5.4.15 SHALLOW GROUNDWATER FLOODING

This section provides a hazard profile and vulnerability assessment of the shallow groundwater flooding 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 shallow groundwater flooding hazard.

Description

As detailed in the flood hazard profile (Section 5.4.5), a flood is a general and temporary condition of partial or complete inundation of normally dry land areas, resulting from:

- Overflow of inland or tidal waters
- Unusual and rapid accumulation of runoff or surface waters
- Mudslides/mudflows caused by accumulation of water

A situation in which rainfall is so intense and severe and runoff so rapid that is precludes recording and relating it to stream stages and other information in time to forecast a flood condition (New York State Disaster Preparedness Commission [NYSDPC] 2005).
According to the Federal Interagency Floodplain Management Task Force, flooding in the United States can be separated into several types (Federal Interagency Floodplain Management Task Force 1992), including "shallow or high groundwater levels."

Per the FEMA's "Multi-Hazard Identification and Risk Assessment – The Cornerstone of the National Mitigation Strategy (1997), "high groundwater levels may be of concern and can cause problems even when there is no surface flooding. Basements are susceptible to high groundwater levels. Seasonally high groundwater is common in many areas, while in others high groundwater occurs only after long periods of above-average precipitation."

Groundwater is a crucial water resource that supplies springs, wells, and base flow to streams. Groundwater is the sole source of freshwater supply in Nassau and Suffolk Counties on Long Island (USGS 2020). When groundwater is close to the surface, it can cause chronic issues to those who experience basement flooding and compromised septic systems. Groundwater is stored and flows within the pore spaces of soil and rocks. It is present in all areas, even those that are not underlain by a major aquifer. Groundwater flooding occurs when soil becomes too saturated from rainfall to absorb more water and the water table rises to the surface. For homeowners, groundwater flooding can cause many problems that may include structural damage, sewer system back-ups, and damaged appliances.

For the purposes of this planning effort, the shallow groundwater flooding hazard has been defined as the condition of a sufficiently shallow groundwater table (saturated zone) either cyclically or persistently above the level of subsurface structures resulting in negative impacts. Impacts to subsurface structures include groundwater seepage into basements and septic system failures. In some cases, shallow groundwater breaches the land surface and floods low-lying roadways, as covered more generally under the "flooding" hazard in this Plan. The hazard definition for this planning effort does not include groundwater seepage as a result of heavy precipitation events where the actual groundwater table (saturated zone) does not impinge on subsurface structures.

Extent

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. One element is the size of rivers and streams in an area; but an equally important factor is the land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris 2001).

Unlike coastal flooding or flash flooding, shallow groundwater flooding is less likely to result in swift moving floodwaters and is less likely to be a threat to life. However, given the nature of groundwater, shallow groundwater flooding events are much more likely to take place for an extended period of time than other forms of flooding.

Location

Shallow groundwater flooding has occurred throughout the County for many years, resulting in persistent structural flood losses. These conditions in Suffolk County typically occur in low-lying areas along the coast, near surface water bodies (including wetlands, marshes and bogs) and along ancestral drainage courses. Soil permeability often exacerbates shallow groundwater problems in such areas, as in morainal areas that contain glacial till (as opposed to areas with higher permeability geologies such as outwash deposits). Further, the presence and severity of shallow groundwater conditions is a function of long-term precipitation trends in the County, particularly in the areas around the Northeast Branch of the Nissequogue River and Lake Ronkonkoma in the Town of Smithtown.

The Northeast Branch of the Nissequogue River is one of the most widely recognized areas affected by shallow groundwater flooding in Suffolk County. It is a series of ponds and streams that bring water to New Mill Pond for discharge to the Long Island Sound via the Nissequogue River. The Northeast Branch serves to drain stormwater and groundwater from its watershed. The waterway's ability to efficiently transport excess groundwater to downstream waters depends on the condition of the stream. The Northeast Branch has a recurring groundwater flooding issue. At least 268 homes are known to have experienced damages related to this flooding issue and an additional 662 homes have been identified as likely to have experienced damages relating to groundwater flooding (Schumer 2013).

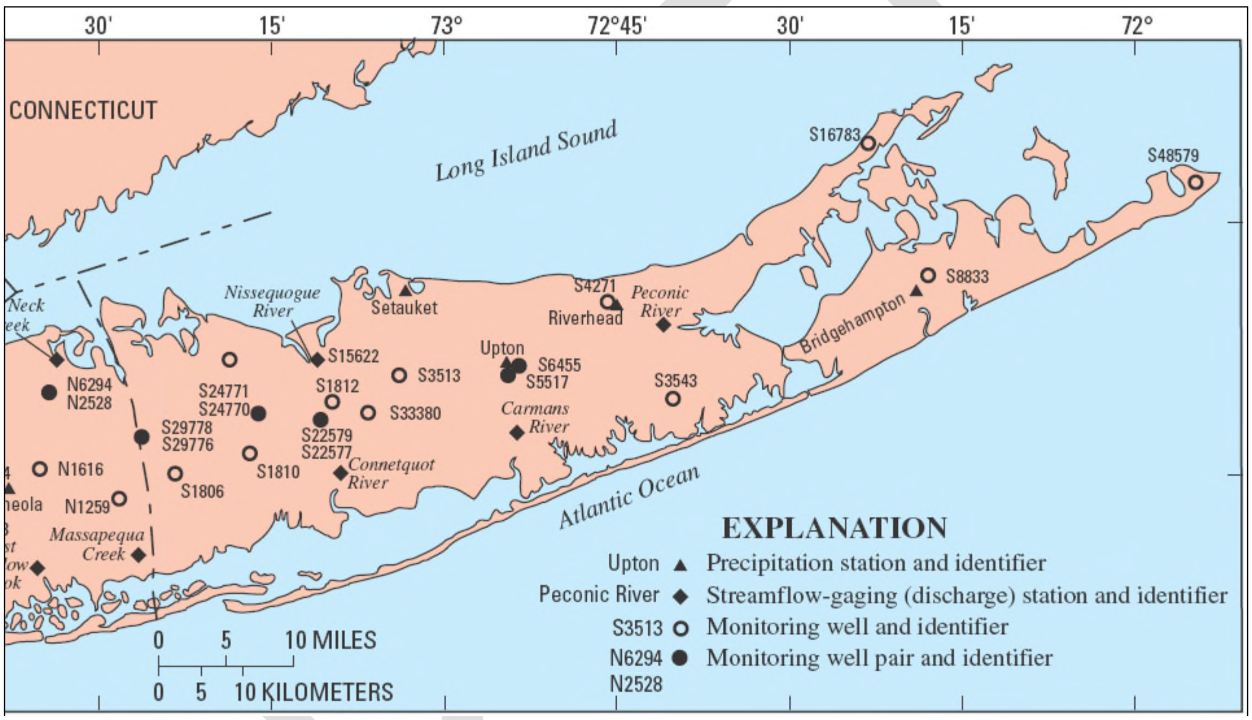
Long Island's aquifer system consists of a series of gently sloping Pleistocene glacial, glaciofluvial, and glaciolacustrine deposits and Cretaceous fluvial or deltaic deposits of unconsolidated sand, gravel, and clay. The upper surface of the groundwater system is the water table, which typically lies 0 to 190 ft beneath land surface; the lower limit is the Precambrian gneiss and schist bedrock that lies between 0 and 2,700 ft below land surface. The groundwater system is bounded laterally by saltwater. The saltwater interface (the diffuse boundary between fresh and salty water) has generally migrated landward in response to groundwater withdrawal in nearshore areas and the rise in sea level since Pleistocene time. The water table may rise or fall depending on several factors. Heavy rains or melting snow may increase recharge and cause the water table to rise. An extended period of dry weather may decrease recharge and cause the water table to fall (USGS 1993).

