5.4.6 Landslide

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

5.4.6.1 Hazard Profile

This section provides profile information regarding the hazard, including: description, extent, location, previous occurrences and losses, and probability of future occurrences.

Description

A landslide is the process that results in downward and outward movement of slope-forming materials (New York State Geological Survey [NYSGS] No Date [n.d.]). Landslide materials can consist of natural rock, soil, artificial fill, or any combination of these materials (NYS Division of Homeland Security and Emergency Services [DHSES] 2014). The materials move by falling, toppling, sliding, spreading, or flowing (NYSGS 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 removal or change in type of vegetation covering slopes. Landslide hazard areas exist where the land has characteristics that contribute to risk of 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
- Presence or potential for snow avalanches
- Presence of an alluvial fan, indicating vulnerability to flow of debris or sediments
- 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 generally prone to landslide hazards include previous landslide areas, bases of steep slopes, 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 falling 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 (U.S. Geological Survey [USGS] 2013).

Several different types of landslides include:

- *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 noticed only by presence of crooked trees and disturbed structures
- *Block Slides:* blocks of rock that slide along a slip plane as a unit down a slope
- *Debris Avalanche:* predominantly 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).

Extent

Extent of a landslide hazard is determined by identifying affected areas and assessing probability of a landslide occurring within a time period. Natural variables that contribute to 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, defined as follows:

- **Landslide incidence** is categorized by percentage of a given geographic area that has undergone landslides. 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, Dorothy H. et al. 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. Assumedly, unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have been involved with landslides in the past. Landslide susceptibility depends on slope angle and geologic material underlying the slope. Landslide susceptibility applies only to areas potentially affected, and does not imply a time frame within which a landslide might occur. High, medium, and low susceptibility are delimited by the same percentages used for classifying incidence of landsliding (Radbruch-Hall, Dorothy H. et al. 1982).

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation. This could result in economic losses for businesses. Other potential problems resulting from landslides are power and communication failures. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Landslides also can destabilize foundations of structures, which may result in monetary loss for residents. They also can damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat.

Location

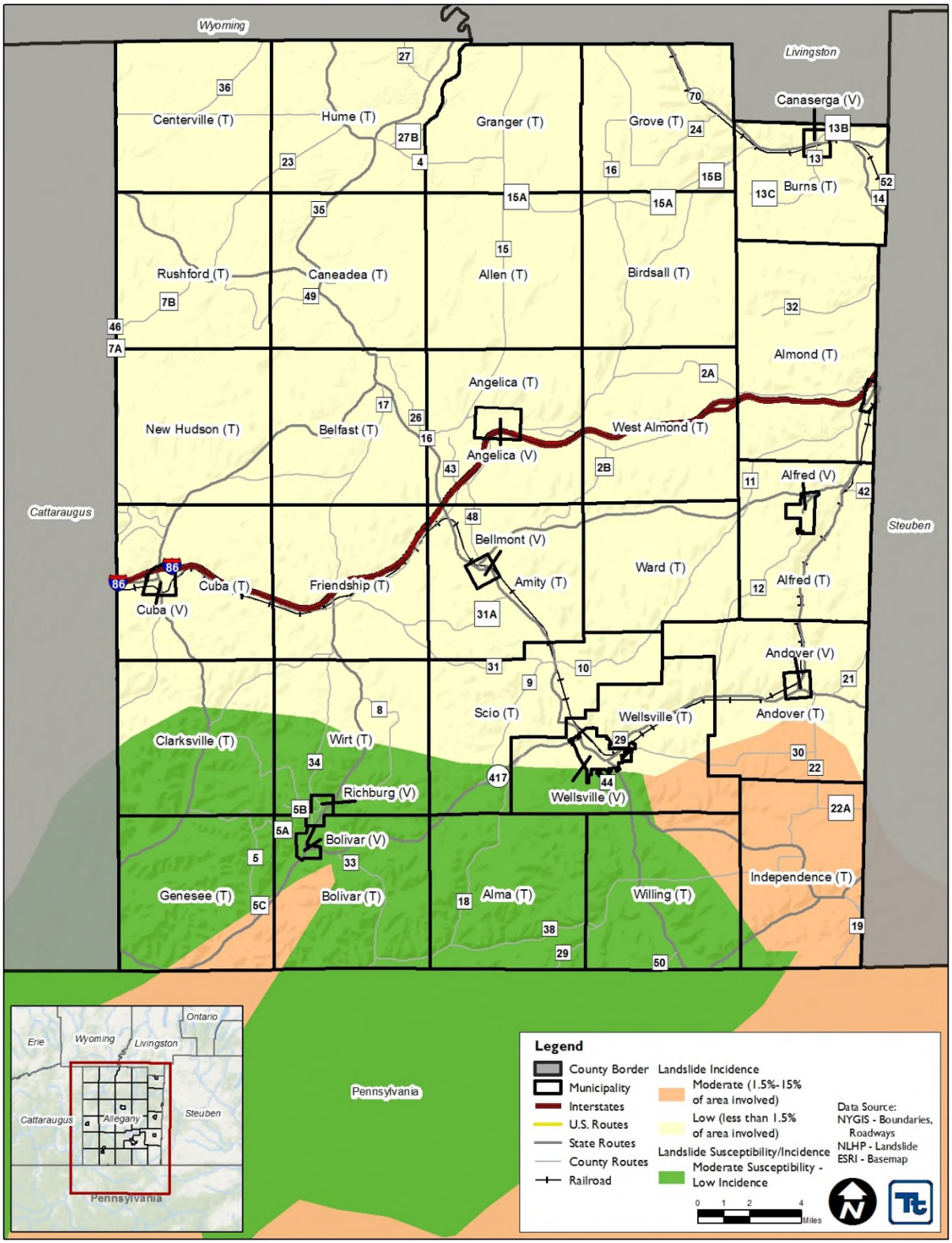
The entire United States undergoes landslides; 36 states have been identified with moderate to highly severe landslide hazards. Expansion of urban and recreational developments into hillside areas exposes more people to the threat of landslides each year. According to USGS, some areas within Allegany County have moderate and high landslide potential. For a figure displaying landslide potential within the conterminous United States, refer to http://pubs.usgs.gov/fs/2005/3156/2005-3156.pdf (USGS 2005).

