	0	0	16	12	8	6	1	1
Quogue (V)	19	13	0	0	8	6	1	0	0	0
Riverhead (T)	428	346	0	0	24	23	18	17	3	3
Sag Harbor (V)	37	24	0	0	10	9	5	5	0	0
Sagaponack (V)	3	3	0	0	0	0	0	0	0	0
Saltaire (V)	8	6	0	0	0	0	2	1	5	4
Shelter Island (T)	41	32	0	0	1	1	3	3	2	2
Shoreham (V)	7	5	1	1	0	0	0	0	0	0
Smithtown (T)	708	542	0	0	2	2	4	4	0	0
Southampton (T)	667	580	0	0	36	33	23	23	4	3
Southampton (V)	63	44	1	0	0	0	0	0	3	2
Southold (T)	275	230	1	0	26	22	26	24	4	3

Jurisdiction	Total CFs	Total Lifelines	CEHA Buffer (CF)	CEHA Buffer (Lifelines)	Moderate CRA (CF)	Moderate CRA (Lifelines)	High CRA (CF)	High CRA (Lifelines)	Extreme CRA (CF)	Extreme CRA (Lifelines)
Southold (T)	38	23	0	0	0	0	0	0	0	0
Village of the Branch (V)	5	5	2	2	0	0	3	3	2	2
Westhampton Dunes (V)	47	39	3	3	11	7	2	2	4	4
Westhampton Beach (V)	22	22	0	0	14	14	2	2	1	1
Shinnecock Tribal Nation	11	10	0	0	4	4	0	0	1	1
Unkechaug Tribal Nation	10,486	8,117	17	13	873	661	192	170	94	84
Suffolk County (Total)	**10,220**	**8,117**	**15**	**13**	**857**	**661**	**188**	**170**	**90**	**84**

Source: NYS DEC 2004/2007; NYSDOS, 2013/2014; Suffolk County GIS 2020
Notes: CFs = Critical Facilities; CEHA = Coastal Erosion Hazard Area; CRA = Coastal Risk Area

Table 5.4.1-8. Total Lifelines in the Coastal Erosion Hazard Areas

Lifeline Categories	Total Lifelines in County	Coastal Erosion Hazard Area (CEHA) Exposure	Moderate Coastal Risk Area Exposure	High Coastal Risk Area Exposure	Extreme Coastal Risk Area Exposure
Communication	126	0	6	4	1
Energy	397	1	20	17	14
Food, Water, Shelter	1,458	6	71	34	14
Health and Medical	1,081	0	79	7	2
Safety and Security	1,956	6	216	69	28
Transportation	3,099	0	269	39	25
Suffolk County (Total)	**8,117**	**13**	**661**	**170**	**84**

Source: NYS DEC 2004/2007; NYSDOS 2013/2014; Suffolk County GIS 2020

An additional exposure analysis was complete for several of the planning partners' critical facilities land area including acres within the Town of Smithtown, the Suffolk County Water Authority, the Shinnecock and Unkechaug Tribal Nations. Specifically, the Shinnecock and Unkechaug Tribal Nations provided the locations of sacred land. Table 5.4.1-6 below summarizes results of the exposure analysis.

Table 5.4.1-9. Planning Partner Property Specific Exposure Analysis

Entity/Type	Municipality	Total Acres of Critical Properties	Acres Exposed				% of Total Exposed			
			CEHA	CRA Moderate	CRA High	CRA Extreme	CEHA	CRA Moderate	CRA High	CRA Extreme
SCWA	Babylon (T)	76	0	0	2	0	0.0%	0.0%	2.9%	0.0%
SCWA	Belle Terre (V)	1	0	0	0	0	0.0%	0.0%	0.3%	2.3%
SCWA	Brookhaven (T)	458	0	0	3	0	0.0%	0.0%	0.6%	0.1%
SCWA	Islip (T)	234	0	0	1	0	0.1%	0.0%	0.2%	0.2%

