5.4.5 EARTHQUAKE

This section provides a hazard profile and vulnerability assessment of the earthquake 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 earthquake hazard and secondary hazards such as tsunamis.

Description

An earthquake is the sudden movement of the Earth's surface caused by the release of stress accumulated within or along the edge of the Earth's tectonic plates, a volcanic eruption, or by a manmade explosion (Federal Emergency Management Agency [FEMA] 2001; Shedlock and Pakiser 1997). Most earthquakes occur at the boundaries where the Earth's tectonic plates meet (faults); less than 10% of earthquakes occur within plate interiors. As plates continue to move and plate boundaries change geologically over time, weakened boundary regions become part of the interiors of the plates. These zones of weakness within the continents can cause earthquakes in response to stresses that originate at the edges of the plate or in the deeper crust (Shedlock and Pakiser 1995).

According to the U.S. Geological Society (USGS) Earthquake Hazards Program, an earthquake hazard is any disruption associated with an earthquake that may affect residents' normal activities. This includes surface faulting, ground shaking, landslides, liquefaction, tectonic deformation, tsunamis, and seiches; each of these terms is defined below:

- *Surface faulting*: Displacement that reaches the earth's surface during a slip along a fault. Commonly occurs with shallow earthquakes—those with an epicenter less than 20 kilometers.
- *Ground motion (shaking):* The movement of the earth's surface from earthquakes or explosions. Ground motion or shaking is produced by waves that are generated by a sudden slip on a fault or sudden pressure at the explosive source and travel through the Earth and along its surface.
- *Landslide*: A movement of surface material down a slope.
- *Liquefaction*: A process by which water-saturated sediment temporarily loses strength and acts as a fluid, like the wet sand near the water at the beach. Earthquake shaking can cause this effect. Liquefaction susceptibility is determined by the geological history, depositional setting, and topographic position of the soil (Stanford 2003). Liquefaction effects may occur along the shorelines of the ocean, rivers, and lakes and they can also happen in low-lying areas away from water bodies in locations where the ground water is near the earth's surface.
- *Tectonic Deformation*: A change in the original shape of a material caused by stress and strain.
- *Tsunami*: A sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major sub-marine slides, or exploding volcanic islands.
- *Seiche*: The sloshing of a closed body of water, such as a lake or bay, from earthquake shaking (USGS 2012a).

Tsunamis are a series of enormous waves created by an underwater disturbance (for example, earthquake, landslide, volcanic eruptions, or meteorite). They can move hundreds of miles per hour in the open ocean and crash into land with waves as high as 100 feet or more. From the area where the tsunami originates, waves travel outward in all directions (International Tsunami Information Center 2016).

A tsunami consists of a series of high-energy waves that travel outward, like pond ripples, from the area in which the tsunami originated. The sequence of tsunami waves arrives at the shoreline over an extended period of time and builds height as it gets closer. A tsunami approaching the shoreline may take three forms:

- Non-breaking waves that act as a rapidly rising tide
- A large, turbulent wall-like wave (bore)
- A series of partially developed waves (Humboldt County Hazard Mitigation Plan, 2008).

Extent

An earthquake's magnitude and intensity are used to describe the size and severity of the event. Magnitude describes the size at the focus of an earthquake and intensity describes the overall felt severity of shaking during the event. The earthquake's magnitude is a measure of the energy released at the source of the earthquake and is expressed by ratings on the Richter scale and/or the moment magnitude scale. The Richter Scale measures magnitude of earthquakes and has no upper limit; however, it is not used to express damage (USGS 2014). Table 5.4.5-1 presents the Richter scale magnitudes and corresponding earthquake effects. The moment magnitude scale (MMS) is used to describe the size of an earthquake. It is based on the seismic moment and is applicable to all sizes of earthquakes (USGS 2012b). The Richter Scale is not commonly used anymore, as it has been replaced by the MMS which is a more accurate measure of the earthquake size (USGS 2014). The MMS is described below.

Table 5.4.5-1. Richter Scale

Richter Magnitude	Earthquake Effects
2.5 or less	Usually not felt, but can be recorded by seismograph
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter

Source: USGS 1989

The intensity of an earthquake is based on the observed effects of ground shaking on people, buildings, and natural features, and varies with location. The Modified Mercalli (MMI) scale expresses intensity of an earthquake and describes how strong a shock was felt at a particular location in values. Table 5.4.5-2 summarizes earthquake intensity as expressed by the Modified Mercalli scale. Table 5.4.5-3 displays the MMI scale and its relationship to the areas peak ground acceleration.

Table 5.4.5-2. Modified Mercalli Intensity Scale

Mercalli Intensity	Shaking	Description
I	Not Felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Source: USGS 2016

Table 5.4.5-3. Modified Mercalli Intensity (MMI) and PGA Equivalents

Modified Mercalli Intensity	Acceleration (%g) (PGA)	Perceived Shaking	Potential Damage
I	< .17	Not Felt	None
II	.17 – 1.4	Weak	None
III	.17 – 1.4	Weak	None
IV	1.4 – 3.9	Light	None
V	3.9 – 9.2	Moderate	Very Light
VI	9.2 – 18	Strong	Light
VII	18 – 34	Very Strong	Moderate
VIII	34 – 65	Severe	Moderate to Heavy
IX	65-124	Violent	Heavy
X	>124	Extreme	Very Heavy

Source: Freeman et al. (Purdue University) 2004
Note: PGA Peak Ground Acceleration

National maps of earthquake shaking hazards have been produced since 1948. They provide information essential to creating and updating the seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning used in the U.S. Scientists frequently revise these maps to reflect new information and knowledge. Buildings, bridges, highways and utilities built to meet modern seismic design requirements are typically able to withstand earthquakes better, with less damages and disruption. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes (Brown et al. 2001).

The USGS updated the National Seismic Hazard Maps in 2014, which superseded the 2008 maps. New seismic, geologic, and geodetic information on earthquake rates and associated ground shaking were incorporated into these revised maps. The 2014 map represents the best available data as determined by the USGS. According to the data, Suffolk County has a PGA between 3%g and 5%g (USGS 2014). The 2014 PGA map can be found at http://pubs.usgs.gov/of/2014/1091/pdf/ofr2014-1091.pdf.

A probabilistic assessment was conducted for the 100-, 500- and 2,500-year mean return periods (MRP) in HAZUS-MH 4.2 to analyze the earthquake hazard for Suffolk County. The HAZUS analysis evaluates the statistical likelihood that a specific event will occur and what consequences will occur. Figure 5.4.5-1 through Figure 5.4.5-2 illustrates the geographic distribution of PGA (*g*) across the County or 100-, 500- and 2,500-year MRP events by Census-tract.

Figure 5.4.5-1. Peak Ground Acceleration Modified Mercalli Scale for a 100-Year MRP Earthquake Event

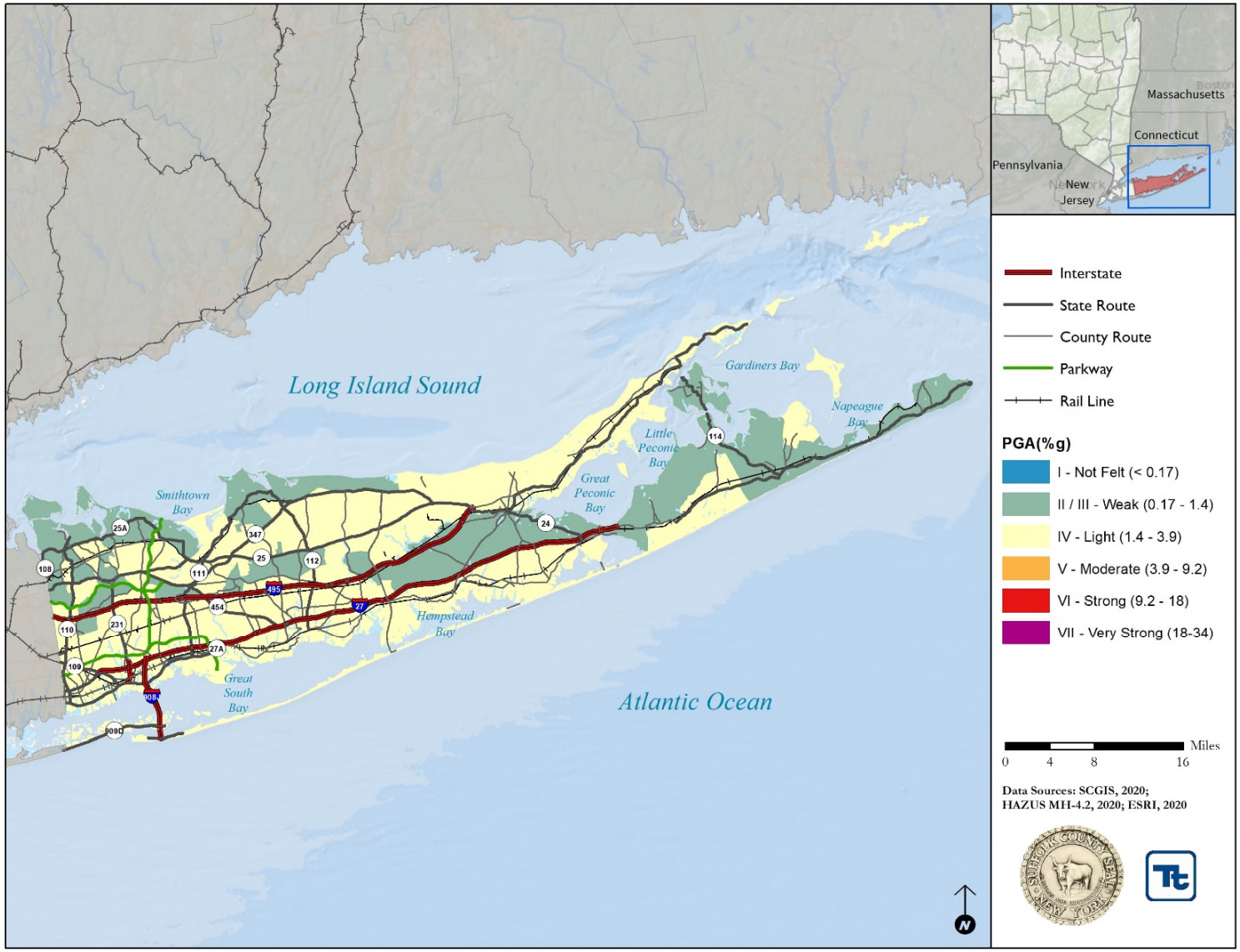


Figure 5.4.5-2. Peak Ground Acceleration Modified Mercalli Scale for a 500-Year MRP Earthquake Event

