Section 3.14 LANDSLIDE

2014 SHMP Update
• Reformatted document into new outline • Updated data related to occurrence, vulnerability and loss • Added information / key terms into the Characteristics Section • Inserted Historical Landslide Event and Losses Table • Inserted Historical Landslide Event and Losses Map • Added Local Plan Integration Table • Moved pilot study to the appendix

3.14.1 Landslide Profile

Hazard	Definitions and Key Terms
Landslide	• *Rock Fall-* Blocks of rock fall away from a bedrock unit *without* a rotational component. • *Rock Topple-* Blocks of rock fall away from a bedrock unit *with* a rotational component. • *Rotational Slump-* Blocks of fine grained sediment rotate and move down slope. • *Translational slide-* Sediments move along a flat surface without a rotational component. • *Earth flow-* Fine grained sediments flow downhill and typically form a fan structure. • *Creep-* Slow moving landslide often only noticed through crooked trees and disturbed structures. • *Block Slide-* A block of rock slides along a slip plane as a unit down slope. • *Debris Avalanche-* Predominately gravel, cobble, boulder sediments and trees move quickly down slope. • *Debris Flow-* Coarse sediments flow downhill and spread out over relatively flat areas.

Characteristics

Another hazard to which New York State is vulnerable to is landslides. Landslide materials may be composed of natural rock, soil, artificial fill, or a combination of these materials. They can be caused by a variety of factors including volcanic eruptions, earthquakes, fire, storms, and by human land modifications. Landslides can transpire quickly oftentimes with little to no warning. Dependent on where they occur, landslides can pose significant risks to health, safety, transportation, as well as other services.

In a landslide, large rock, earth, or debris moves along a downward slope. Mudflow and debris flow are rivers of rock, earth, and other debris that become saturated with water. When water collects in the ground during heavy rains or quick snowmelts, this modifies the earth into flowing rivers of mud in essence creating landslides. They flow rapidly striking at avalanche speeds that can travel several miles growing in size as they pick up trees, boulders, cars and other materials.

This hazard can be initiated particularly in mountain, canyon and coastal regions where areas of burned forest and brush have taken place creating lower thresholds for precipitation. Zoning, professional inspections, and proper designing can assist in minimizing landslides, mudflows, and debris flow problems.

The terms listed below can be used to help describe any type of slide's shape and size. It is important to note that while many of these terms can be used for many types of slides, the geometries and materials of different slides can be very different.

Location

The potential for landslides exists across the entire State and the entire northeast region of the United States. Scientific and historical landslide data exists which indicates that some areas of the State have a substantial landslide risk. According to information provided by USGS and NYS Geological Survey (NYSGS), it is estimated that 80% of New York State has a low susceptibility to landslide hazard. In general the highest potential for landslides can be found along major rivers and lake valleys that were formerly occupied by glacial lakes resulting in glacial lake deposits (glacial lake clays) and usually associated with steeper slopes. A good example of this is the Hudson and Mohawk River Valleys.

Table 3.14a represents populations at risk of landslide incidence determined by susceptibility zones and listed by county generated from USGS data. **Figure 3.14a** created by New York State Department of Homeland Security and Emergency Services (DHSES) (formerly the Office of Emergency Management), displays landslide hazard susceptibility throughout the State of New York according to USGS.

Table 3.14a: Population at Risk in Landslide Incidence and Susceptibility Zones by County

