5.4.8 LANDSLIDE

This section provides a profile and vulnerability assessment of the landslide hazard for Monroe County.

5.4.8.1 Hazard Profile

This section provides information regarding the description, extent, location, previous occurrences and losses, climate change projections and the probability of future occurrences for the landslide hazard.

Hazard Description

A landslide is the process that results in the downward and outward movement of slope-forming materials (NYS Geological Survey n.d.). Landslide materials can consist of natural rock, soil, artificial fill, or any combination of these materials (NYS DHSES 2014). The materials move by falling, toppling, sliding, spreading, or flowing (NYS Geological Survey n.d.).

Landslides are caused by one or more of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes. Landslide hazard areas exist where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 33 percent
- A history of landslide activity or movement during the last 10,000 years
- Stream or wave activity that has caused erosion, undercut a bank, or cut into a bank to cause the surrounding land to be unstable
- The presence or potential for snow avalanches
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes caused by construction or erosion, earthquakes, and changes in groundwater levels. Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, developed hillsides, and areas recently burned by forest and brush fires (NYS DHSES 2014). Human activities that contribute to slope failure include altering the natural slope gradient, increasing soil water content, and removing vegetation cover. Warning signs for landslide activity include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavement, or sidewalk
- Soil moving away from foundations
- Ancillary structures, such as decks and patios, tilting and moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls, or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity
- Sudden increase in creek water levels while rain is still failing or just recently ended
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb

- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together (USGS 2013).

There are several different types of landslides including:

- *Rock Falls:* blocks of rock that fall away from a bedrock unit without a rotational component
- *Rock Topples:* blocks of rock that fall away from a bedrock unit with a rotational component
- *Rotational Slump:* blocks of fine grained sediment that rotate and move down slope
- *Transitional Slide:* sediments that move along a flat surface without a rotational component
- *Earth Flows:* fine-grained sediments that flow downhill and typically form a fan structure
- *Creep:* a slow moving landslide often only noticed through crooked trees and disturbed structures
- *Block Slides:* blocks of rock that slide along a slip plane as a unit down a slope
- *Debris Avalanche:* predominately gravel, cobble, boulder, and sediment portions, and trees that move quickly down slope
- *Debris Flows:* coarse sediments that flow downhill and spread out over relatively flat areas (NYS DHSES 2014)