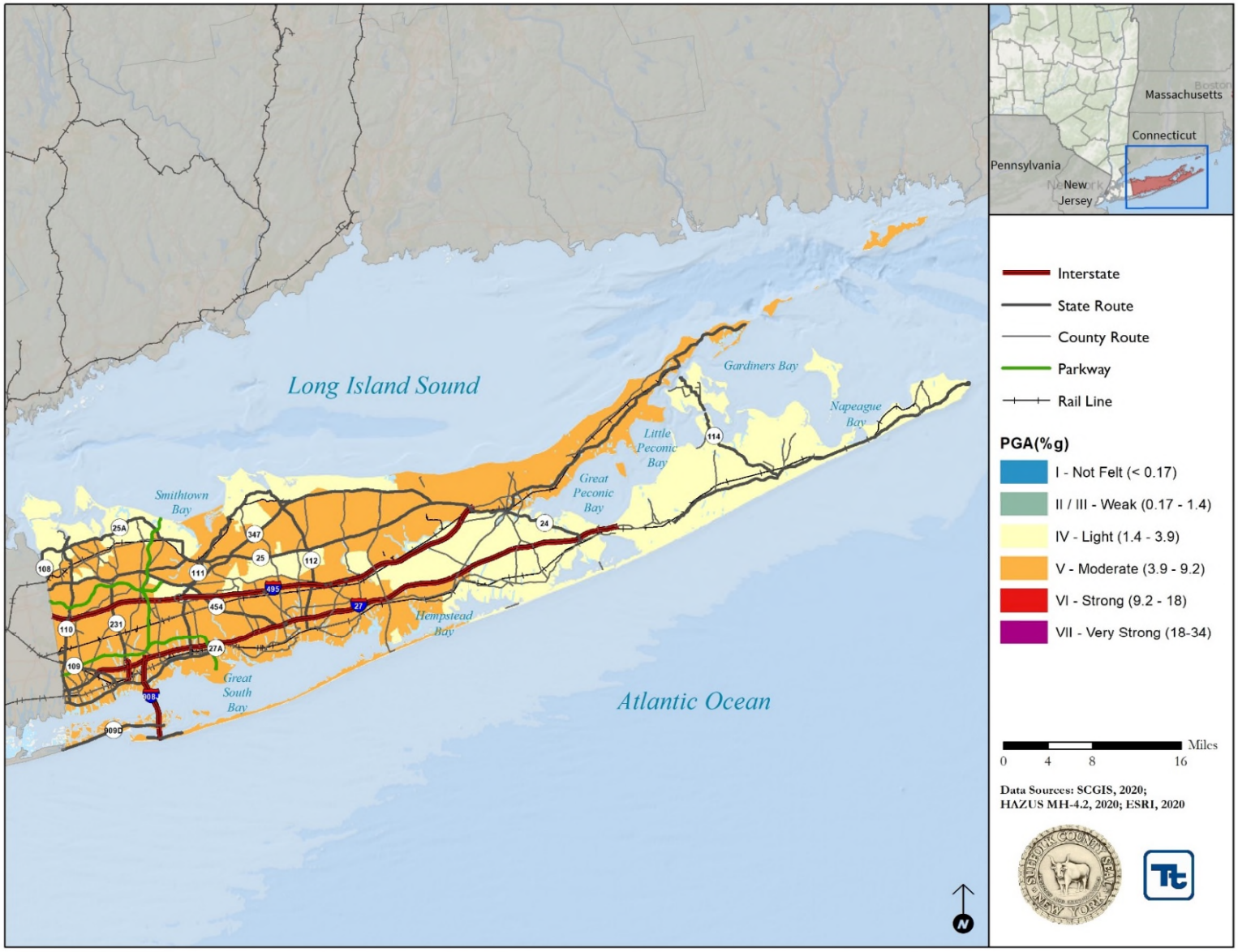
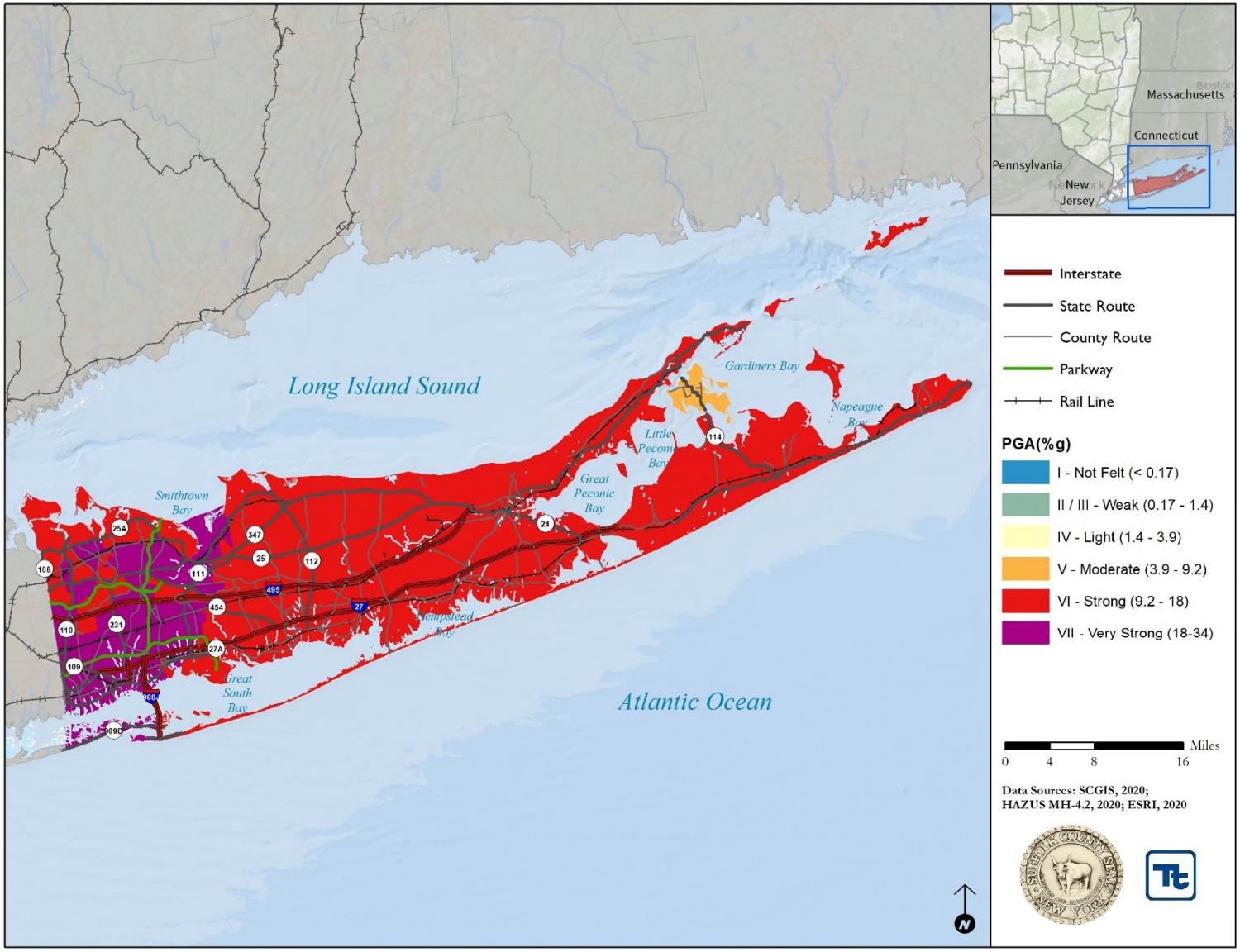


Figure5.4.5-3. Peak Ground Acceleration Modified Mercalli Scale for a 2,500-Year MRP Earthquake Event



The New York State Geological Survey conducted seismic shear-wave tests of the State's surficial geology (glacial deposits). Based on these test results, the surficial geologic materials of New York State were categorized according to the National Earthquake Hazard Reduction Program's (NEHRP) Soil Site Classifications (Table 5.4.5-4). The NEHRP developed five soil classifications defined by their shear-wave velocity that impact the severity of an earthquake. The soil classification system ranges from A to E, as noted in Table 5.4.5-4, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses. Class E soils include water-saturated mud and artificial fill. The strongest amplification of shaking due is expected for this soil type. Seismic waves travel faster through hard rock than through softer rock and sediments. As the waves pass from harder to softer rocks, the waves slow down and their amplitude increases. Shaking tends to be stronger at locations with softer surface layers where seismic waves move more slowly. Ground motion above an unconsolidated landfill or soft soils can be more than 10 times stronger than at neighboring locations on rock for small ground motions (FEMA 2016).

Table 5.4.5-4. NEHRP Soil Classifications

Soil Classification	Description
A	Hard Rock
B	Rock
C	Very dense soil and soft rock
D	Stiff soils
E	Soft soils

Source: FEMA 2016

Figure 5.4.5-4 illustrates the NEHRP soils located Suffolk County. The data was available from the NYS DHSES. The available NEHRP soils information is incorporated into the HAZUS-MH earthquake model for the risk assessment (discussed in further detail later in this section). According to this figure, Suffolk County is primarily comprised of NEHRP soil classes B through D. The majority of the County is soil class D. USGS data also shows areas where there is high susceptibility for landslides (refer to Figure 5.4.5-5). During an earthquake, these areas may experience greater damages from ground movement and land displacement.

Figure 5.4.5-4. NEHRP Soils in Suffolk County

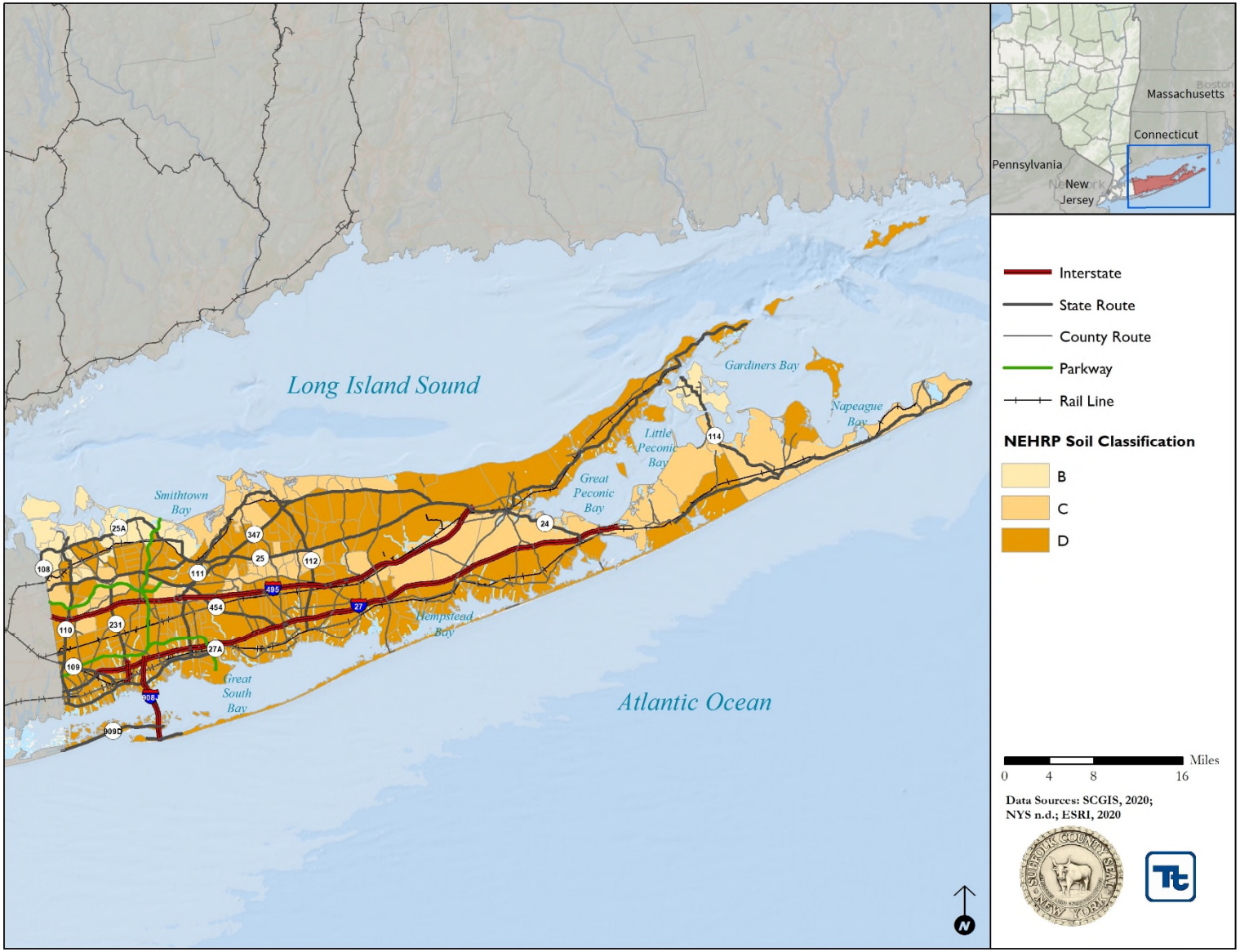
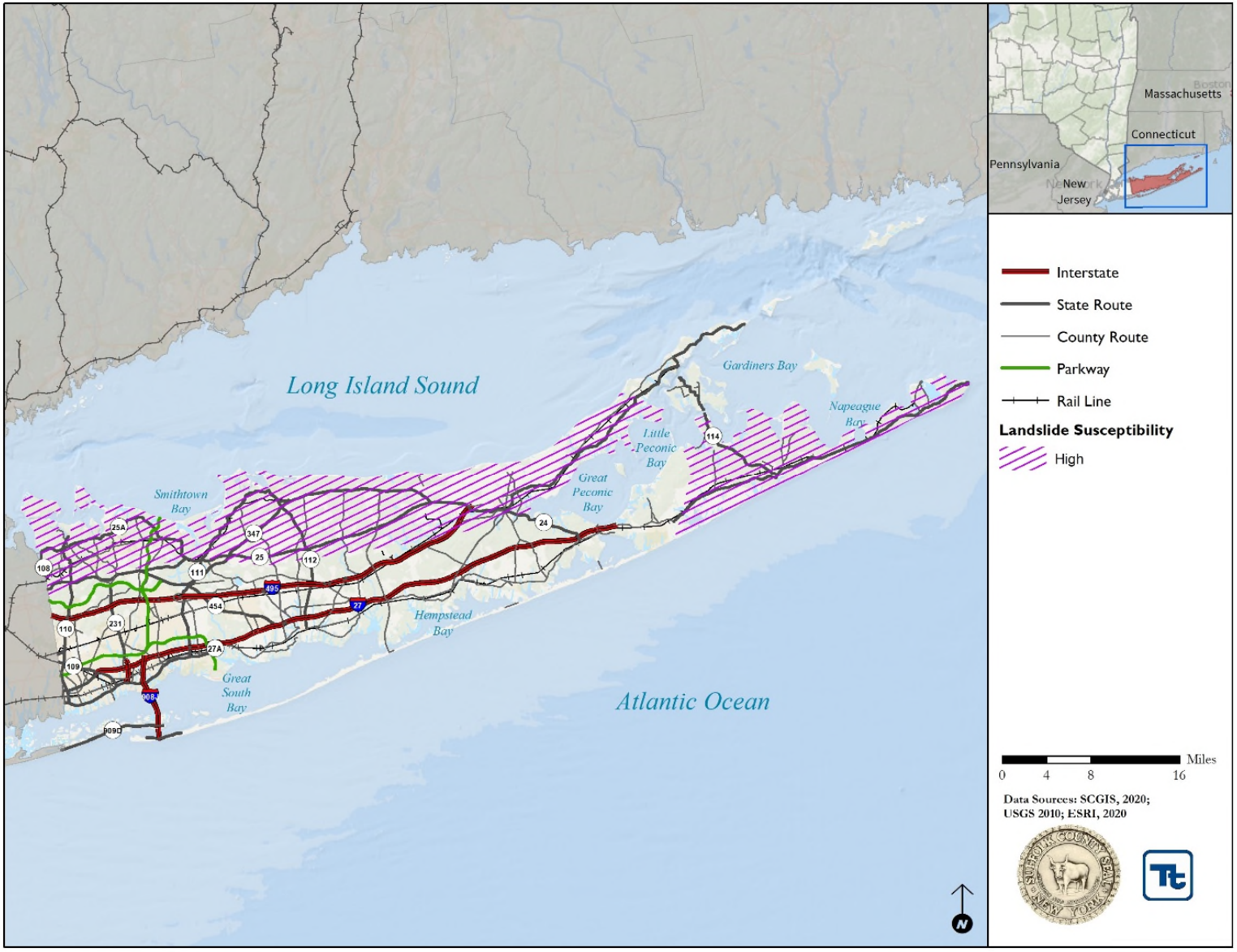


Figure 5.4.5-6. High Landslide Susceptibility in Suffolk County



NOAA issues tsunami warnings in the United States and has two Tsunami Warning Centers: the West Coast and Alaska Tsunami Warning Center (WC/ATWC) located in Palmer, Alaska and the Pacific Tsunami Warning Center (PTWC) located in Ewa Beach, Hawaii. WC/ATWC issues information to all states except Hawaii, U.S. territories in the Caribbean, and Canada. PTWC is responsible for Hawaii, U.S. territories in the Pacific, and international recipients in the Pacific and Indian Oceans, and the Caribbean Sea.