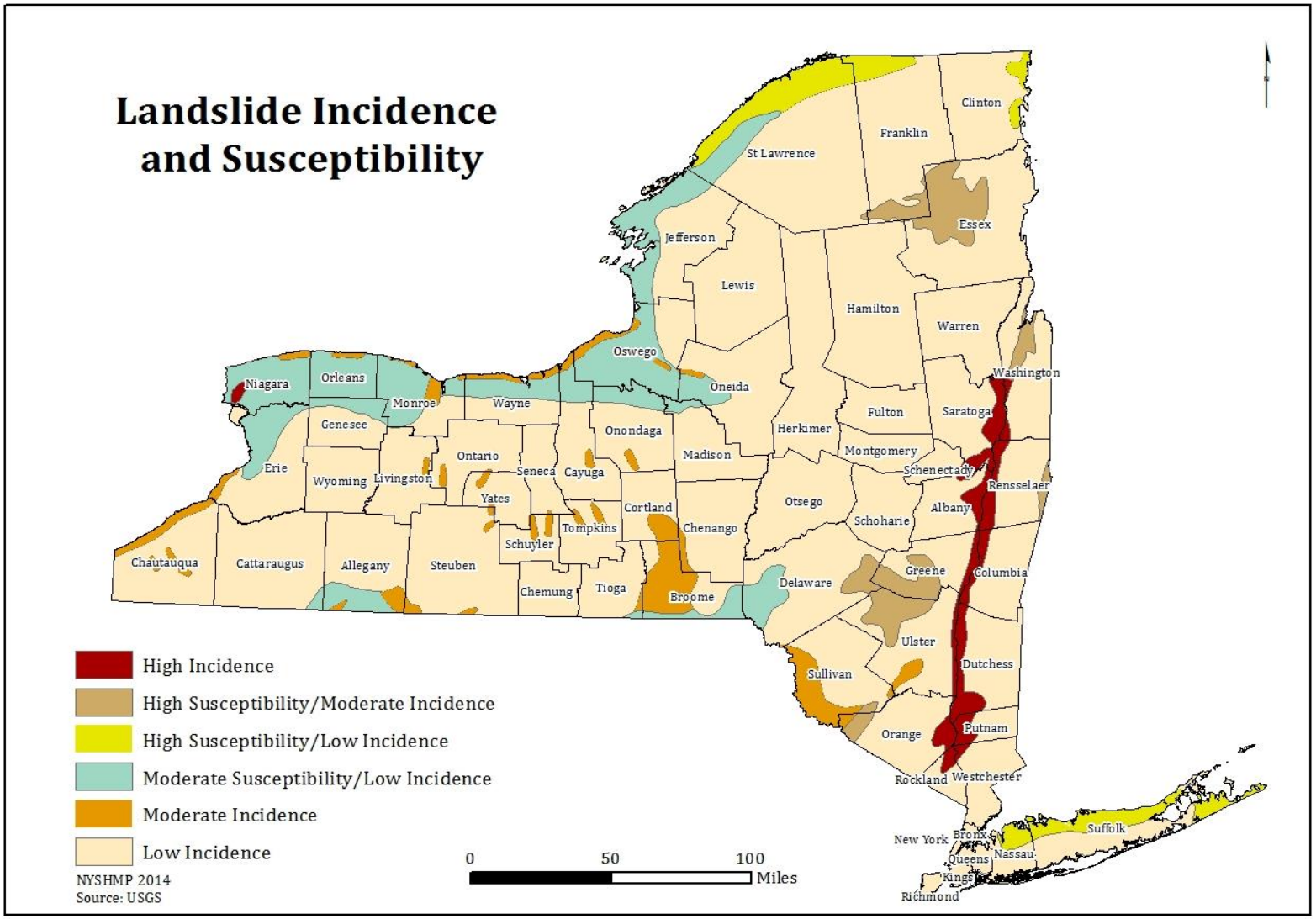
County	High Incidence	High Susceptibility/ Moderate Incidence	High Susceptibility/ Low Incidence	Moderate Susceptibility/ Low Incidence	Moderate Incidence	Low Incidence
Albany	197,010					107,194
Allegany				8,125	2,330	38,491
Bronx						1,345,456
Broome				6,923	180,000	13,677
Cattaraugus				2,854		77,463
Cayuga				6,939	2,352	70,575
Chautauqua					41,279	93,447
Chemung						88,830
Chenango					1,395	49,082
Clinton			33,032			49,096
Columbia	15,400					47,696
Cortland					2,812	46,524
Delaware		4,931		8,509		34,540
Dutchess	157,726					139,756
Erie				736,098	16,802	166,113
Essex		10,681				28,689
Franklin		4,495	8,991			37,871
Fulton						55,531
Genesee				9,489		50,590
Greene	15,671	4,788				28,762
Hamilton						4,836
Herkimer						64,519
Jefferson				26,097		89,383