The fact that shallow groundwater tables are found in low-lying areas and in proximity to surface water bodies throughout Suffolk County are well recognized and understood. The upper glacial aquifer is the uppermost unit in Long Island's groundwater reservoir and contains the water table throughout the majority of the island. The upper surface of the upper glacial aquifer forms the present day land surface of most of Long Island. While in parts of Long Island, the upper glacial aquifer overlies geologies with high hydraulic conductivities, some parts of the aquifer overlay areas of limited conductivity (Gardiners clay along the much of the southern shore, and subcrops of the Raritan clay confining unit along parts of the northern shore).

As stated in U.S. Geological Survey (USGS) Water-Resources Investigations Report (WRIR) 01-4165, the upper glacial aquifer consists of till, outwash deposits, and three major glaciolacustrine and marine clay units. These include the "Smithtown clay' in north central Suffolk County, the "Manorville clay" in east-central Suffolk County, and "the "20-foot clay" in southwestern Suffolk County. These minor clay units impede the downward movement of water, and each one creates locally elevated water tables (Busciolano 2002).

Precipitation is the sole source of all naturally occurring fresh groundwater on Long Island, and seasonal or long-term fluctuations in precipitation are reflected by the water levels in all aquifers (Busciolano 2002). The general trends in the rise and fall of the water table follow general trends in precipitation (H2M 1980). Long-term surface water data collection by the USGS in most parts of the Long Island began in the 1930s and 1940s (Busciolano 2002). This report clearly demonstrates the correlation between groundwater levels and long-term precipitation trends, as determined through measurements collected at the precipitation-monitoring stations and groundwater monitoring wells shown on Figure 5.4.15-1.

Figure 5.4.15-1. Locations of Selected Precipitation and Groundwater Monitoring Stations on Long Island



Source: Busciolano 2005.
Note: Base from USGS State base map, 1979.

Long term precipitation records at eight selected stations across Long Island were found to indicate generally similar long-term trends, with a deficit of rain in the 1960s as the major. Precipitation monitoring at the Setauket (Town of Brookhaven), Upton (Town of Brookhaven), and Riverhead stations (see Figure 5.4.15-1 and Table 5.4.15-1) indicated the following notable short- and long-term precipitation trends:

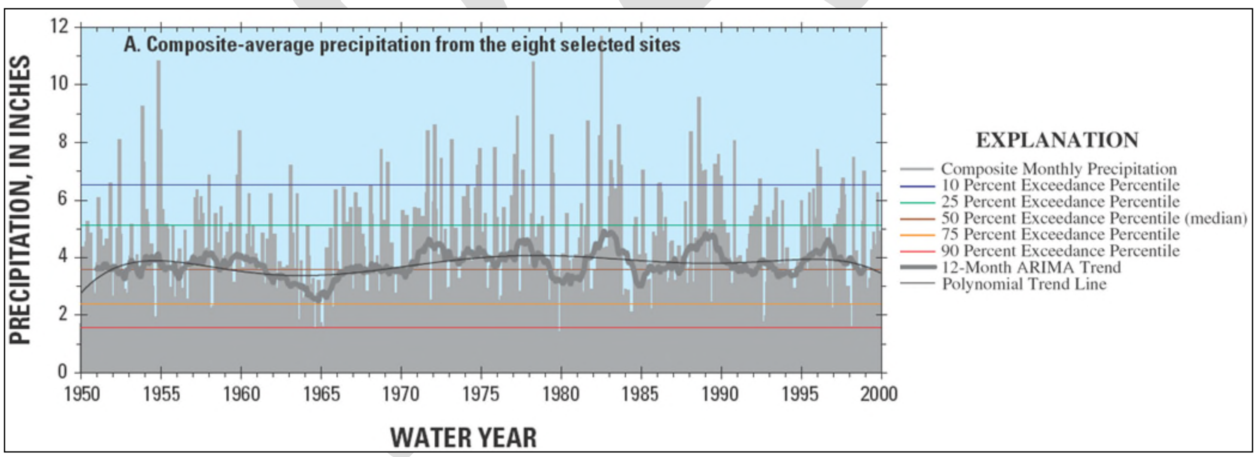
Table 5.4.15-1. Short- and Long-Term Precipitation Trends at Selected Monitoring Stations

	Period of record			Relation to mean		Cumulative value	
Station	Long or short term	Period	No. of years	1951-2000 mean	Above or below	Surplus (inches)	Deficit (inches)
Setauket	Short term	1958-60	3	44.93	above	17.22	--
		1961-66	6		below	--	44.48
		1972-76	5		above	22.85	--
		1982-84	3		above	25.45	--
		1989-91	3		above	19.50	--
	Long term	1961-68	8		below	--	50.88
		1972-79	8		above	41.57	--
Upton	Short term	1962-66	5	48.85	below	--	32.19
		1982-84	3		above	27.49	--
		1985-88	4		below	--	38.16
		1989-91	3		above	26.98	--
		1992-95	4		below	--	30.61
	Long term	1972-79	8		above	25.10	--
Riverhead	Short term	1958-61	4	46.01	above	20.90	--
		1962-66	5		below	--	37.96
		1982-84	3		above	28.37	--
		1989-91	3		above	25.30	--
		1996-98	3		above	19.42	--
	Long term	1962-71	10		below	--	60.19
		1972-79	8		above	29.98	--

Source: Busciolano 2005

Figure 5.4.15-2 shows a 50-year composite-average hydrograph of monthly precipitation for the eight monitoring stations used in the USGS report to evaluate overall precipitation trends for Nassau and Suffolk Counties.