Location

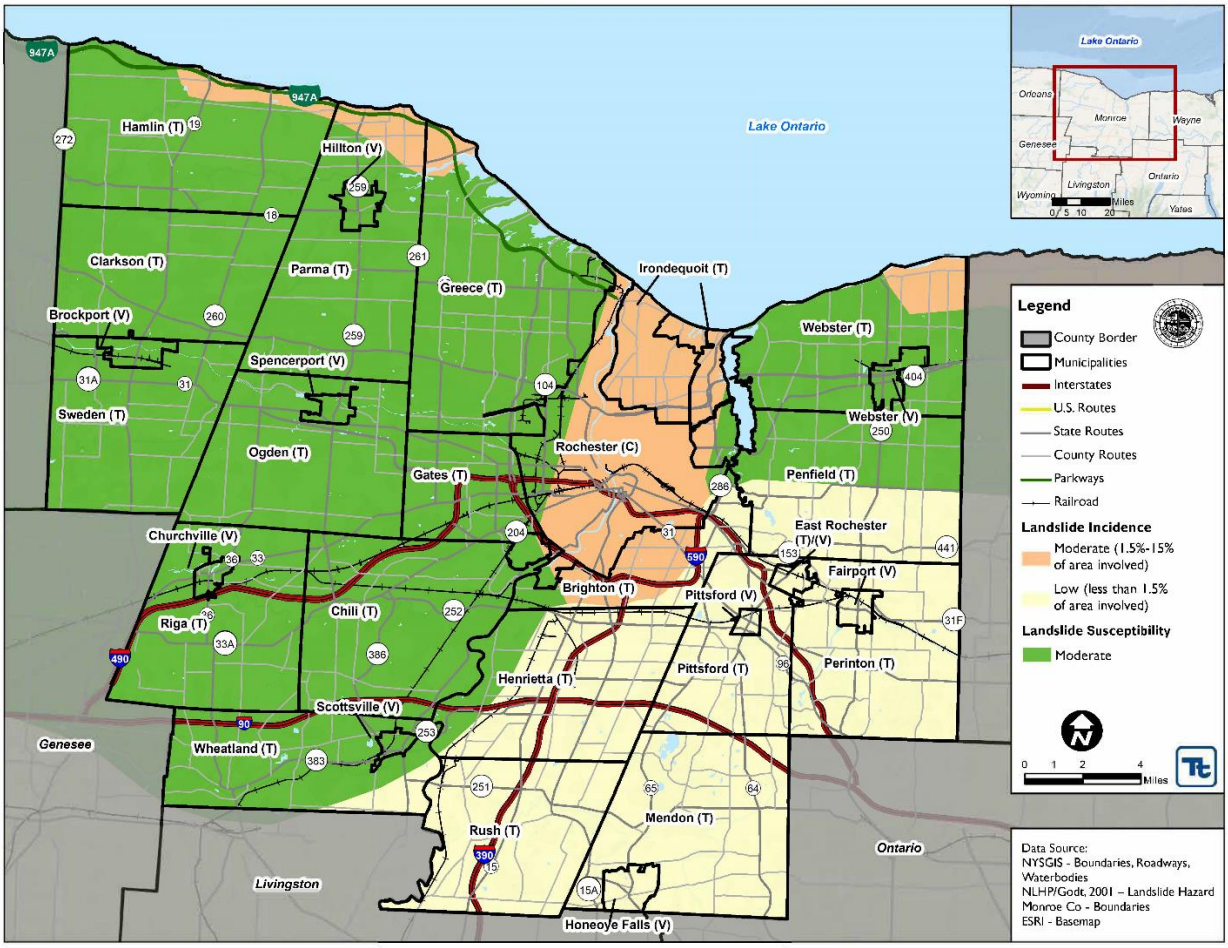
Landslides have occurred in several areas of Monroe County, often as a result of flooding and erosion along the Lake Ontario shoreline and bluffs. Landslides have also occurred in some of the large open gravel pits. Natural variables such as soil properties, topographic position, and slope contribute to determining the overall risk of the landslide hazard in a given area. Specific areas of the County which have historically been most susceptible include:

- The high-angle slope areas surrounding Irondequoit Bay and the south shore of Lake Ontario, including the houses and businesses and other nearby structures
- Specific areas within Monroe County parks
- Open mine pits.

The underlying cause of a landslide is another significant variable influencing the occurrence of an event. These causes, or triggers, can be natural or human-induced sources. The three most common landslide triggers are water saturation of the ground; loading, or increased weight at the top or high end of the slope; and taking away soil or removing mass from the bottom (NYS DHSES 2014).

256,266 persons in Monroe County live in a moderate incidence area and 323,263 persons live in a moderate susceptibility area (NYS DHSES 2014). Figure 5.4.8-1 shows the landslide incidence and susceptibility in Monroe County based on terrain slopes and soil type throughout the County (Monroe County 2022).

Figure 5.4.8-1. Landslide Incidence and Susceptibility in Monroe County



Source: Monroe County 2022

Extent

The extent of a landslide hazard is determined by identifying the affected areas and assessing the probability of a landslide occurring within a time period. Natural variables that contribute to the overall extent of potential landslide activity in any particular area include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions. As a result, the landslide hazard is often represented by landslide incidence and susceptibility, as defined below.

- Landslide incidence is the number of landslides that have occurred in a given geographic area. High incidence means greater than 15 percent of a given area has been involved in landsliding; medium incidence means that 1.5 to 15 percent of an area has been involved; and low incidence means that less than 1.5 percent of an area has been involved (Radbruch-Hall 1982).

- Landslide susceptibility is defined as the probable degree of response of geologic formations to natural or artificial cutting, to loading of slopes, or to unusually high precipitation. It can be assumed that unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced landslides in the past. Landslide susceptibility depends on slope angle and the geologic material underlying the slope. Landslide susceptibility only identifies areas potentially affected and does not imply a time frame when a landslide might occur. High, medium, and

low susceptibility are delimited by the same percentages used for classifying the incidence of landsliding (Radbruch-Hall 1982).

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with landslides throughout New York State and Monroe County; therefore, the loss and impact information for many events varies depending on the source. The accuracy of monetary figures discussed is based on the available information in cited sources.