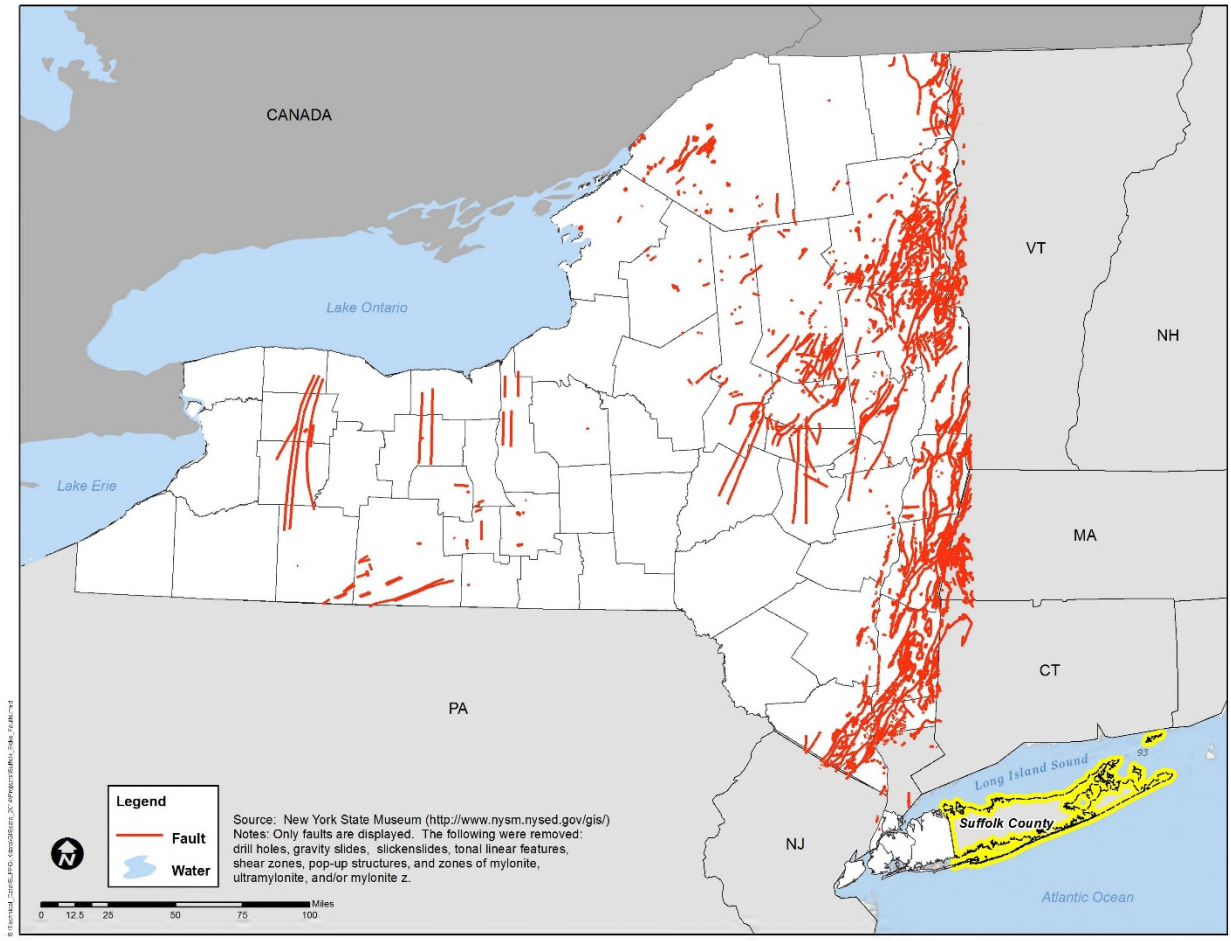
The Warning Centers monitor a worldwide network of seismic and sea level stations, providing a basis for which tsunami warnings, advisories, providing the basis for which tsunami warnings, advisories, watches, and information statements are issued. There are four types of tsunami messages issued by the Warning Centers and are as follows:

- Warnings are initially based solely on seismic data and are issued as quickly as possible indicating that a significant inundation may occur. They can be cancelled or downgraded to an advisory.
- Advisories indicate potential beach and harbor danger due to strong currents; however, significant widespread inundation is not expected.
- Watches indicate that a potentially dangerous distant event has occurred, and the area needs to be alert for more information (NOAA 2016).
- Location
- As noted in the NYS HMP, the potential for earthquakes exists across all of New York State and the entire northeastern side of the United States (NYS DHSES 2019). The New York City Area Consortium for Earthquake Loss Mitigation (NYCEM) ranks New York State as having the third highest earthquake activity level east of the Mississippi River (Tantala et al. 2003).

The closest plate boundary to the East Coast is the Mid-Atlantic Ridge, which is approximately 2,000 miles east of New York State. Over 200 million years ago, when the continent Pangaea rifted apart forming the Atlantic Ocean, the Northeast coast of America was a plate boundary. Being at the plate boundary, many faults were formed in the region. Although these faults are geologically old and are contained in a passive margin, they act as pre-existing planes of weakness and concentrated strain. When a strain exceeds the strength of the ancient fault, it ruptures causing an earthquake (Lehigh Earth Observatory 2006).

There are numerous faults throughout New York State. Figure 5.4.5-6 illustrates the faults relative to Suffolk County (New York State Museum 2012).

Figure 5.4.5-7. Faults in New York State



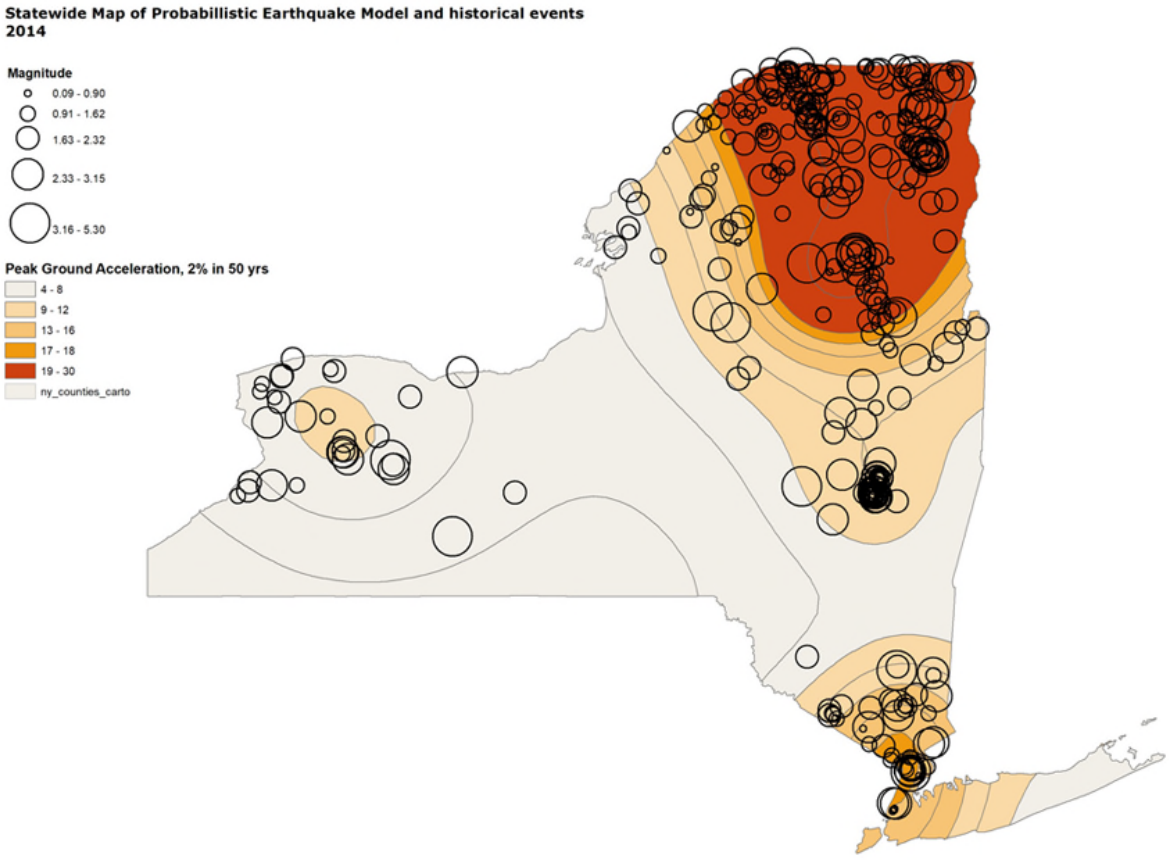
Source: New York State Museum 2012
Note: Suffolk County is highlighted in yellow

Areas of New York State that would experience an amplification of ground motion during seismic activity according to the National Earthquake Hazard Reduction Program soil classification map include the following:

- Northwest NY - Northern Erie County, North Central
- Northeast NY - Jefferson, St. Lawrence, and Northern Franklin Counties
- Upper Hudson River area of Eastern NY - Northern Saratoga, Washington and Southern Warren Counties
- Southeastern NY- Western Nassau County, and New York City (NYS DHSES 2019)

Figure 5.4.5-7 illustrates historic earthquake epicenters across New York State. There have been multiple earthquakes originating outside New York's borders that have been felt within the State. These quakes have come from Quebec, Canada Delaware, and Massachusetts. According to the NYS HMP, such events are considered significant for hazard mitigation planning because they could produce damage within the State in certain situations.

Figure 5.4.5-7. Statewide Map of Probabilistic Earthquake Model and Historical Events



Source: NYS DHSES 2019

Tsunamis impact areas along the coastline; therefore, all coastal areas of Suffolk County are exposed to the threat of a tsunami. However, the tsunami threat level for the east and Gulf coasts of the United States, which includes Suffolk County, has a relatively low threat to tsunamis (NOAA National Tsunami Warning Center 2016).

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with earthquake events throughout New York State and 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.

FEMA Major Disasters and Emergency Declarations

Between 1954 and 2020, New York State was included in one earthquake-related major disaster (DR) or emergency (EM) declaration. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declaration. Suffolk County was not included in any DRs or EMs (FEMA 2020).

Table 5.4.5-5 summarizes the known earthquake events that have impacted Suffolk County between 2013 and 2020. Events identified in the 2014 HMP are included in Appendix E.

Table 5.4.5-5. Earthquake Events in Suffolk County, 2013 to 2020

Dates of Event	Event Type	Location	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
August 14, 2014	Earthquake 2.7	6km SSW of Deep River Center, Connecticut	N/A	N/A	The quake was felt in Connecticutt, Massachusetss, New Jersey, and New York.	USGS
November 30, 2017	Earthquake 4.1	9km ENE of Dover, Delaware	N/A	N/A	The quake was felt in Delaware, Maryland, Pennsylvania, New Jersey, and New York	USGS
April 9, 2019	Earthquake 3.0	51km SE of Southampton, New York	N/A	N/A	No reference and/or no damage reported.	USGS

Source(s): FEMA 2020; NYS DHSES 2019; USGS 2020
DR Disaster Declaration
FEMA Federal Emergency Management Agency
N/A Not Applicable
NEIC National Earthquake Information Center
NYSDPC New York State Disaster Preparedness Commission
USGS U.S. Geological Survey

Earthquakes in Suffolk County are not common, with documented information on earthquake events and their location is being relatively scarce. According to the USGS, there has been only one earthquake with its epicenter in the County. It had a magnitude of 2.8 and occurred on March 10, 1992. However, depending on the magnitude, the impacts of earthquake events can be far-reaching; therefore, reported incidences within the surrounding counties or states could have created indirect impacts upon the County.

Probability of Future Occurrences

The frequency of damaging earthquakes within and adjacent to New York State has been relatively low. However, geologists predict that an earthquake of magnitude 5.0 [some sources describe 5.0 as moderately destructive] or above on the Richter scale has a 2% probability of occurring in the New York area within the next 50 years (NYS DHSES 2019).

Researchers indicate New York City is due for a significant earthquake originating near the five boroughs, based on previous smaller earthquakes in and around the city. There are numerous fault lines within the city. New York City is susceptible to at least a magnitude 5 earthquake once every 100 years, a 6 about every 670 years, and 7 about every 3,400 years (NYS DHSES 2019).

Earthquakes tend to occur in clusters over relatively short periods of time (e.g., 12 months to 8 years). Earthquake activity in the New York metropolitan region (portions of New York, New Jersey, Pennsylvania, and Connecticut) is spatially and temporally cyclical. The ability to identify these cycles assists in predicting earthquakes. Increased earthquake activity was predicted for the next several years, and from 1986-2016 the area had 17 events.) (NYS DHSES 2019).

While New York State has a low risk of an earthquake event, Pennsylvania, to the south, reported its first fracking related quake in April of 2016. Although New York State is not participating in fracking activities, it is unclear how to measure the risk of induced earthquake activity due to proximity of activity in surrounding states (NYS DHSES 2019).

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 Planning Committee, the probability of occurrence for earthquake in Suffolk County is considered 'occasional'.

It is anticipated that the County will experience indirect impacts from earthquakes that may affect the general building stock, local economy and may induce secondary hazards such ignite fires and cause utility failure.

Climate Change

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

Vulnerability Assessment

A probabilistic assessment was conducted for the 100-, 500- and 2,500-year MRPs through a Level 2 analysis in HAZUS-MH to analyze the earthquake hazard and provide a range of loss estimates. Figure 5.4.5-4 shows the geographic distribution of the NEHRP soil types in the County. Refer to Section 5.1 (Methodology and Tools) for additional details on the methodology used to assess earthquake risk.

Impact on Life, Health and Safety

The entire County may experience an earthquake. However, the degree of impact is dependent on many factors including the age and type of construction people live in, the soil types their homes are located on, the intensity of the earthquake. Whether directly or indirectly impacted, residents could be faced with business closures, road closures that could isolate populations, and loss of function of critical facilities and utilities. There is a higher risk to public safety for those inside buildings due to structural damage or people walking below building ornamentations and chimneys that may be shaken loose and fall because of an earthquake.

As noted earlier, NEHRP Soil Classes D and E can amplify ground shaking to damaging levels even during a moderate earthquake, and thus increase risk to the population. Populations within municipalities located on NEHRP Class D soils were estimated and are listed in Table 5.4.5-5; as noted earlier, there are no Class E soils identified in Suffolk County. Overall, approximately 1,162,130 residents (78.1-percent of the County's population) are located on NEHRP Class D soils with 17 jurisdictions that have 100-percent of their population residing on this soil type.

Furthermore, persons within the County can be at risk of residual impacts from earthquakes, particularly in areas where there is high landslide susceptibility. The estimated population within high landslide susceptibile areas is summarized by Table 5.4.5-7. Approximately 3-percent of the County's population is located in high landslide susceptible areas. The Town of Brookhaven has the greatest number of persons exposed to high landslide susceptible areas.