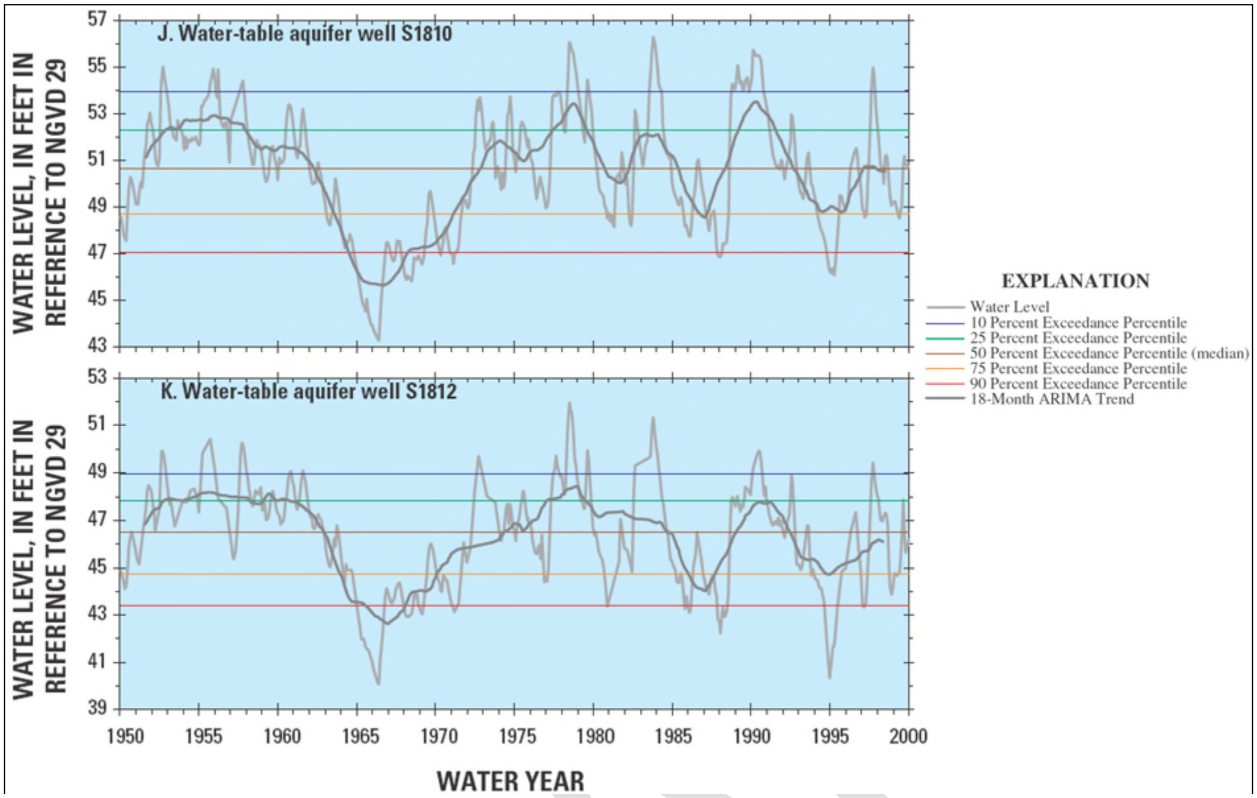
Figure 5.4.15-3. 50-Year Average Precipitation on Long Island



Source: Busciolano 2005

Examination of groundwater level monitoring data at monitoring well S1810 (Brentwood, Town of Islip) and S1812 (Village of the Branch, Town of Smithtown) demonstrate the high degree of correlation between precipitation trends and groundwater elevations in this area, as shown in Figure 5.4.15-3.