Landslides have occurred in several areas within Monroe County, however, none have caused personal injury. High water levels on Lake Ontario caused severe erosion in 1993, 1997, and 1998, and contributed to landslides. Cliffs along the shoreline in the Town of Webster, and along the Irondequoit Bay were eroded. In 1998, severe erosion exposed a sanitary sewage transmission main near Sea Breeze, in the Town of Irondequoit, prompting emergency measures for repair and a call for immediate protective relief from the International Joint Commission that regulates lake levels (NYS DHSES 2014). On April 2, 1997, a house on the west side of Irondequoit Bay slid off its foundation into the bay; however, the cause was unknown. In January, 1998, a basement wall on the uphill side of a home in Webster collapsed from the pressure of saturated soils and downhill drainage. On August 31, 2004, excessive rain saturated a hillside in the Town of Irondequoit and caused brush and dirt to slide 40 feet toward bayside houses known as German Village (more than ten were affected). According to the NYS HMP and other sources reviewed, there has only been one landslide since 2010, occurring in 2020 south of Oakdale (Lacrosse Tribune 2020).

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2022, FEMA issued one disaster declaration (DR) for landslides in New York State. 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; Monroe County was not included in this declaration (FEMA 2022).

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2015 and 2022, Monroe County was included in the following USDA-designated agricultural disasters that included or may have included losses due to landslides:

- S3885 - 2015 Excessive Rain, High Winds, Hail, Lightning, and Tornado
- S4274 - 2017 Excessive Rain and Related Flooding
- S4265 - 2017 Excessive Rain and Related Flooding, High Winds, and Hail
- S4479 - 2018 Excessive Rain
- S4622 - 2019 Excessive Rain, Moisture, Humidity

The USDA crop loss data provide another indicator of the severity of previous events. Additionally, crop losses can have a significant impact on the economy by reducing produce sales and purchases. Such impacts may have long-term consequences, particularly if crop yields are also low in the following years. USDA records indicate that Monroe County has not experienced crop losses from landslide events.

Previous Events

For this 2022 HMP Update, known landslide events that have impacted Monroe County between 2015 and 2022 are identified in Table 5.4.8-1. However, Table 5.4.8-1 may not include a complete record of all landslide events that have occurred within the County.

Table 5.4.8-1. Landslide Events between 2015 and 2022

Dates of Event	Event Type	FEMA Declaration Number	Location / County Designated?	Losses / Impacts
August 28, 2020	Landslide	N/A	No	A Monroe County home on Hope Road, south of Oakdale, was damaged by a landslide event.

Sources: *Lacrosse Tribune 2020*
FEMA *Federal Emergency Management Agency*
N/A *Not applicable*

Climate Change Impacts

Providing projections of future climate change for a specific region is challenging. Shorter-term projections are more closely tied to existing trends making longer-term projections even more challenging. The further out a prediction reaches, the more it is subject to change.

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Monroe County is part of Region 1, Western New York, Great Lakes Plain. In Region 1, it is estimated that temperatures will increase by 3.0 ºF to 5.5 ºF by the 2050s and 4.5 ºF to 8.5 ºF by the 2080s (baseline of 48.0 ºF, mid-range projection). Precipitation totals will increase between 0 and 10 percent by the 2050s and 0 to 15 percent by the 2080s (baseline of 37.0 inches, mid-range projection). Table 5.4.8-2 displays the projected seasonal precipitation change for ClimAID Region 1 (NYSERDA 2014).

Table 5.4.8-2. Projected Seasonal Precipitation Change in Region 1, 2050s (% change)

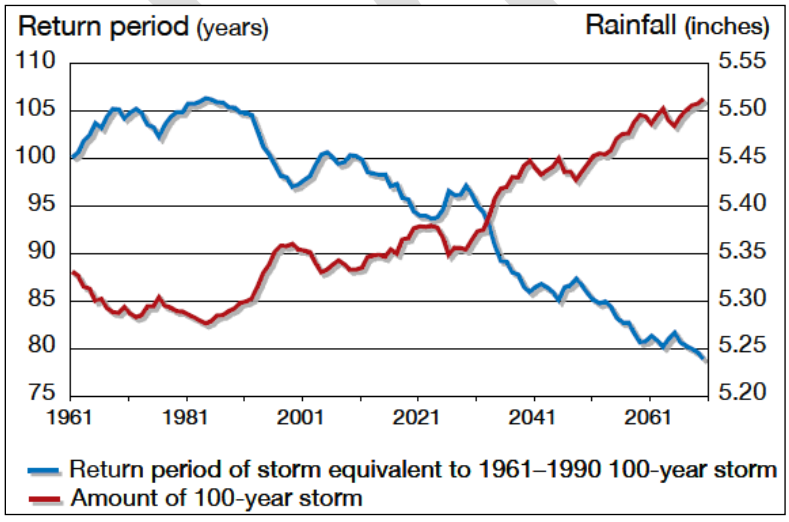
Winter	Spring	Summer	Fall
+5 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSERDA 2014