Table 5.4.5-6. Approximate Population within NEHRP Class D Soil Areas

Jurisdiction	Total Population (ACS 5-Year 2014-2018)	Population in Class D NEHRP Soils	
		Number of Persons	% of Total
Amityville (V)	9,452	9,452	100.0%
Asharoken (V)	443	221	50.0%
Babylon (T)	162,968	162,968	100.0%
Babylon (V)	12,089	12,089	100.0%
Belle Terre (V)	681	0	0.0%
Bellport (V)	2,008	2,008	100.0%
Brightwaters (V)	3,069	3,069	100.0%
Brookhaven (T)	448,342	340,110	75.9%
Dering Harbor (V)	0	0	0.0%
East Hampton (T)	18,685	6,088	32.6%
East Hampton (V)	1,034	1,033	99.9%
Greenport (V)	1,945	1,945	100.0%
Head of the Harbor (V)	1,463	362	24.8%
Huntington (T)	189,840	92,947	49.0%
Huntington Bay (V)	1,366	0	0.0%
Islandia (V)	3,345	3,185	95.2%
Islip (T)	326,416	310,394	95.1%
Lake Grove (V)	11,130	9,795	88.0%
Lindenhurst (V)	27,053	27,053	100.0%
Lloyd Harbor (V)	3,676	24	0.7%
Nissequogue (V)	1,574	180	11.4%
North Haven (V)	919	0	0.0%
Northport (V)	7,348	0	0.0%
Ocean Beach (V)	24	24	100.0%
Old Field (V)	812	0	0.0%
Patchogue (V)	12,398	12,398	100.0%
Poquott (V)	992	0	0.0%
Port Jefferson (V)	7,871	0	0.0%
Quogue (V)	803	803	100.0%
Riverhead (T)	33,625	24,503	72.9%
Sag Harbor (V)	2,184	775	35.5%
Sagaponack (V)	260	260	100.0%
Saltaire (V)	8	8	100.0%

Jurisdiction	Total Population (ACS 5-Year 2014-2018)	Population in Class D NEHRP Soils	
		Number of Persons	% of Total
Shelter Island (T)	2,744	22	0.8%
Shoreham (V)	437	0	0.0%
Smithtown (T)	112,224	84,567	75.4%
Southampton (T)	51,008	32,836	64.4%
Southampton (V)	3,263	3,261	99.9%
Southold (T)	20,202	15,271	75.6%
Village of the Branch (V)	1,770	1,770	100.0%
Westhampton Dunes (V)	69	69	100.0%
Westhampton Beach (V)	1,653	1,653	100.0%
Shinnecock Tribal Nation	662	662	100.0%
Unkechaug Tribal Nation	324	324	100.0%
Suffolk County (Total)	**1,488,179**	**1,162,130**	**78.1%**

Source: American Community Survey 2018, NYS n.d.

Table 5.4.5-7. Approximate Population within High Landslide Susceptibility Areas

Jurisdiction	Total Population (ACS 5-Year 2014-2018)	Population in High Landslide Susceptibility Area	
		Number of Persons	% of Total
Amityville (V)	9,452	0	0.0%
Asharoken (V)	443	443	100.0%
Babylon (T)	162,968	0	0.0%
Babylon (V)	12,089	0	0.0%
Belle Terre (V)	681	681	100.0%
Bellport (V)	2,008	0	0.0%
Brightwaters (V)	3,069	0	0.0%
Brookhaven (T)	448,342	220,343	49.1%
Dering Harbor (V)	0	0	0.0%
East Hampton (T)	18,685	18,684	100.0%
East Hampton (V)	1,034	1,034	100.0%
Greenport (V)	1,945	0	0.0%
Head of the Harbor (V)	1,463	1,463	100.0%
Huntington (T)	189,840	127,914	67.4%
Huntington Bay (V)	1,366	1,366	100.0%
Islandia (V)	3,345	0	0.0%
Islip (T)	326,416	0	0.0%

Jurisdiction	Total Population (ACS 5-Year 2014-2018)	Population in High Landslide Susceptibility Area	
		Number of Persons	% of Total
Lake Grove (V)	11,130	6,554	58.9%
Lindenhurst (V)	27,053	0	0.0%
Lloyd Harbor (V)	3,676	3,676	100.0%
Nissequogue (V)	1,574	1,574	100.0%
North Haven (V)	919	919	100.0%
Northport (V)	7,348	7,348	100.0%
Ocean Beach (V)	24	0	0.0%
Old Field (V)	812	812	100.0%
Patchogue (V)	12,398	0	0.0%
Poquott (V)	992	992	100.0%
Port Jefferson (V)	7,871	7,871	100.0%
Quogue (V)	803	0	0.0%
Riverhead (T)	33,625	33,625	100.0%
Sag Harbor (V)	2,184	2,184	100.0%
Sagaponack (V)	260	260	100.0%
Saltaire (V)	8	0	0.0%
Shelter Island (T)	2,744	0	0.0%
Shoreham (V)	437	437	100.0%
Smithtown (T)	112,224	60,095	53.5%
Southampton (T)	51,008	10,874	21.3%
Southampton (V)	3,263	145	4.4%
Southold (T)	20,202	12,464	61.7%
Village of the Branch (V)	1,770	413	23.3%
Westhampton Dunes (V)	69	0	0.0%
Westhampton Beach (V)	1,653	118	7.1%
Shinnecock Tribal Nation	662	0	0.0%
Unkechaug Tribal Nation	324	0	0.0%
Suffolk County (Total)	**1,488,179**	**43,968**	**3.0%**

Source: American Community Survey 2018; USGS 2010

Populations considered most vulnerable are those located in/near the built environment, particularly those near unreinforced masonry structures. Of these most vulnerable populations, socially vulnerable populations, including the elderly (persons over age 65) and individuals living below the census poverty threshold, are most susceptible. Factors leading to this higher susceptibility include decreased mobility and financial ability to react or respond during a hazard, and the location and construction quality of their housing. There are 239,284 persons

over the age of 65 and 104,660 persons living in poverty in Suffolk County. The distribution of these vulnerable populations can be found in Section 4 (County Profile).

Residents may be displaced or require temporary to long-term sheltering due to an earthquake event. The number of people requiring shelter is generally less than the number displaced as some displaced persons use hotels or stay with family or friends following a disaster event. Table 5.4.5-8 summarizes the households HAZUS-MH v4.2 estimates will be displaced and population that may require short-term sheltering as a result of the 100-, 500- and 2,500-year MRP earthquake events. HAZUS-MH v4.2 estimates are also summarized by jurisdiction for the 500- and 2,500-year MRP earthquake events in Table 5.4.5-9.

Table 5.4.5-8. Summary of Estimated Sheltering Needs for Suffolk County

Scenario	Displaced Households	People Requiring Short-Term Shelter
100-Year Earthquake	0	0
500-Year Earthquake	6	3
2,500-Year Earthquake	135	86

Source: HAZUS-MH 4.2

Table 5.4.5-9. Estimated Displaced Households and Population Seeking Short-Term Shelter from the 500- and 2,500-year MRP Events by Jurisdiction

Jurisdiction	500-Year MRP		2,500-Year MRP	
	Displaced Households*	People Requiring Short-Term Shelter*	Displaced Households*	People Requiring Short-Term Shelter*
Amityville (V)	0	0	2	1
Asharoken (V)	0	0	0	0
Babylon (T)	1	1	21	15
Babylon (V)	0	0	1	1
Belle Terre (V)	0	0	0	0
Bellport (V)	0	0	0	0
Brightwaters (V)	0	0	0	0
Brookhaven (T)	1	1	35	22
Dering Harbor (V)	0	0	0	0
East Hampton (T)	0	0	1	0
East Hampton (V)	0	0	0	0
Greenport (V)	0	0	0	0
Head of the Harbor (V)	0	0	0	0
Huntington (T)	2	1	27	17
Huntington Bay (V)	0	0	0	0
Islandia (V)	0	0	0	0
Islip (T)	0	0	21	15

Jurisdiction	500-Year MRP		2,500-Year MRP	
	Displaced Households*	People Requiring Short-Term Shelter*	Displaced Households*	People Requiring Short-Term Shelter*
Lake Grove (V)	0	0	1	1
Lindenhurst (V)	0	0	4	2
Lloyd Harbor (V)	0	0	0	0
Nissequogue (V)	0	0	1	0
North Haven (V)	0	0	0	0
Northport (V)	0	0	0	0
Ocean Beach (V)	0	0	0	0
Old Field (V)	0	0	0	0
Patchogue (V)	0	0	5	3
Poquott (V)	0	0	0	0
Port Jefferson (V)	0	0	1	1
Quogue (V)	0	0	0	0
Riverhead (T)	0	0	1	1
Sag Harbor (V)	0	0	0	0
Sagaponack (V)	0	0	0	0
Saltaire (V)	0	0	0	0
Shelter Island (T)	0	0	0	0
Shoreham (V)	0	0	0	0
Smithtown (T)	1	0	8	4
Southampton (T)	0	0	1	1
Southampton (V)	0	0	0	0
Southold (T)	0	0	1	0
Village of the Branch (V)	0	0	0	0
Westhampton Dunes (V)	0	0	0	0
Westhampton Beach (V)	0	0	0	0
Shinnecock Tribal Nation	0	0	0	0
Unkechaug Tribal Nation	0	0	0	0
Suffolk County (Total)	**6**	**4**	**136**	**86**

Source: HAZUS-MH v4.2

**Note: Population results are referencing 2010 Census population statistics. Results may be under-estimated.*

According to the 1999-2003 NYCEM Summary Report (Earthquake Risks and Mitigation in the New York / New Jersey / Connecticut Region), a strong correlation exists between structural building damage and number of injuries and casualties from an earthquake event. Further, time of day also exposes different sectors of the community to the hazard. For example, HAZUS-MH v4.2 considers residential occupancy at its maximum at 2:00 AM, whereas educational, commercial, and industrial sectors are at their maximum at 2:00 PM, and peak

commute time is at 5:00 PM. Whether directly impacted or indirectly impacted, the entire population will be affected to some degree. Business interruption could prevent people from working, road closures could isolate populations, and loss of utilities could impact populations that suffered no direct damage from an event.

Table 5.4.5-10 and Table 5.4.5-11 summarize the County-wide injuries and casualties estimated for the 500- and 2,500-year MRP earthquake events, respectively. There are no estimated injuries or casualties for the 100-year MRP earthquake event.

Table 5.4.5-10. Estimated Number of Injuries and Casualties from the 500-Year MRP Earthquake Event

Level of Severity	Time of Day		
	2:00 AM	2:00 PM	5:00 PM
Injuries	17	52	33
Hospitalization	1	5	3
Casualties	0	0	0

Source: HAZUS-MH 4.2

Table 5.4.5-11. Estimated Number of Injuries and Casualties from the 2,500-Year MRP Earthquake Event

Level of Severity	Time of Day		
	2:00 AM	2:00 PM	5:00 PM
Injuries	183	554	351
Hospitalization	17	82	50
Casualties	1	12	7

Source: HAZUS-MH 4.2

Impact on General Building Stock

The entire County's general building stock is considered at risk and exposed to this hazard. As stated earlier, soft soils (NEHRP Soil Classes D and E) can amplify ground shaking to damaging levels even during a moderate earthquake (NYCEM 2003). Therefore, buildings located on NEHRP Classes D and E soils are at increased risk of damage from an earthquake. NEHRP Class E soils are not present in Suffolk County; therefore, Table 5.4.5-12 summarizes the number and replacement cost value of buildings in Suffolk County located on NEHRP Class D soils. Additionally, the number of buildings and total replacement cost value of structures in the County built in high landslide susceptible hazard areas was assessed (refer to Table 5.4.5-13). Overall, more than three quarters and more than one third of Suffolk County's buildings are built on NEHRP Class D soils and high landslide susceptible hazard areas, respectively.

There is a strong correlation between PGA and damage a building might undergo (NYCEM 2003). The HAZUS-MH model is based on best available earthquake science and aligns with these statements. The HAZUS-MH probabilistic earthquake model was applied to analyze effects from the earthquake hazard on general building stock in Suffolk County. See Figure 5.4.5-1 through Figure 5.4.5-3 earlier in this profile which illustrates the geographic distribution of PGA (g) across the County for 100-, 500- and 2,500-year MRP events at the Census-tract level.

A building's construction determines how well it can withstand the force of an earthquake. The NYCEM report indicates that unreinforced masonry buildings are most at risk during an earthquake because the walls are prone to collapse outward, whereas steel and wood buildings absorb more of the earthquake's energy. Additional attributes that affect a building's capability to withstand an earthquake's force include its age, number of stories, and quality of construction. HAZUS-MH v4.2 considers building construction and age of building as part of the

analysis. Because a custom general building stock was used for this HAZUS-MH v4.2 analysis, the building ages and building types from the inventory were incorporated into the HAZUS-MH v4.2 model.