Landslides have occurred in several areas of Allegany County, with the largest percentage in the Towns of Caneadea, Hume, Belfast, and New Hudson. These areas are more vulnerable because of soil type there and proximity to the Genesee River. When the river floods, water saturates the Caneadea soil layer, and water is trapped by the underlying clay layer. This also reduces the stream's ability to contain floods.

The underlying cause or trigger of a landslide can be natural or human-induced. The three most common landslide triggers are water saturation of ground, loading or increased weight at the top or high end of a slope, and removal of soil or mass from the bottom (NYS DHSES 2014).

According to the NYS DHSES, 8,125 persons in Allegany County live in a moderate susceptibility/low incidence landslide area; 2,330 live in a moderate incidence area; and 38,491 live in a low incidence area (NYS DHSES 2014). Figure 5.4.6-1 shows landslide incidence and susceptibility in Allegany County based on terrain slopes and soil type throughout the County (Allegany County 2016). The map is consistent with the historical record of landslides within the County. Although the southern region has a higher susceptibility, incidents are rare. In contrast, the northwestern area of the County, with its high-slippage soils, has undergone landslides of various magnitudes.

Figure 5.4.6-1. Landslide Incidence and Susceptibility in Allegany County



Source: National Landslide Hazards Program (NLHP)

Previous Occurrences and Losses

Landslides have occurred in several areas within Allegany County; however, few have been reported due to the low amounts of damage and minimal threat they presented. The Town of Caneadea undergoes at least one slide annually, but damage is typically limited to flooding, ditch obstructions, exacerbation of roadway shoulder erosion, etc. NYS has records of 12 landslide events in Allegany County, although no details on these events are available (only USGS records include landslide incidents; Spatial Hazard Events and Losses Database for the United States (SHELDUS) records indicate no landslides in Allegany County). The photograph below shows a continuous landslide/geologic hazard on East River Road near the Genesee River in the Town of Caneadea.

Figure 5.4.6-2. Landslide/Geologic Hazard in Town of Caneadea

Between 1954 and 2016, the Federal Emergency Management Agency (FEMA) issued one disaster declaration (DR) for landslides in NYS (DR-487). Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Per FEMA records, Allegany County was not included in the DR. The 2014 NYS Hazard Mitigation Plan (HMP) did allude to inclusion of Allegany County in a Presidential DR for Landslide Events, but because the specific DR was not identified, this information has not been considered in this HMP update.