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. Downpours are very likely to increase in frequency and intensity, a change which has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways, and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA 2011). Less frequent rainfall during the summer months may impact the ability of water supply systems. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants (NYSERDA 2011).

Figure 5.4.8-2 displays the project rainfall and frequency of extreme storms in New York State. The amount of rainfall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011). Heavy rainfall events are likely to loosen soils and could contribute to increased frequency and severity of landslides.

Figure 5.4.8-2. Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA 2011

Global temperature increase could affect the snowpack and its ability to hold and store water. Warming temperatures also could increase occurrence and duration of droughts, which could increase probability of wildfire and likely reduce the vegetation that helps support steep slopes. All these factors could increase the probability of landslide occurrence.

Probability of Future Occurrences

As indicated in the NYS HMP, and given the history of landslides in New York State, it is certain that future landslides will occur, but the severity of these landslides cannot be determined. Therefore, the probability of future landslides in New York State is considered high; however, since documentation on landslides in Monroe County is sparse, it is difficult to predict the extent of future landslides in the County.

The frequency of damaging landslides within Monroe County can be classified, relative to other higher risk areas, as low. However, the fact that high landslide susceptibility exists and landslides have occurred in the past suggests that the certain parts of the County's infrastructure, as well as people, are at risk from damaging landslide hazards in in the County.

In Section 5.3, the identified hazards of concern for Monroe County were ranked using various parameters. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Steering Committee, the probability of occurrence for landslides in Monroe County is considered 'unlikely' (not likely to occur or is unlikely to occur with less than a 1 percent annual chance probability) in Table 5.3-2.

5.4.8.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For this analysis, the hazard area is defined as the moderate susceptibility and moderate incidence landslide zones.

Impact on Life, Health, and Safety

Table 5.4.8-3 summarizes the area within each hazard ranked area, specific to Monroe County municipalities. To estimate the population located within the landslide hazard areas, the approximate hazard area boundaries were overlaid upon the 2020 Census population data (U.S. Census 2020). The Census blocks having their center (centroid) within the boundary of the landslide incidence hazard areas were used to calculate the estimated population considered exposed to this hazard. In total, 256,266 (34%) of the County's population is exposed to the moderate incidence hazard area, and 323,263 (42.9%) of the County's population is exposed to the moderate susceptibility hazard area.

Table 5.4.8-3. Estimated Population Exposed to Landslides in Monroe County

Municipality	Total Population (U.S. Census 2020)	Landslide Incidence		Landslide Susceptibility	
		Moderate	% of Total	Moderate	% of Total
Brighton (T)	37,137	18,626	50.2%	749	2.0%
Brockport (V)	7,104	0	0.0%	7,104	100.0%
Chili (T)	29,123	0	0.0%	29,123	100.0%
Churchville (V)	2,091	0	0.0%	2,091	100.0%
Clarkson (T)	6,904	0	0.0%	6,904	100.0%
East Rochester (V/T)	6,334	0	0.0%	0	0.0%