County	High Incidence	High Susceptibility/ Moderate Incidence	High Susceptibility/ Low Incidence	Moderate Susceptibility/ Low Incidence	Moderate Incidence	Low Incidence
Kings						2,445,684
Lewis						27,087
Livingston				202	1,035	64,156
Madison				8,365		65,077
Monroe				316,093	263,031	163,647
Montgomery						50,219
Nassau			153,703			1,154,363
New York						1,546,373
Niagara	16,329			197,444	1,775	809
Oneida				9,163	383	225,332
Onondaga				111,568	1,623	353,835
Ontario					1,963	105,968
Orange	29,914	19,367			1,545	321,982
Orleans				41,587	1,296	
Oswego				85,147	29,826	6,050
Otsego						62,259
Putnam	18,391					81,319
Queens						2,205,988
Rensselaer	98,182	1,016				60,231
Richmond						457,690
Rockland	30,116					281,564
Saratoga	65,947					153,660
Schenectady	22,833					131,894
Schoharie						32,749
Schuyler					1,902	16,441

County	High Incidence	High Susceptibility/ Moderate Incidence	High Susceptibility/ Low Incidence	Moderate Susceptibility/ Low Incidence	Moderate Incidence	Low Incidence
Seneca					75	35,176
St Lawrence			46,130	5,689		59,508
Steuben					1,025	97,963
Suffolk			518,910			953,025
Sullivan		721			14,287	62,539
Tioga				1,099	6,578	43,448
Tompkins					5,771	95,793
Ulster	20,345	6,133			3,278	152,737
Warren	250					65,457
Washington	5,039	10,174				48,003
Wayne				32,803	7,424	53,237
Westchester	36,662					910,704
Wyoming						42,155
Yates					1,073	24,275
Totals	**729,815**	**62,306**	**760,766**	**1,614,194**	**590,860**	**15,386,518**

Source: USGS

Figure 3.14a: Landslide Incidence and Susceptibility in New York State



Some natural variables that contribute to determining the overall risk of landslide activity in any particular area include soil properties, topographic position and slope, and lastly historical incidence. **Figure 3.14a**, used previously, categorizes the State using color codes provided by the USGS landslide susceptibility map and the NYSGS landslide incidence map. This map was created comprising two primary characteristics that define landslide potential: terrain slopes, soil makeup, or type.

Most of New York State (NYS) soil consists of dense glacial till that stands up well to landslide tendency. However, certain types of soil exist throughout the State that has higher risks of landslide susceptibility and incidence. More specific, glacial lake clay soils which are abundant throughout NYS have a higher risk for landslide occurrence. Logically, the steeper the slope the higher risk for landslide occurrence assuming other conditions that lead to landslides are present. However, according to the NYSGS, landslides can occur with very little slope, sometimes classified as earth slumping or earth flow. The threshold is estimated at 10 degrees slope or higher (> 10 degrees) when the susceptibility becomes significant. A tall slope or hill, commonly referred as *relief*, could potentially lead to a high risk. Geologists at the NYSGS identify relief (height) greater than 40 ft. as the general threshold where the potential becomes more significant.

Another significant factor in landslide occurrence is what sets off the landslide or the causes (triggers) of the landslide. Causes or triggers of landslides on marginally stable slopes can be both naturally occurring or human induced and include three (3) primary factors: 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.

Previous Occurrences

On May 6, 2011 the Adirondack Mountains of Keene Valley, New York, recorded potentially the largest, slowest landslide for the State. Geologist state that the 82-acre landmass, found on the Little Porter Mountain, has slow progressive movement downhill at a rate of six inches to two feet per day (Howard, 2001). The unusually slow moving slide was triggered by excessive groundwater stemming from heavy rain and snow of that year. The momentum of the slide has dragged boulders, trees and home foundations along with it (Howard, 2001). It has been reported that one home has been lost with the potential of five others that sit near the edge of a 30-foot drop. Eighty percent of the State has a low susceptibility to landslide hazards. However, the Adirondacks elevations are particularly defenseless to slides due to the loose soil that is piled atop bedrock. There have been no recorded injuries or deaths relating to this slide.