Figure 5.4.15-4. Monthly water levels (1951-2000) at S1810 and S1812

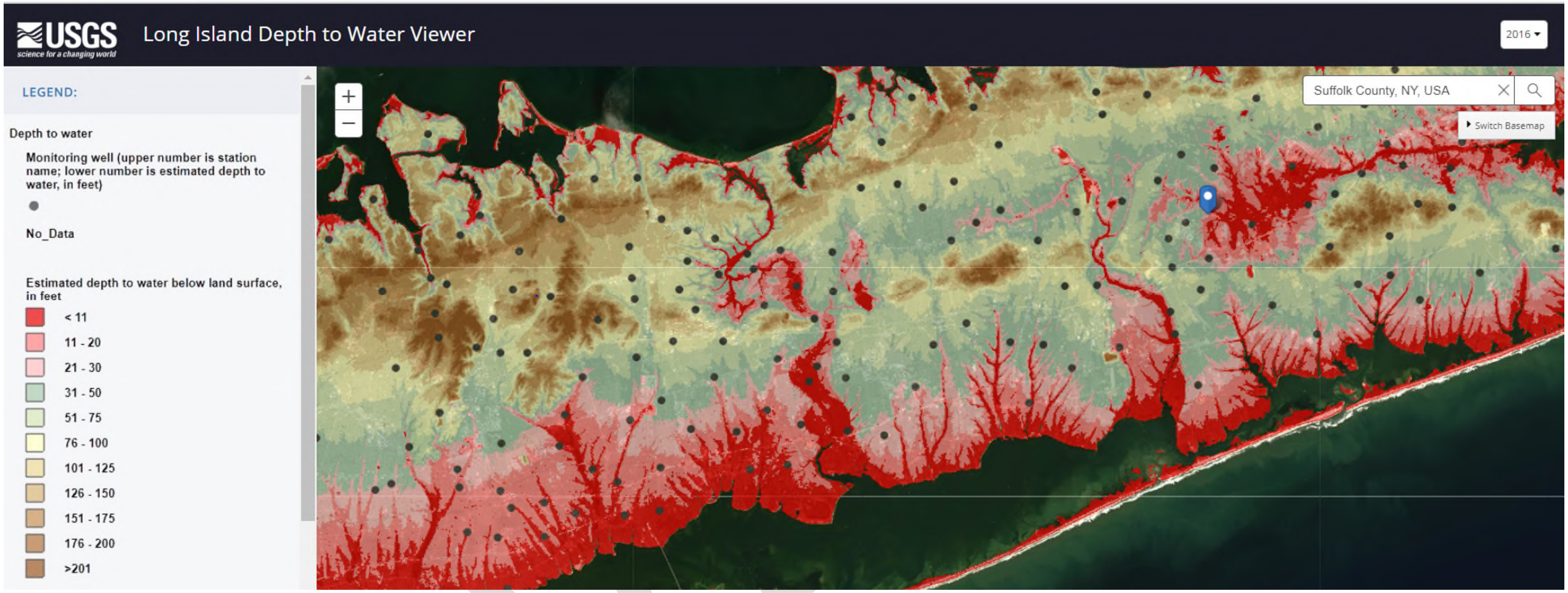


Source: Busciolano 2005

Long Island has seen extensive growth and development over the last 100 years, due in part to its proximity to the New York Metropolitan Area, as well as the abundance of fresh groundwater resources. This growth and development has generally resulted in the drawing down of groundwater in populated areas as a result of (1) increased groundwater pumping; (2) the installation of storm and sanitary sewers; and (3) increases in impervious surfaces which limit the infiltration of precipitation into the ground (Busciolano 2002). This effect becomes less evident as one moves from west to east across Long Island, following the trend of a decline in both population density and the level of sewering (while most of Nassau County is sewered, in Suffolk County, only the Atlantic Coast portions of the Towns of Babylon, Islip and Brookhaven have sanitary sewers). While development is known to lead to overall declines in groundwater levels, development pressures also have led to construction in areas with chronic or historically recurrent shallow groundwater conditions.

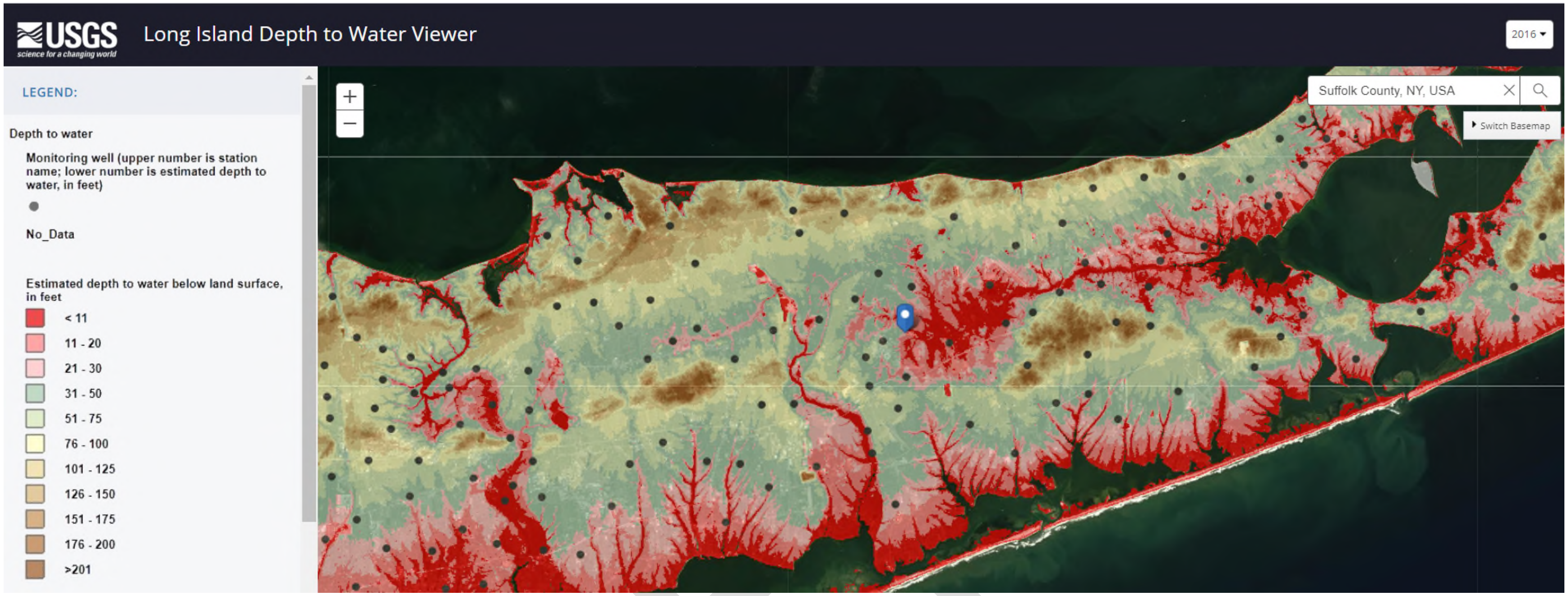
The USGS produced maps and an interactive map viewer to show depth to water on Long Island. Areas shown in red have the least depth to water and the most vulnerable to issues associated with a high water table. Figure 5.4.15-4 through Figure 5.4.15-6 shows these maps for Suffolk County.