Municipality	Total Population (U.S. Census 2020)	Landslide Incidence		Landslide Susceptibility	
		Moderate	% of Total	Moderate	% of Total
Fairport (V)	5,501	0	0.0%	0	0.0%
Gates (T)	29,167	3	0.0%	29,164	100.0%
Greece (T)	96,926	907	0.9%	94,586	97.6%
Hamlin (T)	8,725	915	10.5%	7,774	89.1%
Henrietta (T)	47,096	0	0.0%	8,787	18.7%
Hilton (V)	6,027	0	0.0%	6,027	100.0%
Honeoye Falls (V)	2,706	0	0.0%	0	0.0%
Irondequoit (T)	51,043	46,987	92.1%	3,687	7.2%
Mendon (T)	6,389	0	0.0%	0	0.0%
Ogden (T)	16,585	0	0.0%	16,585	100.0%
Parma (T)	10,190	1,294	12.7%	8,733	85.7%
Penfield (T)	39,438	0	0.0%	16,149	40.9%
Perinton (T)	39,128	0	0.0%	0	0.0%
Pittsford (T)	25,714	0	0.0%	0	0.0%
Pittsford (V)	1,419	0	0.0%	0	0.0%
Riga (T)	3,495	0	0.0%	3,495	100.0%
Rochester (C)	211,328	184,647	87.4%	25,478	12.1%
Rush (T)	3,490	0	0.0%	0	0.0%
Scottsville (V)	2,009	0	0.0%	2,009	100.0%
Spencerport (V)	3,685	0	0.0%	3,685	100.0%
Sweden (T)	6,140	0	0.0%	6,134	99.9%
Webster (T)	39,676	2,885	7.3%	36,625	92.3%
Webster (V)	5,651	0	0.0%	5,651	100.0%
Wheatland (T)	2,888	0	0.0%	2,722	94.3%
Monroe County (Total)	**753,109**	**256,266**	**34.0%**	**323,263**	**42.9%**

Source: *Godt, 2001; U.S. Census 2020*
Notes: *C City*
T Town
V Village

Impact on General Building Stock

In general, the building environment located in the high susceptibility zones and the population, structures, and infrastructure located downslope are vulnerable to this hazard. The Census blocks having their center (centroid) within the boundary of the landslide incidence hazard areas were used to calculate the estimated building stock exposed to this hazard. Table 5.4.8-4 lists the results of the general building stock exposed to this hazard.

Table 5.4.8-4. Number of Buildings located in the Landslide Hazard Area

Municipality	Total Number of Buildings	Landslide Incidence		Landslide Susceptibility	
		Moderate	% of Total	Moderate	% of Total
Brighton (T)	11,693	5,997	51.3%	298	2.5%
Brockport (V)	2,224	0	0.0%	2,224	100.0%
Chili (T)	11,534	20	0.2%	11,514	99.8%
Churchville (V)	1,112	0	0.0%	1,112	100.0%
Clarkson (T)	3,411	0	0.0%	3,411	100.0%
East Rochester (V/T)	2,924	0	0.0%	0	0.0%
Fairport (V)	2,394	0	0.0%	0	0.0%
Gates (T)	11,801	10	0.1%	11,791	99.9%
Greece (T)	36,414	409	1.1%	35,395	97.2%
Hamlin (T)	5,539	573	10.3%	4,944	89.3%
Henrietta (T)	15,982	0	0.0%	2,847	17.8%
Hilton (V)	2,143	0	0.0%	2,143	100.0%
Honeoye Falls (V)	1,155	0	0.0%	0	0.0%
Irondequoit (T)	21,885	20,236	92.5%	1,505	6.9%
Mendon (T)	3,835	0	0.0%	0	0.0%
Ogden (T)	7,407	0	0.0%	7,407	100.0%
Parma (T)	5,509	715	13.0%	4,723	85.7%
Penfield (T)	15,882	0	0.0%	6,619	41.7%
Perinton (T)	16,817	0	0.0%	0	0.0%
Pittsford (T)	10,590	0	0.0%	0	0.0%
Pittsford (V)	804	0	0.0%	0	0.0%
Riga (T)	2,356	0	0.0%	2,356	100.0%
Rochester (C)	89,392	76,911	86.0%	11,952	13.4%
Rush (T)	2,808	0	0.0%	0	0.0%
Scottsville (V)	1,069	0	0.0%	1,069	100.0%
Spencerport (V)	1,654	0	0.0%	1,654	100.0%
Sweden (T)	3,465	0	0.0%	3,460	99.9%
Webster (T)	16,660	1,438	8.6%	15,132	90.8%
Webster (V)	1,633	0	0.0%	1,633	100.0%
Wheatland (T)	1,926	0	0.0%	1,751	90.9%
Monroe County (Total)	**312,018**	**106,309**	**34.1%**	**134,940**	**43.2%**

Source: *Godt 2001; Monroe County*
Notes: *C City*
T Town
V Village

Impact on Critical Facilities

To estimate exposure, the approximate landslide hazard areas were overlaid upon the critical facilities and lifeline facilities. Table 5.4.8-5 and Table 5.4.8-6 list the critical facilities (e.g., police, fire, emergency

operations centers [EOC], hospitals, and schools) that are located in the landslide susceptibility/ incidence hazard areas. In total, 744 critical facilities and 705 lifeline facilities are located in the moderate incidence landslide area, representing 39.4 and 39.8 percent of the County totals. 737 critical facilities and 693 lifeline facilities are located in the moderate susceptibility landslide area, representing 39.0 and 39.1 percent of the County totals.