Entity/Type	Municipality	Total Acres of Critical Properties	Acres Exposed				% of Total Exposed			
			CEHA	CRA Moderate	CRA High	CRA Extreme	CEHA	CRA Moderate	CRA High	CRA Extreme
ST Parks	Nissequogue (V)	137	57	0	22	86	41.3%	0.0%	16.3%	62.6%
SCWA	Patchogue (V)	12	0	0	2	7	0.0%	0.0%	15.1%	63.8%
Tribe SL	Shinnecock Tribal Nation	37	0	0	10	21	0.0%	0.0%	25.6%	55.9%
ST Parks	Smithtown (T)	1,248	10	1	12	39	0.8%	0.1%	0.9%	3.1%
SCWA	Southampton (T)	275	0	0	6	11	0.0%	0.0%	2.3%	4.1%
Tribe SL	Unkechaug Tribal Nation	2	0	0	0	0	0.0%	0.0%	7.8%	4.1%
SCWA	West Hampton Dunes (V)	2	1	0	1	1	60.3%	0.0%	33.5%	66.5%
SCWA	Westhampton Beach (V)	3	0	0	0	0	0.0%	0.0%	0.5%	3.5%

Source: FEMA, Town of Smithtown, Suffolk County Water Authority, The Unkechaug Tribal Nation, and The Shinnecock Tribal Nation; NYS DEC 2004/2007; NYSDOS 2013/2014; Suffolk County GIS 2020
Note: CRA – Coastal Risk Area, SCWA- Suffolk County Water Authority, ST Parks- Smithtown Parks, Tribe SL- Tribal Sacred Land

Impact on Economy

Rapid coastal erosion, in association with harsh coastal storms, has the potential for financial loss in the local and regional economy. Gradual coastal erosion may also pose a financial risk. These financial risks include but are not limited to general building stock damages and associated tax loss, impacts to utilities and infrastructure, business interruption, and impacts on tourism. In areas that are directly experiencing coastal erosion, renovations of commercial and industrial buildings may be necessary, disrupting associated services. If businesses and residents relocate from waterfront property, the low availability and high cost of housing in coastal areas may present a challenge. However, if residents with waterfront property remain, to protect their property, they may be required to make structural changes or construct bulkheads or riprap. The cost of these interventions may financially stress lower- or middle-income residents (NYC Emergency Management 2019). Refer to the 'Impact on Buildings' subsection earlier which discusses direct impacts to buildings in Suffolk County.

Coastal erosion can cause extensive damage to the County's local economy, such as tourism. The Suffolk County Planning Commission 2017 Annual Report indicates that tourism was a $3 billion industry for the County in 2015 (Suffolk County 2017). Furthermore, state parks along Long Island had more than 20 million attendees in 2014 (Suffolk County 2017). Therefore, destruction caused by coastal erosion in any of these parks and coastal communities that rely on tourism may experience negative economic consequences should the hazard breach these sites. The distribution of parks, beaches, and residential/natural communities that could be impacted by coastal erosion based on their proximity to the coastal erosion hazard area buffers are summarized in Table 5.4.1-7.

Table 5.4.1-10. Beaches, Parks and Residential and Natural Communities Exposed to Coastal Erosion

Reach	Asset
Jones Island Reach	West Gilgo Beach
	Gilgo Beach
	Gilgo State Park
	Cedar Beach
	Oak Beach
	Captree State Park / Island
Fire Island Reach	Democrat Point
	Great South Beach
	Robert Moses State Park
	Kismet
	Saltaire
	Fair Harbor
	Lonelyville
	Atlantique
	Robbins Rest
	Dunewood
	Ocean Beach
	Ocean Bay Park
	Point o'Woods
	Cherry Grove
	Fire Island Beach/Fire Island Pines
	Fire Island National Seashore
	Davis Park
	Bayberry Dunes
	Moriches Inlet
	Smith Point County Park
Westhampton Reach	Cupsoque Beach
	Westhampton Dunes
	Potunk Point
	Westhampton Beach
	Hampton Beach
	Quogue Beach
	Tiana Beach
	Shinnecock Inlet
Ponds Reach	Southampton Beach
	Watermill Beach
	Mecox Beach
	Sagoponack Inlet
	Wainscott Beach
Montauk Reach (South Fork or "The Hamptons")	East Hampton Beach
	Atlantic Double Dunes
	Amagansett Beach
	Napeague Beach
	Montauk Beach