Probability of Future Occurrences

As indicated in the NYS HMP, and given the history of landslides in NYS, future landslides certainly will occur, but severity of these landslides cannot be determined. Therefore, probability of future landslides in NYS is considered high; however, because documentation on landslides in Allegany County is sparse, predicting the extent of future landslides in the County is difficult.

According to the NYSGS Landslide Inventory Study to estimate probability of future landslides (based on documented historical occurrences), NYS can expect on average approximately two major landslides each year; a greater number of smaller but still significant slides, slumps, or flows each year; and at least one landslide causing a fatality once every 12 years.

In Section 5.3, identified hazards of concern for Allegany County were ranked according to various parameters. Probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, probability of occurrence of landslides in Allegany County is considered "Frequent" (hazard event likely to occur within 25 years).

Climate Change Impacts

Projecting future climate change within a specific region is challenging. Shorter-term projections are more closely tied to existing trends, rendering longer-term projections even more challenging. The further into the future a prediction extends, the more it is subject to change.

Temperatures in northeastern parts of the United States have increased 1.5 degrees Fahrenheit (°F) on average since 1900. Most of this warming has occurred since 1970. NYS has undergone an increase in average annual temperatures of 0.25°F over the past century (NYS Energy Research and Development Authority [NYSERDA] 2014). Average winter temperatures across the Northeast have increased by 4°F since 1970 (Northeast Climate Impacts Assessment [NECIA] 2007). By the 2020s, average annual temperature is expected to increase by 1.8°F in the region of NYS where Allegany County is located. By the 2050s, this increase will be 3.6°F, and by 2100, it will be 4.5°F (NYSERDA 2014).

Future climate change may impact storm patterns, increasing probability of more frequent, intense storms with varying duration. Increase in global temperature 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, reducing the vegetation that helps support steep slopes. All these factors could increase probability of landslide occurrences.

5.4.6.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable to the identified hazard. For this analysis, the hazard area is defined as the moderate susceptibility/low incidence and moderate incidence landslide zones. The analysis of potential impacts of the landslide hazard on Allegany County includes the following:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impacts on (1) life, health, and safety of county residents; (2) general building stock; (3) critical facilities; (4) economy; and (5) future growth and development
- Change of vulnerability from the 2011 Allegany County Multi-Jurisdictional HMP
- Further data collections that will increase understanding of this hazard over time.

Overview of Vulnerability

Vulnerability to the landslide hazard is a function of location, soil type, geology, type of human activity, use, and frequency of events. Effects of landslides on people and structures can be lessened by total avoidance of hazard areas or by restriction, prohibition, or imposition of conditions on hazard-zone activity. Local governments can reduce landslide hazard effects by educating themselves on site history, and by obtaining data from planning and engineering departments of local governments (USGS 2004).

Data and Methodology

An attempt to estimate Allegany County's vulnerability to landslides included use of the Geology – Landslide Incidence and Susceptibility geographic information systems (GIS) layer from the National Atlas to roughly delineate the general area of the County susceptible to landslide. The Geology – Landslide Incidence and Susceptibility GIS layer was overlaid on the Allegany County 2010 U.S. Census

population data, updated building inventory, and Allegany County's critical facility inventory to estimate exposure.

According to Radbruch-Hall et al., the Landslide Incidence and Susceptibility GIS layer from National Atlas "…was prepared by evaluating formations or groups of formations shown on the geologic map of the United States (King and Beikman 1974) and classifying them as having high, medium, or low landslide incidence (number of landslides) and being of high, medium, or low susceptibility to landsliding. Map units or parts of units with more than 15 percent of their area involved in landsliding were classified as having high incidence; those with 1.5 to 15 percent of their area involved in landsliding, as having medium incidence; and those with less than 1.5 percent of their area involved, as having low incidence. This classification scheme was modified where particular lithofacies are known to have variable landslide incidence or susceptibility. In continental glaciated areas, additional data were used to identify surficial deposits that are susceptible to slope movement. Susceptibility to landsliding was defined as the probable degree of response of the areal rocks and soils to natural or artificial cutting or loading of slopes or to anomalously high precipitation. High, medium, and low susceptibility are delimited by the same percentages used in classifying the incidence of landsliding. For example, it was estimated that a rock or soil unit characterized by high landslide susceptibility would respond to widespread cutting by some movement in 15 percent or more of the affected area. The effect of earthquakes on slope stability was not evaluated, although many catastrophic landslides have been generated by ground shaking during earthquakes. Areas susceptible to landslides under static conditions would probably also be susceptible to failure during earthquakes" (Radbruch-Hall 1982).