Table 5.4.8-5. Number of Critical Facilities Located in the Moderate Incidence Landslide Hazard Area

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the Moderate Incidence Landslide Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Brighton (T)	69	65	45	65.2%	42	64.6%
Brockport (V)	29	28	0	0.0%	0	0.0%
Chili (T)	111	102	3	2.7%	3	2.9%
Churchville (V)	24	23	0	0.0%	0	0.0%
Clarkson (T)	14	10	0	0.0%	0	0.0%
East Rochester (T/V)	31	29	0	0.0%	0	0.0%
Fairport (V)	17	16	0	0.0%	0	0.0%
Gates (T)	58	54	0	0.0%	0	0.0%
Greece (T)	165	158	2	1.2%	2	1.3%
Hamlin (T)	23	22	0	0.0%	0	0.0%
Henrietta (T)	111	103	0	0.0%	0	0.0%
Hilton (V)	21	20	0	0.0%	0	0.0%
Honeoye Falls (V)	17	16	0	0.0%	0	0.0%
Irondequoit (T)	103	100	97	94.2%	94	94.0%
Mendon (T)	21	20	0	0.0%	0	0.0%
Ogden (T)	42	38	0	0.0%	0	0.0%
Parma (T)	18	16	0	0.0%	0	0.0%
Penfield (T)	73	68	0	0.0%	0	0.0%
Perinton (T)	64	57	0	0.0%	0	0.0%
Pittsford (T)	45	39	0	0.0%	0	0.0%
Pittsford (V)	14	13	0	0.0%	0	0.0%
Riga (T)	20	18	0	0.0%	0	0.0%
Rochester (C)	639	605	594	93.0%	561	92.7%
Rush (T)	29	26	0	0.0%	0	0.0%
Scottsville (V)	14	13	0	0.0%	0	0.0%
Spencerport (V)	13	13	0	0.0%	0	0.0%
Sweden (T)	11	11	0	0.0%	0	0.0%
Webster (T)	55	53	3	5.5%	3	5.7%
Webster (V)	16	15	0	0.0%	0	0.0%
Wheatland (T)	23	21	0	0.0%	0	0.0%
Monroe County (Total)	**1,890**	**1,773**	**744**	**39.4%**	**705**	**39.8%**

Source: *Godt 2001; Monroe County*
Notes: *C City*
T Town
V Village

Table 5.4.8-6. Number of Critical Facilities Located in the Moderate Susceptibility Landslide Hazard Area

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the Moderate Susceptibility Landslide Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Brighton (T)	69	65	2	2.9%	2	3.1%
Brockport (V)	29	28	29	100.0%	28	100.0%
Chili (T)	111	102	108	97.3%	99	97.1%
Churchville (V)	24	23	24	100.0%	23	100.0%
Clarkson (T)	14	10	14	100.0%	10	100.0%
East Rochester (T/V)	31	29	0	0.0%	0	0.0%
Fairport (V)	17	16	0	0.0%	0	0.0%
Gates (T)	58	54	58	100.0%	54	100.0%
Greece (T)	165	158	158	95.8%	151	95.6%
Hamlin (T)	23	22	23	100.0%	22	100.0%
Henrietta (T)	111	103	20	18.0%	18	17.5%
Hilton (V)	21	20	21	100.0%	20	100.0%
Honeoye Falls (V)	17	16	0	0.0%	0	0.0%
Irondequoit (T)	103	100	6	5.8%	6	6.0%
Mendon (T)	21	20	0	0.0%	0	0.0%
Ogden (T)	42	38	42	100.0%	38	100.0%
Parma (T)	18	16	18	100.0%	16	100.0%
Penfield (T)	73	68	23	31.5%	23	33.8%
Perinton (T)	64	57	0	0.0%	0	0.0%
Pittsford (T)	45	39	0	0.0%	0	0.0%
Pittsford (V)	14	13	0	0.0%	0	0.0%
Riga (T)	20	18	20	100.0%	18	100.0%
Rochester (C)	639	605	42	6.6%	41	6.8%
Rush (T)	29	26	0	0.0%	0	0.0%
Scottsville (V)	14	13	14	100.0%	13	100.0%
Spencerport (V)	13	13	13	100.0%	13	100.0%
Sweden (T)	11	11	11	100.0%	11	100.0%
Webster (T)	55	53	52	94.5%	50	94.3%
Webster (V)	16	15	16	100.0%	15	100.0%
Wheatland (T)	23	21	23	100.0%	21	100.0%
Monroe County (Total)	**1,890**	**1,773**	**737**	**39.0%**	**693**	**39.1%**