Table 5.4.5-12. Number and Replacement Cost Value of Buildings within NEHRP Soil Areas

Jurisdiction	Total # Buildings	Total RCV	Total (All Occupancies) Class D NEHRP Soils			
			# Buildings	% Total	RCV	% Total
Amityville (V)	4,161	$5,519,611,238	4,161	100.0%	$5,519,611,238	100.0%
Asharoken (V)	321	$379,192,198	166	51.7%	$211,785,998	55.9%
Babylon (T)	51,514	$82,740,965,827	51,514	100.0%	$82,740,965,827	100.0%
Babylon (V)	4,957	$6,110,029,951	4,957	100.0%	$6,110,029,951	100.0%
Belle Terre (V)	316	$680,761,603	0	0.0%	$0	0.0%
Bellport (V)	1,206	$2,358,752,934	1,206	100.0%	$2,358,752,934	100.0%
Brightwaters (V)	1,162	$1,932,120,865	1,162	100.0%	$1,932,120,865	100.0%
Brookhaven (T)	154,866	$221,811,756,528	117,583	75.9%	$165,460,170,313	74.6%
Dering Harbor (V)	41	$88,595,797	0	0.0%	$0	0.0%
East Hampton (T)	18,243	$26,516,571,402	6,279	34.4%	$9,996,813,179	37.7%
East Hampton (V)	1,938	$5,002,346,911	1,937	99.9%	$5,000,287,111	100.0%
Greenport (V)	982	$1,316,147,268	981	99.9%	$1,314,397,946	99.9%
Head of the Harbor (V)	527	$1,052,509,872	133	25.2%	$273,063,358	25.9%
Huntington (T)	62,226	$82,709,382,979	30,393	48.8%	$43,947,656,163	53.1%
Huntington Bay (V)	593	$642,162,208	0	0.0%	$0	0.0%
Islandia (V)	1,039	$4,798,220,611	974	93.7%	$3,886,638,154	81.0%
Islip (T)	86,764	$157,009,867,271	82,621	95.2%	$149,372,329,973	95.1%
Lake Grove (V)	3,693	$4,999,176,933	3,253	88.1%	$4,591,612,101	91.8%
Lindenhurst (V)	9,387	$9,110,586,538	9,387	100.0%	$9,110,586,538	100.0%
Lloyd Harbor (V)	1,301	$2,057,808,899	8	0.6%	$23,628,000	1.1%
Nissequogue (V)	638	$1,430,093,283	77	12.1%	$115,936,848	8.1%
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	530	100.0%	$483,689,958	100.0%
Old Field (V)	391	$967,667,970	0	0.0%	$0	0.0%
Patchogue (V)	3,900	$11,533,289,631	3,900	100.0%	$11,533,289,631	100.0%
Poquott (V)	379	$540,263,069	0	0.0%	$0	0.0%
Port Jefferson (V)	3,133	$10,546,648,033	0	0.0%	$0	0.0%
Quogue (V)	1,785	$5,371,998,365	1,785	100.0%	$5,371,998,365	100.0%
Riverhead (T)	16,853	$27,561,801,284	12,913	76.6%	$23,436,027,523	85.0%
Sag Harbor (V)	1,887	$3,157,033,580	692	36.7%	$1,376,062,729	43.6%
Sagaponack (V)	908	$3,548,811,980	908	100.0%	$3,548,811,980	100.0%
Saltaire (V)	399	$406,571,331	399	100.0%	$406,571,331	100.0%
Shelter Island (T)	2,729	$3,894,434,021	28	1.0%	$48,307,202	1.2%
Shoreham (V)	216	$381,052,410	0	0.0%	$0	0.0%
Smithtown (T)	35,517	$62,086,530,012	26,863	75.6%	$45,406,093,317	73.1%
Southampton (T)	33,290	$69,558,169,929	21,862	65.7%	$48,587,120,506	69.9%
Southampton (V)	3,500	$13,027,590,722	3,498	99.9%	$13,015,627,322	99.9%
Southold (T)	15,123	$17,842,698,534	11,707	77.4%	$14,348,683,177	80.4%

Jurisdiction	Total # Buildings	Total RCV	Total (All Occupancies) Class D NEHRP Soils			
			# Buildings	% Total	RCV	% Total
Village of the Branch (V)	624	$1,414,333,647	624	100.0%	$1,414,333,647	100.0%
Westhampton Dunes (V)	279	$766,363,715	279	100.0%	$766,363,715	100.0%
Westhampton Beach (V)	1,965	$5,590,458,778	1,965	100.0%	$5,590,458,778	100.0%
Shinnecock Tribal Nation	378	$155,005,274	378	100.0%	$155,005,274	100.0%
Unkechaug Tribal Nation	144	$55,549,783	144	100.0%	$55,549,783	100.0%
Suffolk County (TOTAL)	**533,279**	**$861,988,782,069**	**405,267**	**76.0%**	**$667,510,380,733**	**77.4%**

Sources: American Community Survey 5-year Estimate, 2018; Suffolk County GIS 2020; RS Means 2019; Microsoft, 2018, Open Street Map, 2019; NYS n.d.; Suffolk County Real Property Tax Service, 2020
Note: RCV = Replacement Cost Value; % = Percent; # = Number

Table 5.4.5-13. Number and Replacement Cost Value of Buildings within High Landslide Susceptibility Areas

Jurisdiction	Total # Buildings	Total RCV	Total (All Occupancies) High Landslide Susceptibility Area			
			# Buildings	% Total	RCV	% Total
Amityville (V)	4,161	$5,519,611,238	0	0.0%	$0	0.0%
Asharoken (V)	321	$379,192,198	321	100.0%	$379,192,198	100.0%
Babylon (T)	51,514	$82,740,965,827	0	0.0%	$0	0.0%
Babylon (V)	4,957	$6,110,029,951	0	0.0%	$0	0.0%
Belle Terre (V)	316	$680,761,603	316	100.0%	$680,761,603	100.0%
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	75,410	48.7%	$104,606,296,878	47.2%
Dering Harbor (V)	41	$88,595,797	0	0.0%	$0	0.0%
East Hampton (T)	18,243	$26,516,571,402	18,241	100.0%	$26,513,850,386	100.0%
East Hampton (V)	1,938	$5,002,346,911	1,938	100.0%	$5,002,346,911	100.0%
Greenport (V)	982	$1,316,147,268	0	0.0%	$0	0.0%
Head of the Harbor (V)	527	$1,052,509,872	527	100.0%	$1,052,509,872	100.0%
Huntington (T)	62,226	$82,709,382,979	41,677	67.0%	$44,460,227,567	53.8%
Huntington Bay (V)	593	$642,162,208	593	100.0%	$642,162,208	100.0%
Islandia (V)	1,039	$4,798,220,611	0	0.0%	$0	0.0%
Islip (T)	86,764	$157,009,867,271	0	0.0%	$0	0.0%
Lake Grove (V)	3,693	$4,999,176,933	2,202	59.6%	$3,517,577,030	70.4%
Lindenhurst (V)	9,387	$9,110,586,538	0	0.0%	$0	0.0%
Lloyd Harbor (V)	1,301	$2,057,808,899	1,301	100.0%	$2,057,808,899	100.0%
Nissequogue (V)	638	$1,430,093,283	638	100.0%	$1,430,093,283	100.0%
North Haven (V)	772	$2,221,433,929	772	100.0%	$2,221,433,929	100.0%
Northport (V)	2,702	$2,610,724,998	2,702	100.0%	$2,610,724,998	100.0%
Ocean Beach (V)	530	$483,689,958	0	0.0%	$0	0.0%
Old Field (V)	391	$967,667,970	391	100.0%	$967,667,970	100.0%
Patchogue (V)	3,900	$11,533,289,631	0	0.0%	$0	0.0%
Poquott (V)	379	$540,263,069	379	100.0%	$540,263,069	100.0%
Port Jefferson (V)	3,133	$10,546,648,033	3,133	100.0%	$10,546,648,033	100.0%

Jurisdiction	Total # Buildings	Total RCV	Total (All Occupancies)			
			High Landslide Susceptibility Area			
			# Buildings	% Total	RCV	% Total
Quogue (V)	1,785	$5,371,998,365	0	0.0%	$0	0.0%
Riverhead (T)	16,853	$27,561,801,284	16,853	100.0%	$27,561,801,284	100.0%
Sag Harbor (V)	1,887	$3,157,033,580	1,887	100.0%	$3,157,033,580	100.0%
Sagaponack (V)	908	$3,548,811,980	908	100.0%	$3,548,811,980	100.0%
Saltaire (V)	399	$406,571,331	0	0.0%	$0	0.0%
Shelter Island (T)	2,729	$3,894,434,021	0	0.0%	$0	0.0%
Shoreham (V)	216	$381,052,410	216	100.0%	$381,052,410	100.0%
Smithtown (T)	35,517	$62,086,530,012	18,743	52.8%	$26,042,459,120	41.9%
Southampton (T)	33,290	$69,558,169,929	7,263	21.8%	$19,377,740,112	27.9%
Southampton (V)	3,500	$13,027,590,722	137	3.9%	$750,365,169	5.8%
Southold (T)	15,123	$17,842,698,534	9,433	62.4%	$10,974,033,683	61.5%
Village of the Branch (V)	624	$1,414,333,647	134	21.5%	$288,580,886	20.4%
Westhampton Dunes (V)	279	$766,363,715	0	0.0%	$0	0.0%
Westhampton Beach (V)	1,965	$5,590,458,778	0	0.0%	$0	0.0%
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**	**206,115**	**38.7%**	**$299,311,443,059**	**34.7%**

Sources: American Community Survey 5-year Estimate, 2018; Suffolk County GIS 2020; RS Means 2019; Microsoft, 2018, Open Street Map, 2019; USGS 2010; Suffolk County Real Property Tax Service, 2020
Note: RCV = Replacement Cost Value; % = Percent; # = Number

Potential building damage was evaluated using HAZUS-MH v4.2 across the following damage categories: none, slight, moderate, extensive, and complete. Table 5.4.5-14 provides definitions of these five categories of damage to a light wood-framed building; definitions of categories of damage to other building types appear in HAZUS-MH technical manual documentation.

Table 5.4.5-14 Example of Structural Damage State Definitions for a Light Wood-Framed Building

Damage Category	Description
Slight	Small plaster or gypsum-board cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneer.
Moderate	Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
Extensive	Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations; partial collapse of room-over-garage or other soft-story configurations.
Complete	Structure may have large permanent lateral displacement, may collapse, or be in imminent danger of collapse due to cripple wall failure or the failure of the lateral load resisting system; some structures may slip and fall off the foundations; large foundation cracks.

Source: HAZUS-MH Technical Manual

Building damage as a result of the 100-, 500- and 2,500-year MRP earthquake events was estimated using HAZUS-MH v4.2. Damage loss estimates include structural and non-structural damage to the building and loss of contents. Table 5.4.3-12 summarizes the estimated damages for the County by building type for the 500- and 2,500-year MRP earthquake events. HAZUS-MH estimates that 2 structures in the County will be completely

damaged because of a 500-year earthquake event. Both of these structures are un-reinforced masonry building types. During a 2,500-year earthquake event, HAZUS-MH estimates that 74 structures will be completely damaged, and majority of the buildings are concrete (i.e., 27 total), followed by un-reinforced masonry building types (i.e., 25 total). HAZUS-MH also summarizes damage state estimates for buildings by general occupancy class. Table 5.4.5-15 summarizes the estimated structural damage state for buildings categorized by general building stock for the 500- and 2,500-year MRP earthquake events. Furthermore, Table 5.4.5-16 lists estimated replacement cost values (RCVs) of buildings and contents damaged by the 100-, 500- and 2,500-year MRP earthquake events. Table 5.4.5-17 also breaks down damages by the structural general occupancy class for each jurisdiction. Table 5.4.5-18 through Table 5.4.5-20 breaks down damages by the residential occupancy class, commercial occupancy class, and all other occupancy class, respectively.

Table 5.4.5-15. Estimated Number of Buildings Damaged by Building Type for 500-year and 2,500-year MRP Earthquake Events

Building Category	Expected Number of Buildings Within Damage State Categories by Building Type									
	500-Year MRP					2,500-Year MRP				
	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete
Wood	457,400	4,589	362	13	0	414,759	40,547	6,646	407	5
Steel	189	4	1	0	0	162	20	11	2	0
Concrete	28,687	688	181	8	0	22,493	3,934	2,767	343	27
Precast	10,329	442	270	47	0	7,996	1,323	1,327	429	13
Reinforced Masonry	34	1	0	0	0	30	3	2	1	0
Un-reinforced Masonry	6,606	319	125	19	2	5,279	1,016	599	151	25
Manufactured housing	22,015	694	244	9	0	17,744	3,191	1,848	176	4

Source: HAZUS-MH v4.2

Table 5.4.5-16. Estimated County-Wide Building Damage Severity by General Occupancy Class

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	EQ 500-Year		EQ 2,500-Year	
			Building Count	Percent Buildings in Occupancy Class	Building Count	Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	492,825	None	486,417	98.7%	438,028	88.9%
		Minor	5,628	1.1%	44,852	9.1%
		Moderate	737	0.1%	9,167	1.9%
		Severe	41	0.0%	744	0.2%
		Complete Destruction	2	0.0%	46	0.0%
Commercial Buildings	26,925	None	25,797	95.8%	20,350	75.6%
		Minor	766	2.8%	3,400	12.6%
		Moderate	321	1.2%	2,627	9.8%
		Severe	42	0.2%	523	1.9%
		Complete Destruction	0	0.0%	26	0.1%
	3,227	None	3,084	95.6%	2,290	71.0%

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	EQ 500-Year		EQ 2,500-Year	
			Building Count	Percent Buildings in Occupancy Class	Building Count	Percent Buildings in Occupancy Class
Industrial Buildings		Minor	99	3.1%	462	14.3%
		Moderate	40	1.2%	388	12.0%
		Severe	5	0.1%	83	2.6%
		Complete Destruction	0	0.0%	4	0.1%
Government, Religion, Agricultural, and Education Buildings	10,302	None	9,964	96.7%	7,792	75.6%
		Minor	244	2.4%	1,320	12.8%
		Moderate	86	0.8%	843	8.2%
		Severe	8	0.1%	159	1.5%
		Complete Destruction	0	0.0%	10	0.1%

Source: HAZUS-MH v4.2

Table 5.4.5-17. Estimated Building Value (Building and Contents) By General Occupancy Classes and Estimated Damage in the 100-, 500-, and 2,500-Year MRP Earthquake Events