The limitations of this analysis are recognized, and it is referenced only to provide a general estimate. Over time, acquisition of additional data will lead to better analyses of this hazard. Available information and a preliminary assessment are provided below.

Impact on Life, Health, and Safety

Table 5.4.6-1 estimates the population within each hazard ranked area by municipality. To estimate populations within landslide hazard areas, approximate hazard area boundaries were overlaid on 2010 U.S. Census population data (U.S. Census 2010). Census blocks with centers (centroids) within boundaries of landslide incidence hazard areas were used to calculate estimated populations considered exposed to this hazard. In total, 2,347 (4.8 percent) of the County's population is within the moderate incidence hazard area, and 8,043 (16.4 percent) of the County's population is within the moderate susceptibility/low incidence hazard area.

Table 5.4.6-1. Estimated Populations Exposed to Landslides in Allegany County

Municipality	Total Population (U.S. Census 2010)	Landslide Incidence		Landslide Susceptibility/Incidence	
		Moderate	Percent of Total	Moderate/Low	Percent of Total
Alfred (T)	1,063	0	0.0	0	0.0
Alfred (V)	4,174	0	0.0	0	0.0
Allen (T)	448	0	0.0	0	0.0
Alma (T)	842	0	0.0	842	100.0
Almond (T)	1,218	0	0.0	0	0.0
Almond (V)	415	0	0.0	0	0.0

Municipality	Total Population (U.S. Census 2010)	Landslide Incidence		Landslide Susceptibility/Incidence	
		Moderate	Percent of Total	Moderate/Low	Percent of Total
Amity (T)	1,339	0	0.0	0	0.0
Andover (T)	788	97	12.3	0	0.0
Andover (V)	1,042	0	0.0	0	0.0
Angelica (T)	534	0	0.0	0	0.0
Angelica (V)	869	0	0.0	0	0.0
Belfast (T)	1,663	0	0.0	0	0.0
Belmont (V)	969	0	0.0	0	0.0
Birdsall (T)	221	0	0.0	0	0.0
Bolivar (T)	998	188	18.8	810	81.2
Bolivar (V)	1,047	0	0.0	1,047	100.0
Burns (T)	630	0	0.0	0	0.0
Canaseraga (V)	550	0	0.0	0	0.0
Caneadea (T)	2,542	0	0.0	0	0.0
Centerville (T)	822	0	0.0	0	0.0
Clarksville (T)	1,161	0	0.0	768	66.1
Cuba (T)	1,669	0	0.0	0	0.0
Cuba (V)	1,575	0	0.0	0	0.0
Friendship (T)	2,004	0	0.0	0	0.0
Genesee (T)	1,693	413	24.4	1,280	75.6
Granger (T)	538	0	0.0	0	0.0
Grove (T)	548	0	0.0	0	0.0
Hume (T)	2,071	0	0.0	0	0.0
Independence (T)	1,167	1,156	99.1	11	<1
New Hudson (T)	781	0	0.0	0	0.0
Richburg (V)	450	0	0.0	450	100.0
Rushford (T)	1,150	0	0.0	0	0.0
Scio (T)	1,833	0	0.0	27	1.5
Ward (T)	368	0	0.0	0	0.0
Wellsville (T)	2,718	239	8.8	860	31.6
Wellsville (V)	4,679	0	0.0	181	3.9
West Almond (T)	334	0	0.0	0	0.0
Willing (T)	1,228	254	20.7	974	79.3
Wirt (T)	805	0	0.0	542	67.3
Allegany County (Total)	**48,946**	**2,347**	**4.8**	**8,043**	**16.4**

Sources: Godt 2001, U.S. Census 2010.