Figure 5.4.15-5. Depth to Water – Western Suffolk County



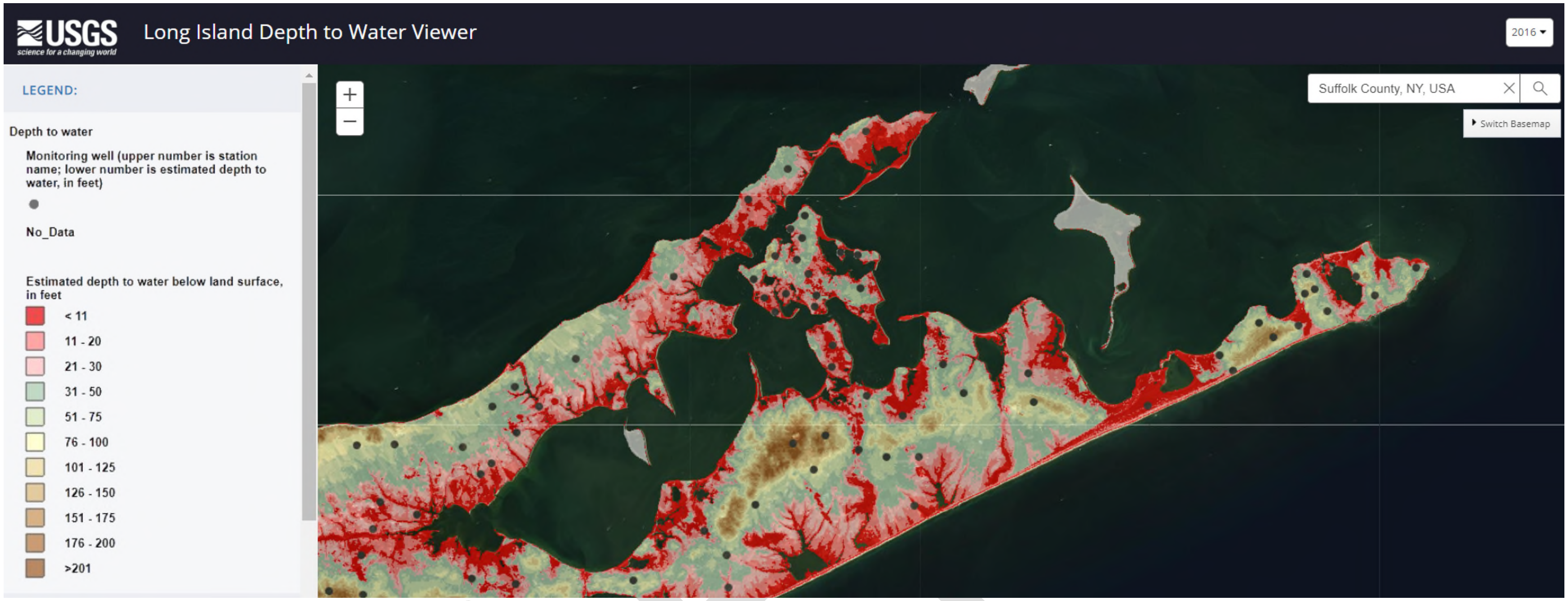
Source: USGS Long Island Depth to Water Viewer 2020

Figure 5.4.15-6. Depth to Water – Central Suffolk County



Source: *USGS Long Island Depth to Water Viewer 2020*

Figure 5.4.15-7. Depth to Water – Eastern Suffolk County



Source: USGS Long Island Depth to Water Viewer 2020

The H2M Study summarized a number of groundwater flooding problems in the Northeast Branch of the Nissequogue River and Lake Ronkonkoma area as follows:

- As of the date of the study, groundwater levels were found to be quite high throughout the area, reflecting high amounts of precipitation over the previous five years.
- A development boom in the late 1960s took place when water levels were very low as a result of severe drought in the early to mid-1960s. This drought period, from 1960 to 1966, was the most severe drought recorded on Long Island, and groundwater levels dropped Island-side as much as 5 to 10 feet. In this area, where groundwater levels are typically among the highest on the Island, the drop in water table actually exceeded 10 feet in places.
- As recovery of groundwater levels occurred steadily from the late 1960s through the 1970s, certain areas began to experience groundwater-related flooding problems. High levels of precipitation in 1978 and 1979 resulted in hundreds of homes and many roadways being affected by groundwater- related flooding.
- While brief periods of low precipitation may make existing problems seem to subside, these problem areas remain and can be impacted when precipitation returns to normal conditions (H2M 1980).

The “Lake Ronkonkoma Clean Lakes Study” (Suffolk County Government 1986) prepared in 1986 by the Suffolk County Planning Department and Suffolk County Department of Health Services, provides further insight into the problems around Lake Ronkonkoma and corroborates the findings of the H2M study. The General Background in the study presents the following assessment of the problem:

> After World War II, many people established year-round residency, and widespread development took place. During the 1960s a severe draught caused a general five to ten foot lowering of the water table in the Lake Ronkonkoma area. At the same time, a building boom occurred resulting in the development of the woodland areas as well as sites that were unsuitable for building because they were located in wetlands, and/or normally had a high water table.
>
> [During this period] former wetland and high water table areas were filled in and subsequently developed. Certain portions of the lake were filled and developed. The northern portion of the lake was formerly located where Smithtown Boulevard (CR16) now separates the lake from the bog. This road was developed in the 1930s; the area south of CR16 and north of the lake and the Old Causeway (Lake Shore Road) was also filled in and developed. The development of Steuben Boulevard required the filling in of the shallow portion of the lake and adjacent wetlands. The western shore was also filled using dredged material from the lake.
>
> During the years following the drought, the recurrence of normal rainfall patterns led to a rise in the water table level and the flooding of numerous basements (north, west and northeast of the lake). In some instances, even the first floors of homes located north of the lake were inundated with water. The residential area north of the lake near the intersection of Nichols Road, Browns Road and Alexander Ave. has had chronic flooding problems. During the early seventies, three recharge basins serving this residential area of Smithtown were interconnected by a system of gravity piping and discharged, via a pump station and force main, about one-half mile south into the Great Bog, west of Browns Road.
>
> Due to a rise in groundwater and lake levels in 1979, and a recurrence in 1984, the lake and the Great Bog became one body of water breached by Smithtown Boulevard, and many of the developed areas are experiencing extensive flooding problems. Today, as many as seventy homes in the general area

have flooded basements, and roads near the lake are periodically flooded. There are approximately fifty additional acres adjacent to the lake that is flooded during periods when lake levels are high. Complicating the picture are homes that sat close to the water table even in dry weather. Both areas have low elevations. A former stream bed winds through neighborhoods by Millers Pond. The swampy area that abuts the damp homes on Charles Court sits at the same elevation as the surface of Lake Ronkonkoma, just across the street (Suffolk County Government 1986).

Previous Occurrences and Losses

Shallow groundwater flooding hazard areas in Suffolk County include those with chronic (persistent) problems, and those areas that experience problems on a cyclical basis in response to long-term precipitation trends.

FEMA Major Disasters and Emergency Declarations

Between 1954 and 2020, FEMA did not include New York State of Suffolk County in any shallow groundwater flooding-related disaster (DR) or emergency (EM) declaration.

In the Northeast Branch of the Nissequogue River and Lake Ronkonkoma area, impacts from shallow groundwater have occurred cyclically in response to long-term precipitation trends. The H2M study reports that some of the older homes of that area have flooding histories dating back to 1936, with documented events during 1951 and 1952. Since the drought period in the early to mid-1960s, impacts from shallow groundwater have been reported in several general events. As groundwater levels recovered during the late 1960s through the 1970s, the basements of certain homes experienced varying degrees of seepage and certain roadways began flooding periodically. High levels of precipitation in 1978 and 1979 exacerbated the problems, with hundreds of homes and many roadways suffering impacts (H2M 1980). In the early 1990s, part of Steuben Road was abandoned after the Town of Smithtown could no longer keep up with the repairs required due to the constant flooding (Newsday 2007).