Reach	Asset
	Montauk Point
	Montauk Park
North Shore	Lloyd Beach (Lloyd Neck, Caumsett State Park)
	Eaton's Neck (Huntington Bay)
	North Port
	Asharoken Beach
	Crab Meadow Park
	Sunken Meadow State Park (Kings Park)
	Nissequogue (Smithtown Bay)
	Stony Brook
	West Meadow Beach
	Port Jefferson Harbor (Setauket)
	Cedar Beach (Mount Sinai)
	Mount Sinai Harbor
	Rocky Point
	Scott's Beach
	Shoreham Beach
	Wading River Beach (Wading River)
	Herod Point
	Wildwood State Park
	Woodcliff Park
	Roanoke Point
	Reeves Park
	Jacob's Point
	Northville
	Mattituck Inlet/Creek
	Duck Pond Point
	Goldsmith Inlet/Park
	Horton Point
	Peconic Dunes Park
	Greenport Park
	Truman Beach
	Orient Point (North Fork)
East End	Orient Beach State Park (Long Beach)
	Mashomack Preserve Nature Conservancy (Shelter Island)
	Cedar Point Park
	Sammy's Beach
	Gardiners Island
	Greenport

Source: ACNYMP

Impact on the Environment

According to the State of New York 2019 Hazard Mitigation Plan, coastal erosion can impact low-lying natural land resources such as wetlands, marshes, and coastal habitats. Receding shorelines may make the habitat unlivable for tidal organisms and can pollute coastal waters placing even greater stress on these aquatic species. Terrestrial habitat along the shore is at risk of losing its rooted foundation, becoming destabilized, and consequentially at greater risk of the impacts from other coastal hazards such as coastal storms or sea level rise. Refer to Section 5.4.8 Flood and Section 5.4.10 Hurricane for more information about the impacts of these hazards.

Cascading Impacts to Other Hazards

NOAA indicates that local changes in sea level rise may be caused by changes in land elevation (NOAA 2017). Since altering beach shape and coastal erosion along the County's shorelines could cause changes in land elevation in the County, the impacts of sea level rise may become enhanced.

Additionally, receding shorelines make coastal properties more susceptible to flooding. FEMA discusses the relationship that flooding and erosion have for coastal communities in the 2018 Coastal Erosion Guidance Document (FEMA 2018). For example, flood map projects for coastal communities are evaluated based on erosion assessments. Estimated flood extents may change based upon the level of erosion that has occurred.

Future Changes That May Impact Vulnerability

Understanding future changes that affect vulnerability can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. Changes in the natural environment and built environment and how they interact can also provide insight about ways to plan for the future. One of the resources that Suffolk County can reference to determine solutions to minimizing risk of coastal erosion is the U.S. Army Corps of Engineers North Atlantic Coast Comprehensive Study. Suffolk County falls within the North Atlantic Coast Comprehensive Study (NACCS) area, which established a plan to identify risk management strategies to mitigate coastal risks, including coastal erosion (USACE 2015). The NACCS was established shortly after Hurricane Sandy struck the north Atlantic states. The NACCS has a goal to help communities, such as those in Suffolk County, identify and take action towards risk management strategies that help to reduce coastal risk and promote resilience.

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located in the defined coastal risk areas could be potentially impacted by coastal erosion similar to those that currently exist within the County. Eight new development projects identified are located in the extreme coastal risk hazard area; 14 new development projects are located in the high coastal risk hazard area; and 15 new development projects are located in the moderate coastal risk hazard area.

It is recommended that the County and municipal partners implement design strategies that mitigate against the risk of coastal erosion. Proposed updates to the New York State Coastal Management Program may provide guidance about how to improve resilience of the shorelines and management of these community's natural and economic resources (New York State 2020).

Please refer to Figure 5.4.1-20 through Figure 5.4.1-22 to view the new development locations and their proximity to the coastal erosion hazard areas throughout the County.

Projected Changes in Population

According to the Suffolk County Department of Economic Development and Planning's February 2017 Annual Report update, the population of the County is growing. The report indicates that slow population growth is expected to continue in the future, but it is important to note that the population is aging (Suffolk County 2017). Since vulnerable populations (i.e., persons over 65) are increasing throughout the County, it can be assumed that there are communities along the shoreline that will also see an increasing number of persons over 65 that may be at greater risk of impacts from coastal erosion. Furthermore, visitors and tourists of the County will continue to occur, driving potential growth in the coastal communities and their amenities, exposing more persons to coastal erosion hazard areas.

Effect of Climate Change on Vulnerability

As mentioned earlier in this section, changes in climate may have an impact on the coastal erosion hazard areas. Impacts of climate change may include an increase of shoreline erosion rates due to coastal flooding or changes in the frequency and intensity of coastal storms. The 2019 New York State HMP states that low-lying coastal areas are at greatest risk of impacts from climate change where sea level rise occurs, and the land is already subsiding (New York State 2019). As a result, the most vulnerable coastal landscapes that could experience exacerbated impacts of erosion due to climate change in Suffolk County include coastal wetlands and barrier islands.