Jurisdiction	RCV	Estimated Total Damage			Percent of Total Building and Contents RCV		
		100-Year	500-Year	2,500-Year	100-Year	500-Year	2,500-Year
Amityville (V)	$5,519,611,238	$0	$4,871,869	$76,059,493	0.0%	0.1%	1.4%
Asharoken (V)	$379,192,198	$0	$61,468	$1,379,323	0.0%	0.0%	0.4%
Babylon (T)	$82,740,965,827	$0	$73,843,384	$1,141,232,897	0.0%	0.1%	1.4%
Babylon (V)	$6,110,029,951	$0	$4,631,859	$72,913,355	0.0%	0.1%	1.2%
Belle Terre (V)	$680,761,603	$0	$478,511	$6,771,426	0.0%	0.1%	1.0%
Bellport (V)	$2,358,752,934	$0	$1,886,843	$22,591,700	0.0%	0.1%	1.0%
Brightwaters (V)	$1,932,120,865	$0	$1,522,773	$23,676,821	0.0%	0.1%	1.2%
Brookhaven (T)	$221,811,756,528	$2,507	$133,558,603	$1,783,985,156	0.0%	0.1%	0.8%
Dering Harbor (V)	$88,595,797	$0	$14,211	$318,640	0.0%	0.0%	0.4%
East Hampton (T)	$26,516,571,402	$0	$6,592,144	$105,647,449	0.0%	0.0%	0.4%
East Hampton (V)	$5,002,346,911	$0	$1,151,624	$17,926,738	0.0%	0.0%	0.4%
Greenport (V)	$1,316,147,268	$0	$923,910	$12,858,219	0.0%	0.1%	1.0%
Head of the Harbor (V)	$1,052,509,872	$57,019	$1,679,880	$16,748,019	0.0%	0.2%	1.6%
Huntington (T)	$82,709,382,979	$0	$55,940,022	$830,635,794	0.0%	0.1%	1.0%
Huntington Bay (V)	$642,162,208	$0	$148,684	$3,235,333	0.0%	0.0%	0.5%
Islandia (V)	$4,798,220,611	$0	$4,390,288	$59,735,275	0.0%	0.1%	1.2%
Islip (T)	$157,009,867,271	$0	$113,317,809	$1,652,889,037	0.0%	0.1%	1.1%
Lake Grove (V)	$4,999,176,933	$0	$3,498,969	$47,271,364	0.0%	0.1%	0.9%
Lindenhurst (V)	$9,110,586,538	$0	$7,188,690	$115,120,855	0.0%	0.1%	1.3%
Lloyd Harbor (V)	$2,057,808,899	$0	$292,736	$6,003,957	0.0%	0.0%	0.3%
Nissequogue (V)	$1,430,093,283	$78,461	$2,284,856	$22,721,324	0.0%	0.2%	1.6%
North Haven (V)	$2,221,433,929	$0	$638,479	$11,151,635	0.0%	0.0%	0.5%
Northport (V)	$2,610,724,998	$0	$314,380	$6,735,033	0.0%	0.0%	0.3%
Ocean Beach (V)	$483,689,958	$0	$75,270	$1,187,489	0.0%	0.0%	0.2%
Old Field (V)	$967,667,970	$0	$962,564	$12,225,463	0.0%	0.1%	1.3%
Patchogue (V)	$11,533,289,631	$0	$9,505,824	$121,443,649	0.0%	0.1%	1.1%
Poquott (V)	$540,263,069	$0	$302,879	$3,850,786	0.0%	0.1%	0.7%
Port Jefferson (V)	$10,546,648,033	$0	$5,167,642	$67,271,990	0.0%	0.0%	0.6%
Quogue (V)	$5,371,998,365	$0	$2,136,295	$30,281,666	0.0%	0.0%	0.6%

Jurisdiction	RCV	Estimated Total Damage			Percent of Total Building and Contents RCV		
		100-Year	500-Year	2,500-Year	100-Year	500-Year	2,500-Year
Riverhead (T)	$27,561,801,284	$0	$18,610,909	$267,045,378	0.0%	0.1%	1.0%
Sag Harbor (V)	$3,157,033,580	$0	$504,806	$8,406,214	0.0%	0.0%	0.3%
Sagaponack (V)	$3,548,811,980	$0	$1,528,322	$22,848,832	0.0%	0.0%	0.6%
Saltaire (V)	$406,571,331	$0	$116,815	$1,842,913	0.0%	0.0%	0.5%
Shelter Island (T)	$3,894,434,021	$0	$234,673	$5,261,957	0.0%	0.0%	0.1%
Shoreham (V)	$381,052,410	$0	$158,203	$1,998,117	0.0%	0.0%	0.5%
Smithtown (T)	$62,086,530,012	$3,089	$37,769,251	$545,819,232	0.0%	0.1%	0.9%
Southampton (T)	$69,558,169,929	$0	$21,517,521	$323,265,564	0.0%	0.0%	0.5%
Southampton (V)	$13,027,590,722	$0	$5,637,244	$77,285,745	0.0%	0.0%	0.6%
Southold (T)	$17,842,698,534	$0	$10,219,697	$152,079,577	0.0%	0.1%	0.9%
Village of the Branch (V)	$1,414,333,647	$0	$1,008,850	$14,176,046	0.0%	0.1%	1.0%
Westhampton Dunes (V)	$5,590,458,778	$0	$180,799	$2,589,227	0.0%	0.0%	0.0%
Westhampton Beach (V)	$766,363,715	$0	$2,005,019	$27,533,560	0.0%	0.3%	3.6%
Shinnecock Tribal Nation	$155,005,274	$0	$258,244	$4,247,168	0.0%	0.2%	2.7%
Unkechaug Tribal Nation	$55,549,783	$0	$53,332	$721,027	0.0%	0.1%	1.3%
Suffolk County (Total)	**$861,988,782,069**	**$141,077**	**$537,186,152**	**$7,728,990,441**	**0.0%**	**0.1%**	**0.9%**

Source: HAZUS-MH v4.2

Notes: RCV = Replacement Cost Value; V = Village; T = Town

Table 5.4.5-18. Estimated Building Value (Building and Contents) By General Occupancy Classes and Estimated Damage in the 100-, 500-, and 2,500-Year MRP Earthquake Events – Residential Occupancy Class

Jurisdiction	RCV	Estimated Residential Damage		
		100-Year	500-Year	2,500-Year
Amityville (V)	$5,519,611,238	$0	$1,622,180	$29,306,976
Asharoken (V)	$379,192,198	$0	$50,987	$1,144,810
Babylon (T)	$82,740,965,827	$0	$22,830,353	$405,958,416
Babylon (V)	$6,110,029,951	$0	$2,093,192	$37,433,026
Belle Terre (V)	$680,761,603	$0	$299,828	$4,330,346
Bellport (V)	$2,358,752,934	$0	$939,744	$10,440,825
Brightwaters (V)	$1,932,120,865	$0	$890,917	$15,118,525
Brookhaven (T)	$221,811,756,528	$2,087	$62,384,449	$859,302,085
Dering Harbor (V)	$88,595,797	$0	$8,526	$228,029
East Hampton (T)	$26,516,571,402	$0	$4,699,862	$80,203,398
East Hampton (V)	$5,002,346,911	$0	$682,670	$11,818,366
Greenport (V)	$1,316,147,268	$0	$218,866	$3,447,368
Head of the Harbor (V)	$1,052,509,872	$47,482	$1,391,982	$14,103,494
Huntington (T)	$82,709,382,979	$0	$19,784,036	$326,448,973
Huntington Bay (V)	$642,162,208	$0	$69,777	$1,569,979
Islandia (V)	$4,798,220,611	$0	$578,710	$9,494,268
Islip (T)	$157,009,867,271	$0	$39,585,762	$655,245,497
Lake Grove (V)	$4,999,176,933	$0	$2,085,789	$29,236,999
Lindenhurst (V)	$9,110,586,538	$0	$3,503,566	$62,685,103
Lloyd Harbor (V)	$2,057,808,899	$0	$224,812	$4,480,423
Nissequogue (V)	$1,430,093,283	$65,338	$1,902,640	$19,256,949
North Haven (V)	$2,221,433,929	$0	$530,380	$9,632,251
Northport (V)	$2,610,724,998	$0	$180,912	$4,049,219
Ocean Beach (V)	$483,689,958	$0	$44,942	$757,837
Old Field (V)	$967,667,970	$0	$647,207	$8,091,239
Patchogue (V)	$11,533,289,631	$0	$2,206,470	$28,123,924
Poquott (V)	$540,263,069	$0	$201,149	$2,519,295
Port Jefferson (V)	$10,546,648,033	$0	$1,292,643	$17,998,103
Quogue (V)	$5,371,998,365	$0	$1,744,313	$25,455,690
Riverhead (T)	$27,561,801,284	$0	$3,861,222	$53,797,773
Sag Harbor (V)	$3,157,033,580	$0	$392,778	$6,854,348
Sagaponack (V)	$3,548,811,980	$0	$1,159,464	$17,702,122
Saltaire (V)	$406,571,331	$0	$69,747	$1,176,118
Shelter Island (T)	$3,894,434,021	$0	$140,799	$3,765,615
Shoreham (V)	$381,052,410	$0	$89,482	$1,113,792
Smithtown (T)	$62,086,530,012	$2,573	$14,610,584	$235,123,281
Southampton (T)	$69,558,169,929	$0	$15,713,964	$246,468,298
Southampton (V)	$13,027,590,722	$0	$3,583,091	$52,609,310
Southold (T)	$17,842,698,534	$0	$3,509,991	$52,982,052
Village of the Branch (V)	$1,414,333,647	$0	$391,436	$6,039,147
Westhampton Dunes (V)	$5,590,458,778	$0	$153,865	$2,233,991
Westhampton Beach (V)	$766,363,715	$0	$1,399,063	$20,137,590

Jurisdiction	RCV	Estimated Residential Damage		
		100-Year	500-Year	2,500-Year
Shinnecock Tribal Nation	$155,005,274	$0	$171,770	$3,049,334
Unkechaug Tribal Nation	$55,549,783	$0	$46,670	$637,417
Suffolk County (Total)	**$861,988,782,069**	**$117,480**	**$217,990,591**	**$3,381,571,601**

Source: HAZUS-MH v4.2
Notes: RCV = Replacement Cost Value; V = Village; T = Town

Table 5.4.5-19. Estimated Building Value (Building and Contents) By General Occupancy Classes and Estimated Damage in the 100-, 500-, and 2,500-Year MRP Earthquake Events – Commercial Occupancy Class

Jurisdiction	RCV	Estimated Commercial Damage		
		100-Year	500-Year	2,500-Year
Amityville (V)	$5,519,611,238	$0	$1,527,373	$21,155,486
Asharoken (V)	$379,192,198	$0	$2,867	$57,394
Babylon (T)	$82,740,965,827	$0	$18,577,513	$252,226,588
Babylon (V)	$6,110,029,951	$0	$1,427,153	$19,638,296
Belle Terre (V)	$680,761,603	$0	$155,945	$2,140,862
Bellport (V)	$2,358,752,934	$0	$721,017	$9,193,109
Brightwaters (V)	$1,932,120,865	$0	$592,489	$7,999,923
Brookhaven (T)	$221,811,756,528	$188	$51,544,452	$653,675,067
Dering Harbor (V)	$88,595,797	$0	$3,819	$59,472
East Hampton (T)	$26,516,571,402	$0	$1,349,595	$17,729,735
East Hampton (V)	$5,002,346,911	$0	$325,005	$4,213,048
Greenport (V)	$1,316,147,268	$0	$619,752	$8,261,555
Head of the Harbor (V)	$1,052,509,872	$4,276	$132,922	$1,230,388
Huntington (T)	$82,709,382,979	$0	$24,598,497	$337,072,208
Huntington Bay (V)	$642,162,208	$0	$67,819	$1,408,583
Islandia (V)	$4,798,220,611	$0	$3,345,147	$43,490,564
Islip (T)	$157,009,867,271	$0	$50,415,964	$666,741,831
Lake Grove (V)	$4,999,176,933	$0	$1,102,716	$13,952,218
Lindenhurst (V)	$9,110,586,538	$0	$1,971,627	$27,193,401
Lloyd Harbor (V)	$2,057,808,899	$0	$11,303	$255,100
Nissequogue (V)	$1,430,093,283	$5,885	$173,387	$1,577,000
North Haven (V)	$2,221,433,929	$0	$69,013	$966,069
Northport (V)	$2,610,724,998	$0	$94,820	$1,885,971
Ocean Beach (V)	$483,689,958	$0	$14,823	$205,182
Old Field (V)	$967,667,970	$0	$216,705	$2,806,729
Patchogue (V)	$11,533,289,631	$0	$6,888,383	$87,865,312
Poquott (V)	$540,263,069	$0	$70,983	$917,703
Port Jefferson (V)	$10,546,648,033	$0	$3,560,655	$45,147,661
Quogue (V)	$5,371,998,365	$0	$273,293	$3,404,427
Riverhead (T)	$27,561,801,284	$0	$8,449,602	$105,730,594
Sag Harbor (V)	$3,157,033,580	$0	$67,787	$901,068
Sagaponack (V)	$3,548,811,980	$0	$215,691	$2,726,023
Saltaire (V)	$406,571,331	$0	$23,004	$318,431
Shelter Island (T)	$3,894,434,021	$0	$63,072	$982,114

Jurisdiction	RCV	Estimated Commercial Damage		
		100-Year	500-Year	2,500-Year
Shoreham (V)	$381,052,410	$0	$51,437	$644,877
Smithtown (T)	$62,086,530,012	$232	$19,170,222	$255,381,856
Southampton (T)	$69,558,169,929	$0	$3,708,186	$47,668,844
Southampton (V)	$13,027,590,722	$0	$1,552,955	$18,578,184
Southold (T)	$17,842,698,534	$0	$4,025,205	$52,799,131
Village of the Branch (V)	$1,414,333,647	$0	$414,685	$5,428,214
Westhampton Dunes (V)	$5,590,458,778	$0	$14,307	$185,912
Westhampton Beach (V)	$766,363,715	$0	$383,892	$4,735,728
Shinnecock Tribal Nation	$155,005,274	$0	$64,856	$909,649
Unkechaug Tribal Nation	$55,549,783	$0	$6,661	$83,610
Suffolk County (Total)	$861,988,782,069	$10,581	$208,066,599	$2,729,545,120

Source: HAZUS-MH v4.2
Notes: RCV = Replacement Cost Value; V = Village; T = Town

Table 5.4.5-20. Estimated Building Value (Building and Contents) By General Occupancy Classes and Estimated Damage in the 100-, 500-, and 2,500-Year MRP Earthquake Events – All Other Occupancy Classes