In 2007, at the Branch Brook Elementary School in the hamlet of Hauppauge, groundwater had been rising up into the septic system and causing raw sewage to flow into the school. The cost for the Smithtown Central School District to pump the septic tanks daily from January 2007 to December 2007 totaled over $600,000 (Hunt 2007). The School District planned to rebuild the septic system with an estimated cost of $589,785 (Ehmann 2007). A further discussion of vulnerability and losses is provided in the Vulnerability Assessment at the end of this profile.

Probability of Future Occurrence

As detailed previously, Suffolk County consists of various shallow groundwater hazard areas that continue to experience chronic flood losses. Structures within areas where shallow groundwater conditions exist at all times would expect to be impacted with a 100-percent probability during times of normal precipitation.

Areas that suffer from cyclical shallow groundwater problems experience such events according to long-term precipitation trends. Since the drought period in the early to mid-1960s, impacts from shallow groundwater flooding have been experienced in three general time periods (1975-1985, peaking about 1979; 1989-1992; and 1995). Based on these records and data on long-term precipitation trends presented earlier in this profile, the probability of occurrence for shallow groundwater flooding events in those areas experiencing cyclical impacts is considered 'frequent' (hazard event that occurs more frequently than once in 10 years).

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 shallow groundwater flooding in Suffolk 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] 2011).

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 2011).

In Region 4, it is estimated that temperatures will increase by 4.1ºF to 5.7ºF by the 2050s and 5.3ºF to 8.8ºF by the 2080s (baseline of 54.6 ºF, mid-range projection). Precipitation totals will increase between 4 and 11% by the 2050s and 5 to 13% by the 2080s (baseline of 49.7 inches, mid-range projection) (NYSERDA 2014). The heaviest 1% of daily rainfalls have increased by approximately 70% between 1958 and 2011 in the Northeast (Horton et al. 2015). Average annual precipitation is projected to increase in the region by four to 11-percent by the 2050s and five to 13-percent by the 2080s (New York City Panel on Climate Change [NPCC] 2015).

Table 5.4.15-3. Projected Seasonal Precipitation Change in Region 4, 2050s (% change)

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSERDA 2011

Even though an increase in annual precipitation is projected, other climate change factors, such as an extended growing season, higher temperatures, and the possibility of more intense, less frequent summer rainfall, may lead to additional droughts and increased short-term drought periods (Cornell University College Of Agriculture And Life Sciences 2011). Droughts can cause deficits in surface and groundwater, which would reduce the County's vulnerability to shallow groundwater flooding. However, according to the University of Hawaii's School of Ocean And Earth Science And Technology (Soest 2012), sea level rise may pose a significant threat of groundwater flooding. The effect of climate change on shallow groundwater flooding will therefore be determined by the balance between sea level rise and drought.

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable in the identified hazard area. A spatial assessment was complete to identify buildings and population at risk to shallow groundwater flooding using data from the Smithtown H2M Study created in 2007.

Impact on Life, Health and Safety

Shallow groundwater flooding can be an issue in developed areas where drainage systems (swales, ditches, storm sewers, stormwater ponds, etc.) are overloaded by large storm events. Shallow groundwater flooding is not generally considered to pose an immediate danger to life; however, there are a number of health and safety concerns associated with the hazard. Health concerns are related to exposure to mold and groundwater contaminated by fecal coliform and hazardous materials, as well as stress. Safety concerns also include slips, trips and falls, both while addressing basement flooding problems, and when walking or driving on ice-covered surfaces in cold weather.

Table 5.4.15-3 summarizes the number of people, including vulnerable populations, living in the identified shallow groundwater flooding hazard areas. Overall, the Town of Islip, the Town of Smithtown, and the Village of the Branch are the three jurisdictions with persons exposed to shallow groundwater hazard areas. The Village of the Branch has the greatest percentage of its population living in shallow groundwater hazard areas (i.e., 39.9-percent of the total population).

Table 5.4.15-3. Population Exposed to Shallow Groundwater Flooding

Jurisdiction	Total Population	Population in Shallow Groundwater Hazard Area	
		Number	% of Total
Amityville (V)	9,452	0	0.0%
Asharoken (V)	443	0	0.0%
Babylon (T)	162,968	0	0.0%
Babylon (V)	12,089	0	0.0%
Belle Terre (V)	681	0	0.0%
Bellport (V)	2,008	0	0.0%
Brightwaters (V)	3,069	0	0.0%
Brookhaven (T)	448,342	0	0.0%
Dering Harbor (V)	0	0	0.0%
East Hampton (T)	18,685	0	0.0%
East Hampton (V)	1,034	0	0.0%
Greenport (V)	1,945	0	0.0%
Head of the Harbor (V)	1,463	0	0.0%
Huntington (T)	189,840	0	0.0%
Huntington Bay (V)	1,366	0	0.0%
Islandia (V)	3,345	0	0.0%
Islip (T)	326,416	497	0.2%
Lake Grove (V)	11,130	0	0.0%
Lindenhurst (V)	27,053	0	0.0%
Lloyd Harbor (V)	3,676	0	0.0%
Nissequogue (V)	1,574	0	0.0%
North Haven (V)	919	0	0.0%
Northport (V)	7,348	0	0.0%
Ocean Beach (V)	24	0	0.0%
Old Field (V)	812	0	0.0%
Patchogue (V)	12,398	0	0.0%
Poquott (V)	992	0	0.0%
Port Jefferson (V)	7,871	0	0.0%
Quogue (V)	803	0	0.0%
Riverhead (T)	33,625	0	0.0%
Sag Harbor (V)	2,184	0	0.0%

Jurisdiction	Total Population	Population in Shallow Groundwater Hazard Area	
		Number	% of Total
Sagaponack (V)	260	0	0.0%
Saltaire (V)	8	0	0.0%
Shelter Island (T)	2,744	0	0.0%
Shoreham (V)	437	0	0.0%
Smithtown (T)	112,224	6,270	5.6%
Southampton (T)	51,008	0	0.0%
Southampton (V)	3,263	0	0.0%
Southold (T)	20,202	0	0.0%
Village of the Branch (V)	1,770	707	39.9%
Westhampton Dunes (V)	69	0	0.0%
Westhampton Beach (V)	1,653	0	0.0%
Shinnecock Tribal Nation	662	0	0.0%
Unkechaug Tribal Nation	324	0	0.0%
Suffolk County (Total)	**1,488,179**	**7,474**	**0.5%**

Sources: 2018 American Community Survey 5-Year Estimates; Smithtown H2M Study 2007
Notes: V = Village, T = Town; % = Percent

Impact on General Building Stock

Suffolk County also has buildings at risk to the impacts from shallow groundwater flooding. Table 5.4.15-4 presents the number of buildings exposed to the shallow groundwater flooding hazard area. Approximately $2.3 billion of building and content replacement costs are built on shallow groundwater hazard areas, or less than 1-percent of the total replacement cost value in the County. The Town of Smithtown has the greatest number of buildings located in the shallow groundwater hazard area (i.e., 1,902 buildings).