Source: *Godt 2001; Monroe County*
Notes: *C City*
T Town
V Village

Table 5.4.8-7 provides the number of lifelines in each FEMA lifeline category located in the landslide hazard areas.

Table 5.4.8-7. Number of Lifelines located in the Landslide Hazard Areas

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Located in the Moderate Incidence Landslide Hazard Area	Number of Lifelines Located in the Moderate Susceptibility Landslide Hazard Area
Communications	68	20	37
Energy	14	3	10
Food, Water, Shelter	286	67	162
Hazardous Material	1	1	0
Health and Medical	93	40	37
Safety and Security	1,274	564	424
Transportation	36	10	22
Monroe County (Total)	**1,772**	**705**	**692**

Source: Godt 2001; Monroe County
Notes: C City
T Town
V Village

Impact on Economy

The impact of a landslide on the economy and estimated dollar losses are difficult to measure. As stated earlier, landslides can impose direct and indirect impacts on society. Direct costs include the actual damage sustained by buildings, property, and infrastructure. Indirect costs, such as clean-up costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity are difficult to measure. Additionally, landslides threaten transportation corridors, fuel and energy conduits, and communication lines (USGS 2003). Estimated potential damage to general building stock can be quantified as discussed above. For the purposes of this analysis, damage to general building stock is discussed below.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. There are zero buildings located in the high incidence and high/moderate susceptibility/incidence landslide hazard areas. A total risk exposure of approximately $129 billion or 41.2-percent of Monroe County's total inventory is estimated for the buildings located in the landslide moderate incidence area. A total risk exposure of approximately $115 billion or 36.7 percent of Monroe County's total inventory is estimated for the buildings located in the landslide moderate susceptibility area. Losses to Monroe County's total building inventory would impact Monroe County's tax base and the local economy.

Interstates 90, 390, 490, and 530 and the Lake Ontario State Parkway traverse the moderate incidence and moderate/susceptibility/low incidence hazard areas. Many of the County's state highways are also located within the hazard area. Refer to Figure 5.4.8-1 to see the location of major roadways in the County in relation to the hazard area.

Table 5.4.8-8. Estimated General Building Stock Replacement Cost Value in the Landslide Hazard Area

Municipality	Total GBS RCV	Landslide Incidence		Landslide Susceptibility	
		Moderate	% of Total	Moderate	% of Total
Brighton (T)	$14,443,886,002	$9,422,351,153	65.2%	$632,361,466	4.4%
Brockport (V)	$5,158,789,593	$0	0.0%	$5,158,789,593	100.0%

Table 5.4.8-8. Estimated General Building Stock Replacement Cost Value in the Landslide Hazard Area