Jurisdiction	RCV	Estimated Damages for All Other Occupancies		
		100-Year	500-Year	2,500-Year
Amityville (V)	$5,519,611,238	$0	$1,722,316	$25,597,031
Asharoken (V)	$379,192,198	$0	$7,614	$177,118
Babylon (T)	$82,740,965,827	$0	$32,435,518	$483,047,893
Babylon (V)	$6,110,029,951	$0	$1,111,513	$15,842,033
Belle Terre (V)	$680,761,603	$0	$22,739	$300,218
Bellport (V)	$2,358,752,934	$0	$226,083	$2,957,765
Brightwaters (V)	$1,932,120,865	$0	$39,367	$558,373
Brookhaven (T)	$221,811,756,528	$231	$19,629,701	$271,008,004
Dering Harbor (V)	$88,595,797	$0	$1,865	$31,139
East Hampton (T)	$26,516,571,402	$0	$542,688	$7,714,316
East Hampton (V)	$5,002,346,911	$0	$143,949	$1,895,325
Greenport (V)	$1,316,147,268	$0	$85,293	$1,149,296
Head of the Harbor (V)	$1,052,509,872	$5,261	$154,977	$1,414,137
Huntington (T)	$82,709,382,979	$0	$11,557,490	$167,114,614
Huntington Bay (V)	$642,162,208	$0	$11,088	$256,770
Islandia (V)	$4,798,220,611	$0	$466,431	$6,750,444
Islip (T)	$157,009,867,271	$0	$23,316,084	$330,901,708
Lake Grove (V)	$4,999,176,933	$0	$310,464	$4,082,146
Lindenhurst (V)	$9,110,586,538	$0	$1,713,497	$25,242,351
Lloyd Harbor (V)	$2,057,808,899	$0	$56,622	$1,268,434
Nissequogue (V)	$1,430,093,283	$7,239	$208,829	$1,887,374
North Haven (V)	$2,221,433,929	$0	$39,087	$553,315
Northport (V)	$2,610,724,998	$0	$38,647	$799,844
Ocean Beach (V)	$483,689,958	$0	$15,506	$224,470
Old Field (V)	$967,667,970	$0	$98,652	$1,327,494
Patchogue (V)	$11,533,289,631	$0	$410,971	$5,454,414
Poquott (V)	$540,263,069	$0	$30,747	$413,788

Jurisdiction	RCV	Estimated Damages for All Other Occupancies		
		100-Year	500-Year	2,500-Year
Port Jefferson (V)	$10,546,648,033	$0	$314,343	$4,126,225
Quogue (V)	$5,371,998,365	$0	$118,689	$1,421,549
Riverhead (T)	$27,561,801,284	$0	$6,300,085	$107,517,011
Sag Harbor (V)	$3,157,033,580	$0	$44,241	$650,798
Sagaponack (V)	$3,548,811,980	$0	$153,166	$2,420,687
Saltaire (V)	$406,571,331	$0	$24,064	$348,364
Shelter Island (T)	$3,894,434,021	$0	$30,801	$514,229
Shoreham (V)	$381,052,410	$0	$17,285	$239,448
Smithtown (T)	$62,086,530,012	$285	$3,988,444	$55,314,095
Southampton (T)	$69,558,169,929	$0	$2,095,371	$29,128,422
Southampton (V)	$13,027,590,722	$0	$501,198	$6,098,251
Southold (T)	$17,842,698,534	$0	$2,684,501	$46,298,393
Village of the Branch (V)	$1,414,333,647	$0	$202,729	$2,708,685
Westhampton Dunes (V)	$5,590,458,778	$0	$12,627	$169,323
Westhampton Beach (V)	$766,363,715	$0	$222,064	$2,660,242
Shinnecock Tribal Nation	$155,005,274	$0	$21,617	$288,185
Unkechaug Tribal Nation	$55,549,783	$0	$0	$0
Suffolk County (Total)	**$861,988,782,069**	**$13,016**	**$111,128,963**	**$1,617,873,720**

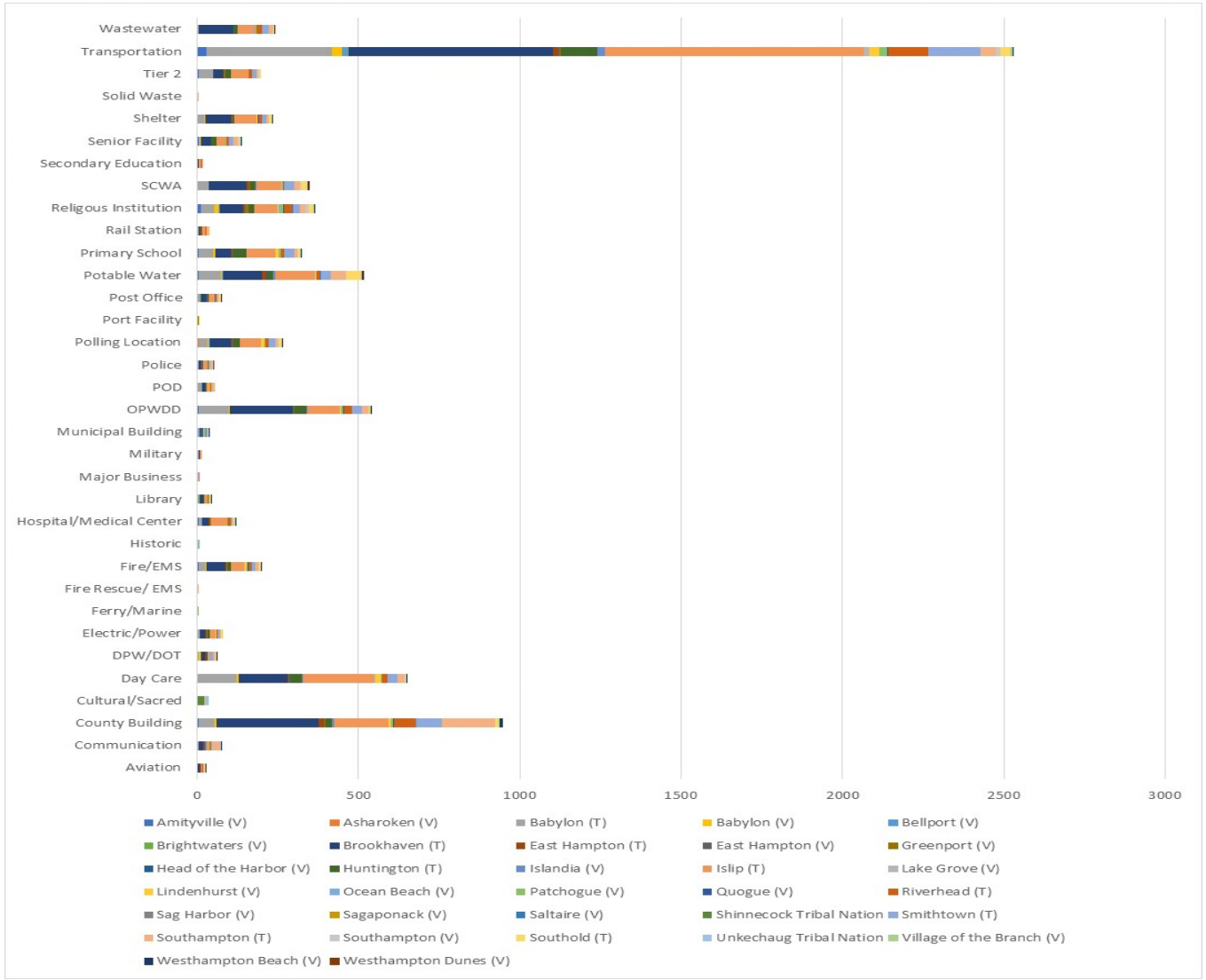
Source: HAZUS-MH v4.2
Notes: RCV = Replacement Cost Value; V = Village; T = Town

HAZUS-MH v4.2 estimates approximately $141,077, $537.1 million, and $7.7 billion of damage as a result of the 100-year MRP event, 500-Year MRP event, and 2,500-year MRP event, respectively. These damages account for less than 1-percent of total building replacement value in Suffolk County for the 100-, 500-, and 2-500-year MRP events. The sum of damages calculated in HAZUS include structural damage, non-structural damage, and loss of contents. Residential buildings account for majority of the building replacement cost damages.

Impact on Critical Facilities

More than 78-percent of the critical facilities in Suffolk County are considered exposed to the earthquake hazard. Refer to subsection "Critical Facilities" in Section 4 (County Profile) of this HMP for a complete inventory of critical facilities in Suffolk County. Of the 10,486 critical facilities in the county, 8,231 are located on NEHRP Class D soils. 6,361 of these critical facilities are considered lifelines for the County. The Town of Brookhaven has the greatest number of critical facilities exposed to the earthquake hazard area, and majority of the exposed critical facilities are transportation facilities. Furthermore, 3,261 critical facilities are located in high landslide susceptible areas. 2,531 of these critical facilities are considered lifelines for the County. Appendix E (Risk Assessment Supplement) summarizes the number of critical facilities, by type, located on NEHRP Soil Class D hazard areas. Figure 5.4.5-9 summarizes the number of critical facilities by type per jurisdiction in Suffolk County located on NEHRP Soil Class D hazard areas. Table 5.4.5-21 summarizes the number of lifelines summarized by FEMA's lifeline categories exposed to NEHRP Class D and high landslide susceptible areas. Majority of the lifelines exposed to earthquake hazard areas are transportation lifelines.

Figure 5.4.5-9. Number of Critical Facilities within the NEHRP Class D Soil Hazard Area



Source: Suffolk County GIS 2020; Notes: SCWA = Suffolk County Water Authority, POD = Point of Distribution, OPWDD = Office for People with Development Disabilities, EMS = Emergency Medical Services, DPW = Department of Public Works, DOT = Department of Transportation; V = Village; T = Town

Table 5.4.5-21. Number of Lifelines Exposed to NEHRP D Soils and High Landslide Susceptible Hazard Areas

Lifeline Categories	Total Lifelines in County	Earthquake NEHRP D Soil Class Exposure	High Landslide Susceptibility Exposure
Communication	126	74	30
Energy	397	319	163
Food, Water, Shelter	1,458	1,095	592
Health and Medical	1,081	850	371
Safety and Security	1,956	1,402	556
Transportation	3,099	2,621	819
Suffolk County (Total)	8,117	6,361	2,531

Source: Suffolk County GIS 2020; FEMA 2020; NYS n.d.; USGS 2010

The analysis found that evacuation routes in Suffolk County are built on NEHRP Class D soils. There is a total 614.7 miles of evacuation routes within Suffolk County. There are approximately 208 miles of these evacuation routes located on NEHRP Class D soils (i.e., 33.8-percent of total miles).

Furthermore, the HAZUS-MH v4.2 earthquake model was used to assign a probability of each damage state category defined in Table 5.4.5-19 through Table 5.4.5-21 to every critical facility in the planning area for the 100-, 500-, and 2,500-year MRP events, which was then averaged across the facility category. In addition, HAZUS-MH v4.2 estimates the time to restore critical facilities to fully functional use. Results are presented as probability of being functional at specified time increments (days after the event). For example, HAZUS-MH v4.2 might estimate that a facility has 5-percent chance of being fully functional at Day 3, and a 95-percent chance of being fully functional at Day 90. For percent probability of sustaining damage, the minimum and maximum damage estimated value for that facility type is presented. As a result of a 100-year MRP event, HAZUS-MH v4.2 estimates that critical facilities will be nearly 100-percent functional with negligible damages. Therefore, the impact to critical facilities is not significant for the 100-year event. Whereas, for the 500- and 2,500-year MRP events, functionality can approximately decrease by 7- and 30-percent, respectively.

Table 5.4.5-22. Estimated Damage and Loss of Functionality for Critical Facilities, Utilities, and Transportation Facilities in Suffolk County for the 100-Year MRP Earthquake Event

Name	Percent Probability of Sustaining Damage					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Critical Facilities									
EOC	100.0%	0.0%	0.0%	0.0%	0.0%	99.8%	99.9%	99.9%	99.9%
Medical	100.0%	0.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%
Police	100.0%	0.0%	0.0%	0.0%	0.0%	99.8%	99.9%	99.9%	99.9%
Fire	100.0%	0.0%	0.0%	0.0%	0.0%	99.8%	99.9%	99.9%	99.9%
Schools	100.0%	0.0%	0.0%	0.0%	0.0%	99.8%	99.9%	99.9%	99.9%
Utilities									
Potable Water	100.0%	0.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%
Electric Power	100.0%	0.0%	0.0%	0.0%	0.0%	99.8%	99.9%	99.9%	99.9%
Transportation									
Bus Facilities	100.0%	0.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%
Port Facilities	100.0%	0.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%
Railway Facilities	100.0%	0.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%

Source: HAZUS-MH 4.2
Notes: EOC = Emergency Operation Center; % = Percent

Table 5.4.5-23. Estimated Damage and Loss of Functionality for Critical Facilities, Utilities, and Transportation Facilities in Suffolk County for the 500-Year MRP Earthquake Event

Name	Percent Probability of Sustaining Damage					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Critical Facilities									
EOC	96.2% - 99.4%	0.0% - 2.2%	0.0% - 1.3%	0.0%	0.0%	96.2% - 99.3%	98.7%	99.8%	99.8%
Medical	98.9%	1.1%	0.0%	0.0%	0.0%	98.8%	98.9%	99.9%	99.9%
Police	93.0% - 99.4%	0.0% - 3.9%	0.0% - 2.6%	0.0%	0.0%	92.9% - 99.3%	96.7% - 99.7%	99.8%	99.8%
Fire	93.0% - 100.0%	0.0% - 3.9%	0.0% - 2.6%	0.0%	0.0%	92.9% - 100%	96.7% - 100%	99.8%	99.8%
Schools	95.6% - 99.5%	0.0% - 2.9%	0.0% - 1.4%	0.0%	0.0%	95.5% - 99.4%	99.3%	99.9%	99.9%
Utilities									
Potable Water	93.3% - 99.4%	0.0% - 3.7%	0.0% - 2.5%	0.0%	0.0%	96.2% - 99.9%	99.8%	99.8%	99.9%
Electric Power	95.8% - 99.3%	0.0% - 2.4%	0.0% - 1.5%	0.0%	0.0%	97.1% - 99.5%	99.8%	99.9%	99.9%
Transportation									
Bus Facilities	98.8%	0.0% - 1.5%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%
Port Facilities	99.1%	1.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%
Railway Facilities	98.9%	0.0% - 1.5%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%

Source: HAZUS-MH 4.2

Notes: EOC = Emergency Operation Center; % = Percent

Table 5.4.5-24. Estimated Damage and Loss of Functionality for Critical Facilities, Utilities, and Transportation Facilities in Suffolk County for the 2,500-Year MRP Earthquake Event