Impact on General Building Stock

In general, the building environment within the high susceptibility zones, as well as population, structures, and infrastructure downslope, are vulnerable to this hazard. Custom building inventory and landslide incidence hazard areas were used to calculate estimated building stock exposed to this hazard. Table 5.4.6-2 and Table 5.4.6-3 list building replacement cost values and numbers of buildings within defined hazard areas, respectively.

Table 5.4.6-2. Estimated General Building Stock Replacement Cost Values in the Landslide Hazard Area

Municipality	Total GBS RCV	Landslide Incidence		Landslide Susceptibility/Incidence	
		Moderate	Percent of Total	Moderate/Low	Percent of Total
Alfred (T)	$371,214,531	$0	0.0	$0	0.0
Alfred (V)	$550,636,847	$0	0.0	$0	0.0
Allen (T)	$162,300,474	$0	0.0	$0	0.0
Alma (T)	$256,374,017	$0	0.0	$255,175,860	99.5
Almond (T)	$312,231,916	$0	0.0	$0	0.0
Almond (V)	$135,692,850	$0	0.0	$0	0.0
Amity (T)	$334,307,982	$0	0.0	$0	0.0
Andover (T)	$230,686,817	$38,383,857	16.6	$0	0.0
Andover (V)	$338,015,430	$0	0.0	$0	0.0
Angelica (T)	$194,212,919	$0	0.0	$0	0.0
Angelica (V)	$284,974,634	$0	0.0	$0	0.0
Belfast (T)	$531,601,630	$0	0.0	$0	0.0
Belmont (V)	$396,945,690	$0	0.0	$0	0.0
Birdsall (T)	$115,899,500	$0	0.0	$0	0.0
Bolivar (T)	$258,709,425	$28,454,702	11.0	$233,124,481	90.1
Bolivar (V)	$409,452,702	$0	0.0	$406,582,943	99.3
Burns (T)	$176,932,773	$0	0.0	$0	0.0
Canaseraga (V)	$200,008,440	$0	0.0	$0	0.0
Caneadea (T)	$506,452,673	$0	0.0	$0	0.0
Centerville (T)	$220,631,685	$0	0.0	$0	0.0
Clarksville (T)	$289,246,885	$0	0.0	$192,014,156	66.4
Cuba (T)	$465,992,122	$0	0.0	$0	0.0
Cuba (V)	$602,554,836	$0	0.0	$0	0.0
Friendship (T)	$649,189,751	$0	0.0	$0	0.0
Genesee (T)	$366,042,711	$126,258,039	34.5	$239,978,012	65.6
Granger (T)	$182,924,910	$0	0.0	$0	0.0
Grove (T)	$203,653,283	$0	0.0	$0	0.0
Hume (T)	$595,483,501	$0	0.0	$0	0.0
Independence (T)	$317,936,823	$307,175,132	96.6	$10,761,691	3.4
New Hudson (T)	$250,742,307	$0	0.0	$0	0.0
Richburg (V)	$115,588,317	$0	0.0	$116,289,733	100.6

Table 5.4.6-2. Estimated General Building Stock Replacement Cost Values in the Landslide Hazard Area

Municipality	Total GBS RCV	Landslide Incidence		Landslide Susceptibility/Incidence	
		Moderate	Percent of Total	Moderate/Low	Percent of Total
Rushford (T)	$676,861,880	$0	0.0	$0	0.0
Scio (T)	$431,175,535	$0	0.0	$70,587,306	16.4
Ward (T)	$115,902,946	$0	0.0	$0	0.0
Wellsville (T)	$720,536,730	$33,559,736	4.7	$306,942,542	42.6
Wellsville (V)	$1,930,580,062	$0	0.0	$22,015,255	1.1
West Almond (T)	$146,702,356	$0	0.0	$0	0.0
Willing (T)	$322,582,548	$66,393,039	20.6	$253,779,140	78.7
Wirt (T)	$219,156,819	$0	0.0	$119,900,071	54.7
Allegany County (Total)	**14,590,137,257**	**$600,224,505**	**4.1**	**$2,227,151,191**	**15.3**

Sources: Godt 2001, Allegany County 2016.