Table 5.4.16-2. Buildings Exposed to Shallow Groundwater Flooding

Jurisdiction	Total # Buildings	Total RCV	Total (All Occupancies) Shallow Groundwater Hazard 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	0	0.0%	$0	0.0%
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	0	0.0%	$0	0.0%
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	0	0.0%	$0	0.0%
Dering Harbor (V)	41	$88,595,797	0	0.0%	$0	0.0%
East Hampton (T)	18,243	$26,516,571,402	0	0.0%	$0	0.0%
East Hampton (V)	1,938	$5,002,346,911	0	0.0%	$0	0.0%
Greenport (V)	982	$1,316,147,268	0	0.0%	$0	0.0%

Jurisdiction	Total # Buildings	Total RCV	Total (All Occupancies) Shallow Groundwater Hazard Area			
			# Buildings	% Total	RCV	% Total
Head of the Harbor (V)	527	$1,052,509,872	0	0.0%	$0	0.0%
Huntington (T)	62,226	$82,709,382,979	0	0.0%	$0	0.0%
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	129	0.1%	$209,229,673	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	0	0.0%	$0	0.0%
Nissequogue (V)	638	$1,430,093,283	0	0.0%	$0	0.0%
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	0	0.0%	$0	0.0%
Old Field (V)	391	$967,667,970	0	0.0%	$0	0.0%
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	0	0.0%	$0	0.0%
Quogue (V)	1,785	$5,371,998,365	0	0.0%	$0	0.0%
Riverhead (T)	16,853	$27,561,801,284	0	0.0%	$0	0.0%
Sag Harbor (V)	1,887	$3,157,033,580	0	0.0%	$0	0.0%
Sagaponack (V)	908	$3,548,811,980	0	0.0%	$0	0.0%
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	0	0.0%	$0	0.0%
Smithtown (T)	35,517	$62,086,530,012	1,902	5.4%	$1,880,751,714	3.0%
Southampton (T)	33,290	$69,558,169,929	0	0.0%	$0	0.0%
Southampton (V)	3,500	$13,027,590,722	0	0.0%	$0	0.0%
Southold (T)	15,123	$17,842,698,534	0	0.0%	$0	0.0%
Village of the Branch (V)	624	$1,414,333,647	226	36.2%	$208,813,660	14.8%
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**	**2,257**	**0.4%**	**$2,298,795,046**	**0.3%**

Sources: Suffolk County GIS 2020; Suffolk County Real Property Tax Service 2020; Smithtown H2M Study 2007
Notes: RCV = Total replacement cost value (structure and contents); % = Percent; V = Village, T = Town

Properties and structures exposed to the shallow groundwater flooding hazard can experience impacts and losses in the following general categories:

- Repair and retrofit of basements, installation of dewatering systems (e.g., French drains, sumps)
- Repair and retrofit of foundations
- Septic System/Cesspool Repair or Replacement
- Mold Abatement
- Utilities to run sump pumps, dehumidifiers

Various sources have provided the following estimates range of costs that can be associated with groundwater flooding:

- Cesspool and Septic System Replacement: $ 15,000 - $25,000 (mounded septic systems)
- Mold Abatement: $8,000 - $14,000 per household
- Carpet Replacement: $2,200 according to one resident located at 17 Village Way in Smithtown (Dodge 2007).
- Annual Utilities: One household on Florence Avenue estimates $4,800. Other specific costs were not provided; however, the low end would being one sump pump running 1 hour per day and one dehumidifier run continuously; the high end representing two sump pumps and one dehumidifier running continuously.

The costs associated with shallow groundwater damages suggest that an individual homeowner could be severely impacted by financial impacts associated with this hazard.

Impact on Critical Facilities

Critical facilities are also at risk of shallow groundwater flooding. The number of critical facilities built in shallow groundwater hazard areas are summarized in Table 5.4.15-5. Out of the 10,486 critical facilities in the County, 31 critical facilities are exposed to the shallow groundwater flooding hazard area; of which 26 are considered community lifelines. The lifelines exposed to the shallow groundwater flood hazard area are summarized by FEMA's lifeline categories in Table 5.4.15-6.

Table 5.4.16-3. Critical Facilities in the Groundwater Flooding Hazard Area

Jurisdiction	Total CFs Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Exposed to Shallow Groundwater Hazard Areas			
			Critical Facilities	% of Total Critical Facilities	Lifelines	% of Total Lifelines
Amityville (V)	85	62	0	0.0%	0	0.0%
Asharoken (V)	4	3	0	0.0%	0	0.0%
Babylon (T)	1,029	741	0	0.0%	0	0.0%
Babylon (V)	93	64	0	0.0%	0	0.0%
Belle Terre (V)	6	5	0	0.0%	0	0.0%
Bellport (V)	35	25	0	0.0%	0	0.0%
Brightwaters (V)	14	11	0	0.0%	0	0.0%
Brookhaven (T)	2,798	2,272	0	0.0%	0	0.0%
Dering Harbor (V)	2	2	0	0.0%	0	0.0%
East Hampton (T)	234	204	0	0.0%	0	0.0%