Name	Percent Probability of Sustaining Damage					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Critical Facilities									
EOC	75.9% - 95.0%	2.8% - 11.0%	1.8% - 10.0%	0.0% - 3.0%	0.0%	75.9% - 94.9%	86.6% - 97.7%	96.9% - 99.6%	98.9%
Medical	81.6% - 98.4%	1.6% - 15.9%	0.0% - 2.5%	0.0%	0.0%	81.5% - 98.3%	97.1% - 99.8%	99.9%	99.9%
Police	70.4% - 95.0%	2.8% - 12.9%	1.8% - 12.5%	0.0% - 4.2%	0.0%	70.3% - 94.9%	82.9% - 97.7%	95.7% - 99.6%	97.8% - 99.8%
Fire	70.4% - 100.0%	0.0% - 12.9%	0.0% - 12.5%	0.0%	0.0%	70.3% - 100.0%	82.9% - 100.0%	95.7% - 100.0%	97.8% - 100.0%
Schools	74.3% - 96.5%	2.3% - 11.6%	1.1% - 10.7%	0.0% - 3.4%	0.0%	74.3% - 96.5%	85.6% - 98.7%	96.5% - 99.8%	99.5%
Utilities									
Potable Water	71.0% - 95.0%	2.8% - 12.7%	1.8% - 12.2%	0.0% - 4.1%	0.0%	82.3% - 97.2%	96.7% - 99.7%	97.7% - 99.8%	99.8% - 99.9%
Electric Power	73.3% - 94.0%	3.3% - 11.9%	2.2% - 11.1%	0.0% - 3.6%	0.0%	80.4% - 95.9%	98.9%	99.9%	99.9%
Transportation									
Bus Facilities	81.6% - 98.0%	1.9% - 15.9%	0.0% - 2.5%	0.0%	0.0%	99.0%	99.9%	99.9%	99.9%
Port Facilities	89.1% - 98.3%	1.6% - 9.9%	0.0% - 1.0%	0.0%	0.0%	99.5%	99.9%	99.9%	99.9%
Railway Facilities	82.4% - 98.0%	1.9% - 15.2%	0.0% - 2.3%	0.0%	0.0%	99.1%	99.9%	99.9%	99.9%
Highway Bridge	100.0%	0.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%

Source: HAZUS-MH 4.2
Notes: EOC = Emergency Operation Center; % = Percent

Impact on Economy

Earthquakes also impact the economy, including loss of business function, damage to inventory (buildings, transportation, and utility systems), relocation costs, wage loss, and rental loss due to repair and replacement of buildings. HAZUS-MH v4.2 estimates building-related economic losses, including income losses (wage, rental, relocation, and capital-related losses) and capital stock losses (structural, non-structural, content, and invsentory losses). Economic losses estimated by HAZUS-MH v4.2 are summarized in Table 5.4.5-25.

Table 5.4.5-25. Building-Related Economic Losses from the 100-, 500-, and 2,500-Year MRP Earthquake Events

Level of Severity	Mean Return Period		
	100-year	500-year	2,500-year
Income Losses			
Wage	$3,000	$11,918,000	$114,049,300
Capital Related	$3,700	$12,766,100	$121,504,100
Rental	$5,500	$14,820,400	$140,080,200
Relocation	$16,800	$27,843,900	$305,452,800
Subtotal	**$29,000**	**$67,348,400**	**$681,086,400**
Capital Stock Losses			
Structural	$49,600	$119,269,200	$1,207,823,300
Non-Structural	$82,200	$307,175,000	$4,380,046,900
Content	$8,700	$110,741,300	$2,141,119,600
Inventory	$0	$803,400	$13,940,600
Subtotal	**$140,500**	**$537,988,900**	**$7,742,930,400**

Source: HAZUS-MH v4.2

Although the HAZUS-MH v4.2 analysis did not compute damage estimates for individual roadway segments and railroad tracks, assumedly these features would undergo damage due to ground failure resulting in interruptions of regional transportation and of distribution of materials. Losses to the community that would result from damage to lifelines could exceed costs of repair (FEMA 2012). Earthquake events can significantly affect road bridges, many of which provide the only access to certain neighborhoods. Because softer soils generally follow floodplain boundaries, bridges that cross watercourses should be considered vulnerable. Another key factor in degree of vulnerability is age of facilities and infrastructure, which correlates with standards in place at time of construction.

HAZUS-MH v4.2 estimates volume of debris that may be generated as a result of an earthquake event to enable the study region to prepare for and rapidly and efficiently manage debris removal and disposal. Debris estimates were divided into two categories: (1) reinforced concrete and steel that require special equipment to break up before transport can occur, and (2) brick, wood, and other debris that can be loaded directly onto trucks by use of bulldozers (HAZUS-MH Earthquake User's Manual).

HAZUS-MH v4.2 estimated the generation of over 64,000 tons of total debris during the 500-year MRP event, and over 691,500 tons of debris during the 2,500-year MRP event. Table 5.4.5-26 below lists estimated debris generated by the 500- and 2,500-year MRP events.

Table 5.4.5-26. Estimated Debris Generated by the 500- and 2,500-year MRP Earthquake Events

Jurisdiction	500-Year		2,500-Year	
	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Amityville (V)	84	430	948	5,677
Asharoken (V)	9	3	67	26
Babylon (T)	1,249	7,289	13,822	97,321
Babylon (V)	92	311	1,020	3,923
Belle Terre (V)	32	28	260	255
Bellport (V)	96	146	781	1,551
Brightwaters (V)	44	93	518	1,190
Brookhaven (T)	6,299	10,920	49,939	115,973
Dering Harbor (V)	1	1	8	9
East Hampton (T)	244	289	2,640	2,713
East Hampton (V)	61	85	504	701
Greenport (V)	17	86	159	921
Head of the Harbor (V)	232	75	1,185	591
Huntington (T)	3,340	4,925	24,484	58,720
Huntington Bay (V)	15	16	110	129
Islandia (V)	72	501	681	5,777
Islip (T)	2,529	9,936	26,396	118,419
Lake Grove (V)	191	217	1,529	2,470
Lindenhurst (V)	152	483	1,736	6,336
Lloyd Harbor (V)	78	26	508	229
Nissequogue (V)	318	101	1,622	793
North Haven (V)	44	15	385	147
Northport (V)	31	28	247	234
Ocean Beach (V)	2	4	25	46
Old Field (V)	81	61	613	591
Patchogue (V)	308	968	2,449	10,244
Poquott (V)	25	20	191	188
Port Jefferson (V)	185	565	1,435	4,739
Quogue (V)	120	43	1,009	469
Riverhead (T)	425	1,789	3,873	26,158
Sag Harbor (V)	27	15	248	157
Sagaponack (V)	54	38	517	525
Saltaire (V)	3	6	38	72
Shelter Island (T)	9	18	137	145
Shoreham (V)	11	12	144	100
Smithtown (T)	1,427	3,112	88	104
Southampton (T)	1,106	669	12,040	33,068
Southampton (V)	367	199	9,778	7,415
Southold (T)	234	761	2,565	1,936

Jurisdiction	500-Year		2,500-Year	
	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Village of the Branch (V)	40	78	2,377	11,290
Westhampton Dunes (V)	9	3	31	15
Westhampton Beach (V)	134	70	320	908
Shinnecock Tribal Nation	16	11	1,007	695
Unkechaug Tribal Nation	4	1	80	41
Suffolk County (Total)	**19,816**	**44,445**	**168,512**	**523,009**

Source: HAZUS-MH 4.2
Notes: V = Village; T = Town

Impact on the Environment

According to USGS, earthquakes can cause damage to the surface of the Earth in various forms depending on the magnitude and distribution of the event (USGS 2020). Surface faulting is one of the major seismic components to earthquakes that can create wide ruptures in the ground. Ruptures can have a direct impact on the landscape and natural environment because it can disconnect habitats for miles isolating animal species or tear apart plant roots.

Furthermore, ground failure as a result of soil liquefaction can have an impact on soil pores and retention of water resources (USGS 2020). The greater the seismic activity and liquefaction properties of the soil, the more likely drainage of groundwater can occur which depletes groundwater resources. In areas where there is higher pressure of groundwater retention, the pores can build up more pressure and make soil behave more like a fluid rather than a solid increasing risk of localized flooding and deposition or accumulation of silt (USGS 2020).

Cascading Impacts to Other Hazards

The Global Geoengineering Research Group in USGS has been investigating the relationship earthquakes have with ground deformation, ground failure, and coastal erosion (USGS 2019). As mentioned in earlier sections, soft and loose soils are more susceptible to earthquake events. Ground failure can become exacerbated due to earthquake events, causing landsliding and coastal erosion. Areas of steep slopes are at greater risk of ground failure and potential erosion during earthquakes (USGS 2019).

Further, residual impacts from earthquakes could alter the floodplain extent for the County if ground failure and erosion occur. Damage to coastal levees or canals may become breached as a result of an earthquake event, which could create flooding in the impacted areas.

Future Changes That May Impact Vulnerability

Understanding future changes that effect vulnerability in the County can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. The County considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

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 earthquake hazard areas could be potentially impacted by earthquakes. There are 39 new development sites located within the earthquake hazard area and 13 new development sites located within the high landslide susceptibility areas.

It is recommended that the County and municipal partners implement design strategies that follow the New York State Department of Transportation Geotechnical Design Manual (2015) for all development projects (NYSDOT 2015). Please refer to Figure 5.4.5-9 and Figure 5.4.5-10 for potential new development in the County and their proximity to the earthquake hazard areas.

Projected Changes in Population

According to the Suffolk County Economic Development and Planning Department'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. Persons that move into older structures in the County are at greater risk of being impacted by earthquake events because older structures are more vulnerable to ground shaking. Refer to Section 4 (County Profile), which includes a more thorough discussion about population trends for the County.

Climate Change

Because the impacts of climate change on the earthquakes are not well understood, a change in the County's vulnerability is difficult to determine. However, climate change has the potential to magnify secondary impacts of earthquakes. As a result of the climate change projections discussed above, the County's assets located on areas of saturated soils and on or at the base of steep slopes, are at a higher risk of landslides/mudslides because of seismic activity.

Change of Vulnerability Since 2014 HMP

Several differences exist between the 2014 plan and this update. For the 2020 plan update, an updated general building stock based upon replacement cost value from RS Means 2019 and updated building stock data provided by Suffolk County and the partnering municipalities. Updated critical facility inventory provided by the County was also used to assess the County's risk to the hazard areas. In addition, the 2018 American Community Survey population estimates were used and estimated at a structural level in place of the 2010 U.S. Census blocks. Finally, an updated version of HAZUS-MH was used to assess the estimated damages from probabilistic earthquake hazard events (i.e., v4.2).

Figure 5.4.5-10. New Development and NEHRP Soil Types in Suffolk County

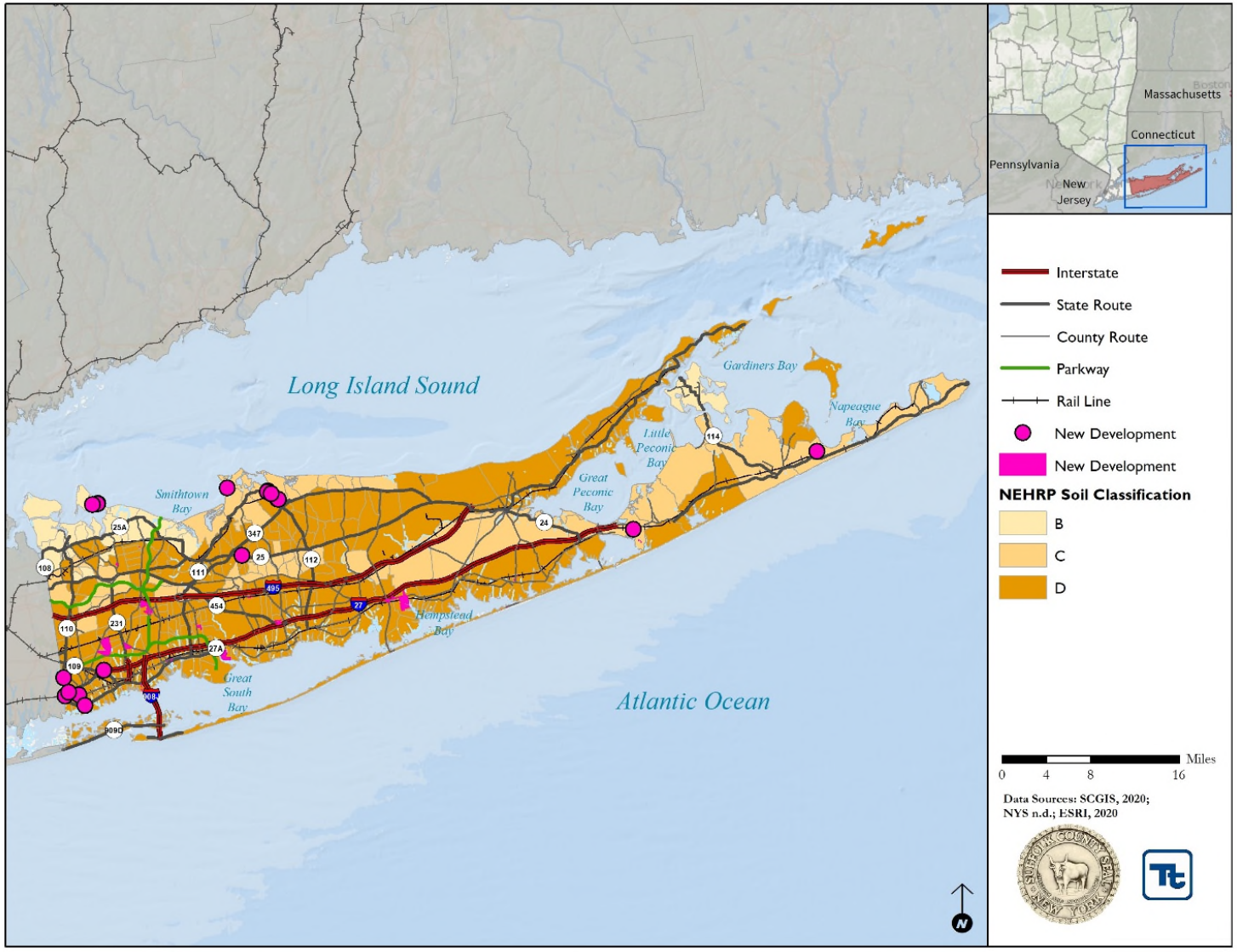


Figure 5.4.5-11. New Development and Areas of High Landslide Susceptibility in Suffolk County