Notes:

GBS General building stock
RCV Replacement cost value

Table 5.4.6-3. Number of Buildings Within the Landslide Hazard Area

Municipality	Total Number of Buildings	Landslide Incidence		Landslide Susceptibility/Incidence	
		Moderate	Percent of Total	Moderate/Low	Percent of Total
Alfred (T)	588	0	0.0	0	0.0
Alfred (V)	546	0	0.0	0	0.0
Allen (T)	399	0	0.0	0	0.0
Alma (T)	602	0	0.0	600	99.7
Almond (T)	634	0	0.0	0	0.0
Almond (V)	189	0	0.0	0	0.0
Amity (T)	676	0	0.0	0	0.0
Andover (T)	445	66	14.8	0	0.0
Andover (V)	485	0	0.0	0	0.0
Angelica (T)	391	0	0.0	0	0.0
Angelica (V)	402	0	0.0	0	0.0
Belfast (T)	961	0	0.0	0	0.0
Belmont (V)	473	0	0.0	0	0.0
Birdsall (T)	310	0	0.0	0	0.0
Bolivar (T)	596	72	12.1	530	88.9
Bolivar (V)	572	0	0.0	566	99.0
Burns (T)	352	0	0.0	0	0.0
Canaseraga (V)	280	0	0.0	0	0.0
Caneadea (T)	1,010	0	0.0	0	0.0

Table 5.4.6-3. Number of Buildings Within the Landslide Hazard Area

Municipality	Total Number of Buildings	Landslide Incidence		Landslide Susceptibility/Incidence	
		Moderate	Percent of Total	Moderate/Low	Percent of Total
Centerville (T)	436	0	0.0	0	0.0
Clarksville (T)	853	0	0.0	533	62.5
Cuba (T)	971	0	0.0	0	0.0
Cuba (V)	733	0	0.0	0	0.0
Friendship (T)	1,067	0	0.0	0	0.0
Genesee (T)	857	261	30.5	597	69.7
Granger (T)	431	0	0.0	0	0.0
Grove (T)	513	0	0.0	0	0.0
Hume (T)	928	0	0.0	0	0.0
Independence (T)	554	532	96.0	22	4.0
New Hudson (T)	517	0	0.0	0	0.0
Richburg (V)	199	0	0.0	200	100.5
Rushford (T)	1,429	0	0.0	0	0.0
Scio (T)	907	0	0.0	141	15.5
Ward (T)	286	0	0.0	0	0.0
Wellsville (T)	1,344	71	5.3	463	34.4
Wellsville (V)	2,565	0	0.0	40	1.6
West Almond (T)	324	0	0.0	0	0.0
Willing (T)	708	148	20.9	554	78.2
Wirt (T)	598	0	0.0	358	59.9
Allegany County (Total)	**26,131**	**1,150**	**4.4**	**4,604**	**17.6**

Sources: Godt 2001, Allegany County 2016.

Impact on Critical Facilities

To estimate exposure, spatial layers depicting approximate landslide hazard areas and locations of essential and municipal facilities were used. Table 5.4.6-4 lists numbers of critical facilities (for example, police, fire, emergency operations centers [EOC], hospitals, and schools) within the landslide incidence and susceptibility/incidence hazard areas.

Table 5.4.6-4. Numbers of Critical Facilities Within the Landslide Hazard Area

Municipality	Facility Types							
	Air	Fire Station	Historic Register	Library	Medical	Police Station	School	Substation
Alfred (T)	0	0	0	0	0	0	0	0