Municipality	Total GBS RCV	Landslide Incidence		Landslide Susceptibility	
		Moderate	% of Total	Moderate	% of Total
Chili (T)	$9,206,843,885	$154,896,989	1.7%	$9,051,946,896	98.3%
Churchville (V)	$938,164,078	$0	0.0%	$938,164,078	100.0%
Clarkson (T)	$1,887,392,030	$0	0.0%	$1,887,392,030	100.0%
East Rochester (V/T)	$3,440,171,127	$0	0.0%	$0	0.0%
Fairport (V)	$2,281,456,075	$0	0.0%	$0	0.0%
Gates (T)	$12,220,599,285	$74,526,464	0.6%	$12,146,072,821	99.4%
Greece (T)	$26,954,378,684	$327,172,568	1.2%	$26,384,056,270	97.9%
Hamlin (T)	$2,318,778,027	$183,674,311	7.9%	$2,125,249,787	91.7%
Henrietta (T)	$23,460,566,322	$0	0.0%	$4,191,877,437	17.9%
Hilton (V)	$2,120,287,988	$0	0.0%	$2,120,287,988	100.0%
Honeoye Falls (V)	$1,813,180,690	$0	0.0%	$0	0.0%
Irondequoit (T)	$13,427,006,840	$12,715,554,454	94.7%	$674,110,440	5.0%
Mendon (T)	$2,852,155,915	$0	0.0%	$0	0.0%
Ogden (T)	$5,558,087,440	$0	0.0%	$5,558,087,440	100.0%
Parma (T)	$3,373,412,574	$251,788,057	7.5%	$3,095,325,391	91.8%
Penfield (T)	$11,119,233,991	$0	0.0%	$4,389,584,462	39.5%
Perinton (T)	$13,125,415,407	$0	0.0%	$0	0.0%
Pittsford (T)	$10,686,774,000	$0	0.0%	$0	0.0%
Pittsford (V)	$1,776,834,511	$0	0.0%	$0	0.0%
Riga (T)	$1,539,492,845	$0	0.0%	$1,539,492,845	100.0%
Rochester (C)	$119,943,371,056	$106,058,619,286	88.4%	$13,258,329,376	11.1%
Rush (T)	$1,816,445,354	$0	0.0%	$0	0.0%
Scottsville (V)	$908,716,753	$0	0.0%	$908,716,753	100.0%
Spencerport (V)	$1,580,844,696	$0	0.0%	$1,580,844,696	100.0%
Sweden (T)	$3,402,258,236	$0	0.0%	$3,344,197,382	98.3%
Webster (T)	$11,510,191,170	$735,955,114	6.4%	$10,730,075,460	93.2%
Webster (V)	$3,634,066,282	$0	0.0%	$3,634,066,282	100.0%
Wheatland (T)	$2,509,077,040	$0	0.0%	$2,247,363,308	89.6%
Monroe County (Total)	**$315,007,877,896**	**$129,924,538,398**	**41.2%**	**$115,596,392,202**	**36.7%**

Source: *Godt 2001; Monroe County*

Notes: *GBS* *General Building Stock;*
RCV *Replacement Cost Value.*
C *City*
T *Town*
V *Village*

Impact on the Environment

A landslide event alters the landscape. In addition to changes in topography, vegetation and wildlife habitats may be damaged or destroyed. Soil and sediment runoff will accumulate downslope, potentially blocking waterways and roadways and impacting quality of streams and other water bodies. Additional environmental impacts include loss of forest productivity.

Furthermore, soil and sediment runoff can accumulate downslope potentially blocking waterways and roadways and impacting quality of streams and other water bodies. Mudflows that erode into downstream waterways can threaten the life of freshwater species (USGS 2020). The impacts of eroded landscape can travel for miles downstream into adjacent waterways and create issues for surrounding watersheds.

Cascading Impacts On Other Hazards

Landslide events can have cascading impacts on utility failure in Monroe County. As discussed in earlier sections, landslides may disrupt the functionality of utilities if the debris falls, topples, or spreads over the utilities providing services to the County. For example, electric utilities may become disconnected if power lines are broken from displaced geologic material. Water utilities may become breached with excess debris and/or contaminants carried by landslide events.

Future Changes That May Impact Vulnerability

Understanding future changes that impact vulnerability in the County can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. 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 (County Profile), areas targeted for future growth and development have been identified across the County. Any areas of growth located in areas with moderate landslide incidence or susceptibility could be potentially impacted by the landslide hazard. Please refer to the specific areas of development indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Projected Changes in Population

According to the 2020 Census, the population of the County has increased by approximately 1.2 percent since 2010. The County's population is anticipated to slightly increase over the next decade (0.7 percent increase by 2030). Changes in the density of the population can impact the number of persons exposed to landslide. Refer to Section 4 (County Profile), which includes a discussion on population trends for the County.

Climate Change

Climate is defined not simply as average temperature and precipitation, but also by the type, frequency, and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as severe storms, including those that may bring intense and prolonged precipitation (EPA 2013). An increase in rainfall intensity and duration will saturate the soil and potentially

erode the local landscape and impact slope stability. This may lead to an increase of landslide events in Monroe County.

While predicting changes in events under a varying 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 (EPA 2013). The potential effects of climate change on Monroe County's vulnerability to landslide events shall need to be considered as a greater understanding of regional climate change impacts develop.

Change of Vulnerability Since 2017 HMP

For this HMP Update, the risk for the County's population, building stock, and critical facilities was assessed, and, overall, the County's landslide vulnerability has remained unchanged.