Change of Vulnerability Since 2014 HMP

Suffolk County, its municipalities, the Suffolk County Water Authority, and the Tribal Nations continue to be vulnerable to the coastal erosion hazard. However, there are several differences between the exposure estimates between this plan update to the results reported in the 2014 HMP. Updated building stock provided by the participating jurisdictions and assessor's data was used to generate the inventory. 2019 RS Means was also used to update the replacement cost value of structures in the County, replacing the 2014 RS Means values used in the 2014 HMP. Further, updated population data referenced the American Community Survey 2018 5-year population estimates, rather than the 2010 Census data. Overall, this vulnerability assessment uses a more accurate and updated asset inventory which provides more accurate exposure estimates for Suffolk County.

Figure 5.4.1-20. New Development Locations in Suffolk County – West

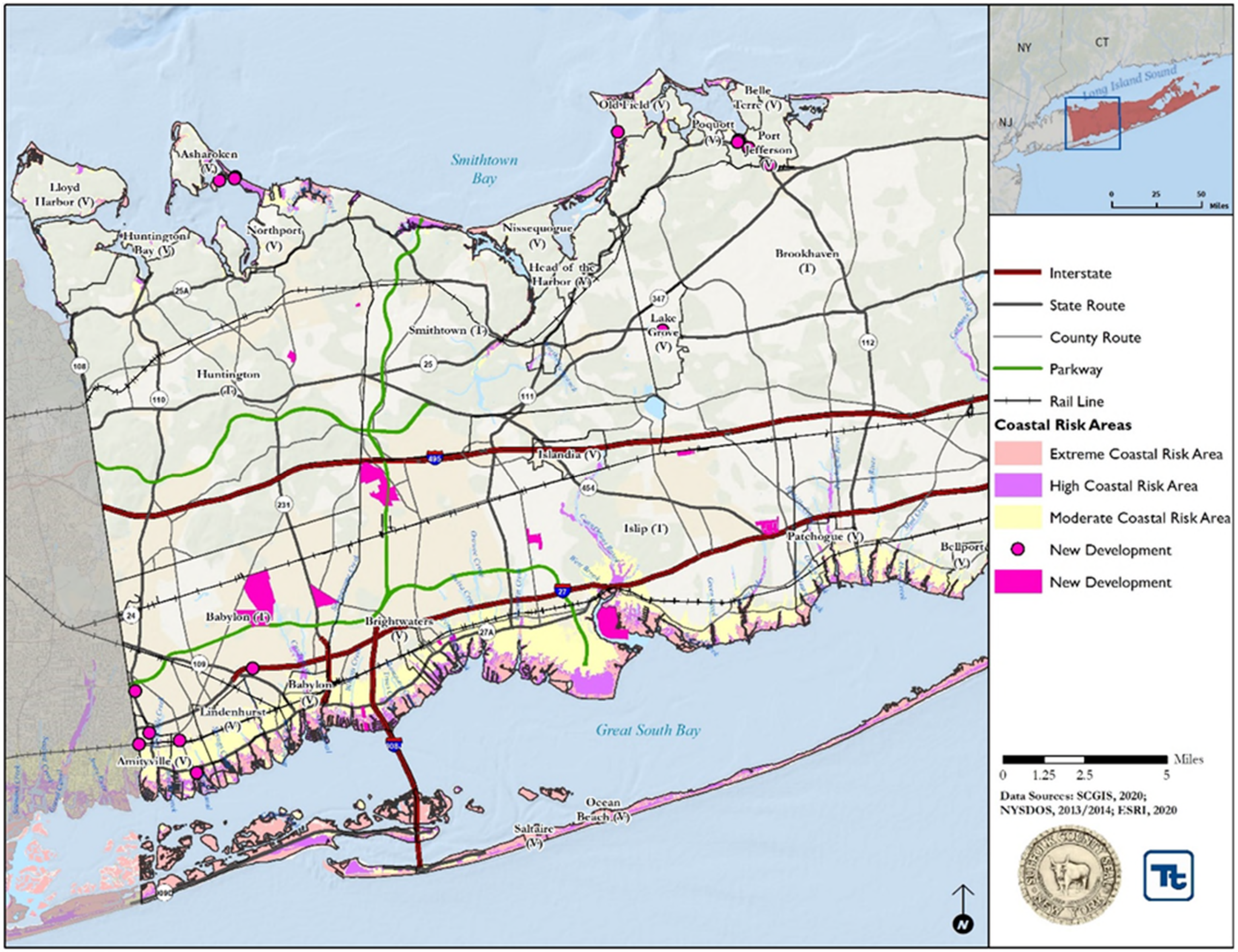


Figure 5.4.1-21. New Development Locations in Suffolk County – Central

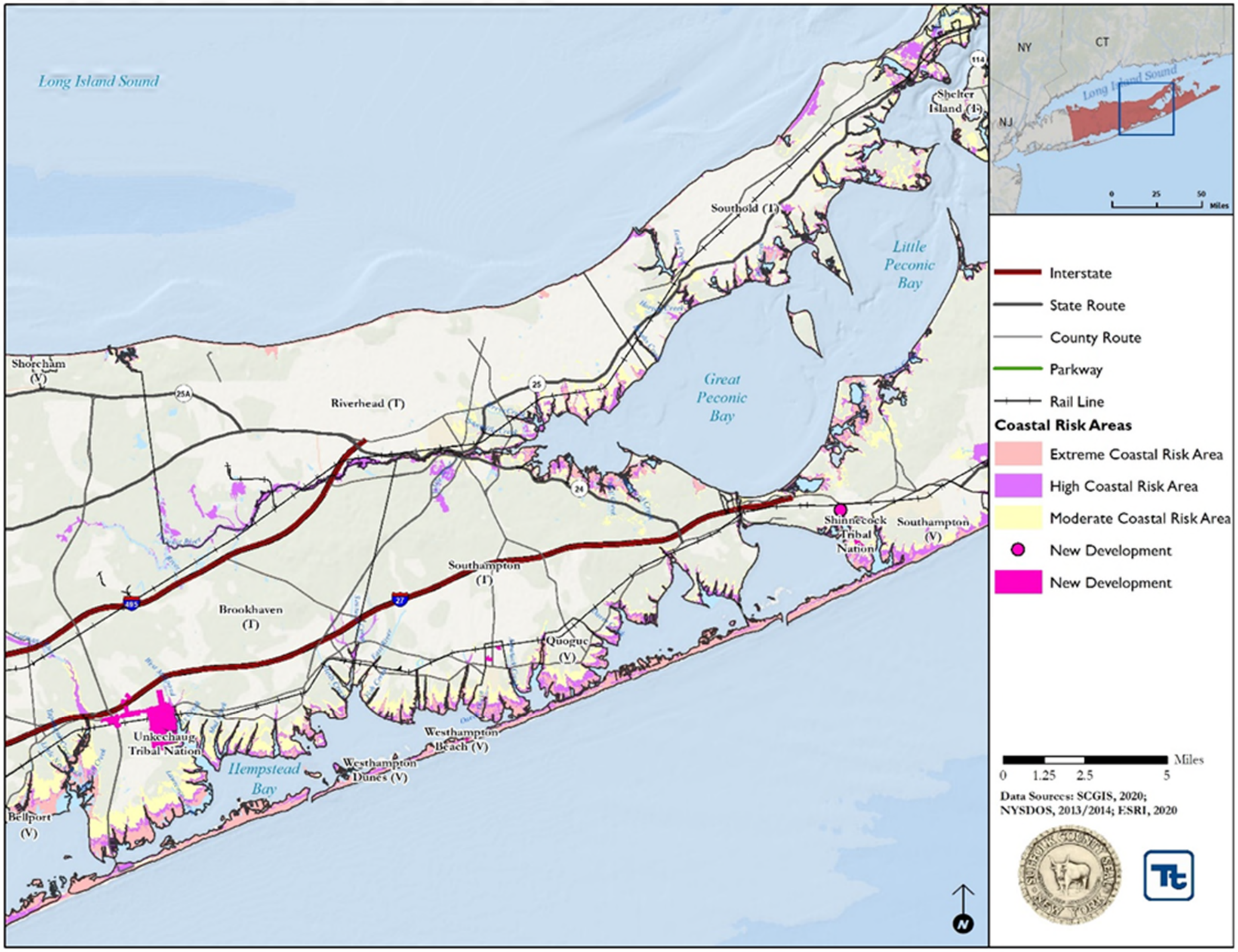


Figure 5.4.1-22. New Development Locations in Suffolk County – East