Table 5.4.6-4. Numbers of Critical Facilities Within the Landslide Hazard Area

Municipality	Facility Types							
	Air	Fire Station	Historic Register	Library	Medical	Police Station	School	Substation
Alfred (V)	0	0	0	0	0	0	0	0
Allen (T)	0	0	0	0	0	0	0	0
Alma (T)	0	2	0	0	0	0	0	0
Almond (T)	0	0	0	0	0	0	0	0
Almond (V)	0	0	0	0	0	0	0	0
Amity (T)	0	0	0	0	0	0	0	0
Andover (T)	0	0	0	0	0	0	0	0
Andover (V)	0	0	0	0	0	0	0	0
Angelica (T)	0	0	0	0	0	0	0	0
Angelica (V)	0	0	0	0	0	0	0	0
Belfast (T)	0	0	0	0	0	0	0	0
Belmont (V)	0	0	0	0	0	0	0	0
Birdsall (T)	0	0	0	0	0	0	0	0
Bolivar (T)	0	0	0	0	0	0	0	0
Bolivar (V)	0	1	1	1	1	1	2	0
Burns (T)	0	0	0	0	0	0	0	0
Canaseraga (V)	0	0	0	0	0	0	0	0
Caneadea (T)	0	0	0	0	0	0	0	0
Centerville (T)	0	0	0	0	0	0	0	0
Clarksville (T)	0	1	0	0	0	0	0	0
Cuba (T)	0	0	0	0	0	0	0	0
Cuba (V)	0	0	0	0	0	0	0	0
Friendship (T)	0	0	0	0	0	0	0	0
Genesee (T)	0	0	1	1	0	0	0	0
Granger (T)	0	0	0	0	0	0	0	0
Grove (T)	0	0	0	0	0	0	0	0
Hume (T)	0	0	0	0	0	0	0	0
Independence (T)	0	1	0	1	0	1	1	0
New Hudson (T)	0	0	0	0	0	0	0	0
Richburg (V)	0	1	0	1	0	0	1	1
Rushford (T)	0	0	0	0	0	0	0	0
Scio (T)	0	1	0	0	0	0	0	0
Ward (T)	0	0	0	0	0	0	0	0
Wellsville (T)	0	0	0	0	0	0	0	0
Wellsville (V)	1	0	0	0	0	0	0	0

Table 5.4.6-4. Numbers of Critical Facilities Within the Landslide Hazard Area

Municipality	Facility Types							
	Air	Fire Station	Historic Register	Library	Medical	Police Station	School	Substation
West Almond (T)	0	0	0	0	0	0	0	0
Willing (T)	0	1	0	0	0	1	0	0
Wirt (T)	0	0	0	0	0	0	0	0
Allegany County (Total)	**1**	**8**	**2**	**4**	**1**	**3**	**4**	**1**

Sources: Allegany County 2016, Godt 2001.

Impact on the Economy

The impact of a landslide on the economy and estimated dollar losses are difficult to measure. As stated earlier, landslides can exert direct and indirect effects on society. Direct costs include 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 estimated costs to repair or replace damaged buildings. No buildings in Allegany County are within high incidence and high/moderate susceptibility/incidence landslide hazard areas. Approximately $600 million in replacement cost value or 4.1 percent of Allegany County's total building inventory is within the estimated landslide moderate incidence area. Total risk exposure of approximately $2.2 billion or 15.3 percent of Allegany County's total building inventory is within the estimated landslide moderate susceptibility/low incidence area. Losses to Allegany County's building inventory would impact Allegany County's tax base and the local economy.

State Highways 19, 248, 275, 305, and 417 traverse the moderate incidence and moderate/susceptibility/low incidence hazard areas. Many of the County's state highways are also within the hazard area. Refer to Figure 5.4.6-1 for locations of major roadways in the County within hazard areas.

Future Growth and Development

As discussed in Section 4 and in Volume II, Section 9, areas targeted for future growth and development have been identified across Allegany County. Exposure of new development within identified hazard areas to these risks is expected. See the jurisdictional annexes of this HMP for anticipated new development areas within landslide hazard risk areas.

Change of Vulnerability

The 2011 HMP included a quantitative assessment of various facilities within the identified landslide hazard area. For the 2017 HMP update, risks to the County's population, building stock, and critical facilities were assessed. Overall, the County remains potentially vulnerable to the landslide hazard.

Additional Data and Next Steps

Obtaining historical records of damage to buildings and infrastructure caused by landslides will improve estimates of loss and future modeling efforts, given a margin of uncertainty. Landslide susceptibility zones can be identified in more detail so that communities can more accurately identify high hazard areas. A pilot study of Schenectady County, New York (as described in the 2011 NYS HMP) developed higher resolution landslide susceptibility zones by applying a methodology that used the following information: Natural Resource Conservation Services (NRCS) Digital Soil Survey soil units and their associated properties, including the American Association of State Highway and Transportation Officials (AASHTO) rating, liquid limit, hydrologic group, percentage of silt and clay, erosion potential, and slope derived from high-resolution digital elevation models. Further research on rainfall thresholds for forecasting landslide potential may also be an option for Allegany County.