Jurisdiction	Total CFs Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Exposed to Shallow Groundwater Hazard Areas			
			Critical Facilities	% of Total Critical Facilities	Lifelines	% of Total Lifelines
East Hampton (V)	37	23	0	0.0%	0	0.0%
Greenport (V)	33	20	0	0.0%	0	0.0%
Head of the Harbor (V)	11	9	0	0.0%	0	0.0%
Huntington (T)	961	664	0	0.0%	0	0.0%
Huntington Bay (V)	2	2	0	0.0%	0	0.0%
Islandia (V)	70	62	0	0.0%	0	0.0%
Islip (T)	2,275	1,740	7	0.3%	6	0.3%
Lake Grove (V)	50	38	0	0.0%	0	0.0%
Lindenhurst (V)	104	62	0	0.0%	0	0.0%
Lloyd Harbor (V)	16	12	0	0.0%	0	0.0%
Nissequogue (V)	7	4	0	0.0%	0	0.0%
North Haven (V)	3	1	0	0.0%	0	0.0%
Northport (V)	40	24	0	0.0%	0	0.0%
Ocean Beach (V)	5	4	0	0.0%	0	0.0%
Old Field (V)	4	3	0	0.0%	0	0.0%
Patchogue (V)	92	63	0	0.0%	0	0.0%
Poquott (V)	2	2	0	0.0%	0	0.0%
Port Jefferson (V)	95	71	0	0.0%	0	0.0%
Quogue (V)	19	13	0	0.0%	0	0.0%
Riverhead (T)	428	346	0	0.0%	0	0.0%
Sag Harbor (V)	37	24	0	0.0%	0	0.0%
Sagaponack (V)	3	3	0	0.0%	0	0.0%
Saltaire (V)	8	6	0	0.0%	0	0.0%
Shelter Island (T)	41	32	0	0.0%	0	0.0%
Shoreham (V)	7	5	0	0.0%	0	0.0%
Smithtown (T)	708	542	0	0.0%	0	0.0%
Southampton (T)	667	580	20	3.0%	16	2.8%
Southampton (V)	63	44	0	0.0%	0	0.0%
Southold (T)	275	230	0	0.0%	0	0.0%
Village of the Branch (V)	38	23	0	0.0%	0	0.0%
Westhampton Dunes (V)	5	5	0	0.0%	0	0.0%
Westhampton Beach (V)	47	39	4	8.5%	4	10.3%
Shinnecock Tribal Nation	22	22	0	0.0%	0	0.0%
Unkechaug Tribal Nation	11	10	0	0.0%	0	0.0%
Suffolk County (Total)	**10,486**	**8,117**	**31**	**0.3%**	**26**	**0.3%**

Source: Smithtown H2M Study 2007; Suffolk County GIS 2020

Table 5.4.16-4. Lifelines Exposed to Shallow Groundwater Hazard Area

Lifeline Categories	Total Lifelines in County	Shallow Groundwater Exposure
Communication	126	0
Energy	397	4
Food, Water, Shelter	1,458	6
Health and Medical	1,081	4
Safety and Security	1,956	2
Transportation	3,099	10
Suffolk County (Total)	**8,117**	**26**

Source: FEMA 2020; Suffolk County GIS 2020; Smithtown H2M Study 2007

In certain areas, flooding has extended above the ground surface and impacted yards and roads throughout the

Impact on Economy

Sufficient information was not available to perform a detailed assessment of estimated losses to the economy associated with this hazard. Potential impacts include closed businesses or schools if impacted by flooding, lost days of work if homeowners miss work to address home flooding, disruption of transportation if roads are flooded, and potential costs for illnesses and injuries that could be associated with the hazard. To estimate damages from flooding, a review of the flood losses section can be used to determine damages caused by flooding at different flood levels. An assessment of flood depths and potential damages is summarized in the Municipal Annexes. Also refer to Section 5.4.8 Flood for more information about flood risks.

Impact on the Environment

Flood events triggered by shallow groundwater may increase in frequency and/or severity as land use changes, more structures are built, and impervious surfaces expand. Furthermore, shallow groundwater extents could evolve alongside natural occurrences such as sea level rise, climate change, and/or severity of coastal storms.

Cascading Impacts to Other Hazards

Shallow groundwater flooding may trigger additional flooding throughout the County. If the groundwater tables are already saturated in the shallow groundwater location, then the excess water from events such as storm surge or severe rain events will not be able to infiltrate into the ground back into the groundwater supply. As a result, this stormwater will become runoff and can turn into flash flooding or ponding across the County.

Future Changes That May Impact Vulnerability

As discussed in Sections 4 and 9, areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by shallow groundwater flooding if located within in the identified hazard area. Areas targeted for potential future growth and development in the next five (5) years have been identified across the County at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP.

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 shallow groundwater flooding hazard areas could be potentially impacted by flooding. There are approximately 49 new development projects identified for the County. Although there are no new development sites within the shallow groundwater hazard area (refer to Figure 5.4.15-

7), it is recommended that the County and municipal partners implement design strategies that mitigate against the risk of flooding.

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. Any growth can create changes in density throughout the County. Refer to Section 4 (County Profile), which includes a discussion on population trends for the County.

Climate Change

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures and precipitation. Annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to increase the risk to flash flooding and riverine flooding, and flood critical transportation corridors and infrastructure. Increases in precipitation may alter and expand the floodplain boundaries and runoff patterns, resulting in the exposure of populations, buildings, and critical facilities and infrastructure that were previously outside the shallow groundwater flood hazard area. This increase in exposure would result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by future flooding events due to loss of service or access.

Furthermore, impacts from changes in climate such as the frequency and intensity of weather events have an impact on the flood extents in Suffolk County. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as flood events. While predicting changes of shallow groundwater flooding under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA] 2006). Modeled 1-foot increment sea level rise inundation areas were reviewed in this HMP to better understand the County's future risk to flooding (refer to Section 5.4.8 Flood). As observed, buildings and persons in the County are expected to be exposed to these 1-foot increment sea level rise inundation areas. This can exacerbate shallow groundwater flooding by altering the groundwater tables.

Change of Vulnerability Since 2014 HMP

Since the 2014 analysis, population statistics have been updated using the 5-Year 2014-2018 American Community Survey Population Estimates. The general building stock was also updated using RS Means 2019 building valuations that estimated replacement cost value for each building in the inventory. Updated building stock provided by the County was utilized to update the user-defined facility inventory and critical facility inventory dataset. Shallow groundwater data from the Smithtown H2M Study from 2007 was used to assess risks for buildings and populations in the County. Refer to Section 5.4.8 Flood for more information about changes in the flood hazard data, which summarizes information referenced in this section about sea level rise and projecting losses caused by flood depths.

Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Suffolk County.

Figure 5.4.16-1. New Development and Shallow Groundwater in Suffolk County