Table 3.14b below displays historical and recent loss information listed by county for landslides for the time frame of 1960 – 2012. The data derives primarily from the Spatial Hazard Events and Loss Database for the United States (SHELDUS™). The table accounts for 23 landslides that were reported in NYS between 1960 and 2012. Essex, Montgomery, and Herkimer Counties, specifically, have had the most events since 1960. Based on historical frequency, there have been no fatalities and only one reported injury in

Montgomery County. The State has had more than $1.8 million in economic losses, majority in property damage. **Figure 3.14b** and **Figure 3.14c Figure 3.14d** illustrate previous occurrences of landslide activity, property loss, as well as Presidential Disaster Declarations.

Table 3.14b: New York State Landslide Events and Losses from 1960-2012

Historical Record (1960-2012)							
County	**Future Probability %**	**Recurrence Interval**	**No. of Events**	**Fatalities**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**
Albany	2	52	1	0	0	$500,000	$0
Allegany	0	0	0	0	0	$0	$0
Bronx	2	52	1	0	0	$833	$0
Broome	0	0	0	0	0	$0	$0
Cattaraugus	0	0	0	0	0	$0	$0
Cayuga	0	0	0	0	0	$0	$0
Chautauqua	0	0	0	0	0	$0	$0
Chemung	0	0	0	0	0	$0	$0
Chenango	0	0	0	0	0	$0	$0
Clinton	0	0	0	0	0	$0	$0
Columbia	0	0	0	0	0	$0	$0
Cortland	0	0	0	0	0	$0	$0
Delaware	0	0	0	0	0	$0	$0
Dutchess	0	0	0	0	0	$0	$0
Erie	0	0	0	0	0	$0	$0
Essex	6	17	3	0	0	$56,000	$0
Franklin	0	0	0	0	0	$0	$0
Fulton	0	0	0	0	0	$0	$0
Genesee	0	0	0	0	0	$0	$0
Greene	0	0	0	0	0	$0	$0
Hamilton	0	0	0	0	0	$0	$0
Herkimer	4	26	2	0	0	$105,000	$0
Jefferson	0	0	0	0	0	$0	$0
Kings	2	52	1	0	0	$833	$0
Lewis	0	0	0	0	0	$0	$0
Livingston	0	0	0	0	0	$0	$0
Madison	0	0	0	0	0	$0	$0
Monroe	0	0	0	0	0	$0	$0
Montgomery	6	17	3	0	1	$1,005,500	$0

Historical Record (1960-2012)							
County	**Future Probability %**	**Recurrence Interval**	**No. of Events**	**Fatalities**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**
Nassau	2	52	1	0	0	$833	$0
New York	0	0	0	0	0	$0	$0
Niagara	0	0	0	0	0	$0	$0
Oneida	0	0	0	0	0	$0	$0
Onondaga	0	0	0	0	0	$0	$0
Ontario	0	0	0	0	0	$0	$0
Orange	2	52	1	0	0	$5,000	$0
Orleans	0	0	0	0	0	$0	$0
Oswego	0	0	0	0	0	$0	$0
Otsego	0	0	0	0	0	$0	$0
Putnam	4	26	2	0	0	$1,000	$0
Queens	2	52	1	0	0	$833	$0
Rensselaer	2	52	1	0	0	$50,000	$0
Richmond	0	0	0	0	0	$0	$0
Rockland	0	0	0	0	0	$0	$0
Saratoga	2	52	1	0	0	$25,000	$0
Schenectady	2	52	1	0	0	$5,000	$0
Schoharie	0	0	0	0	0	$0	$0
Schuyler	0	0	0	0	0	$0	$0
Seneca	0	0	0	0	0	$0	$0
St Lawrence	0	0	0	0	0	$0	$0
Steuben	0	0	0	0	0	$0	$0
Suffolk	2	52	1	0	0	$833	$0
Sullivan	0	0	0	0	0	$0	$0
Tioga	0	0	0	0	0	$0	$0
Tompkins	0	0	0	0	0	$0	$0
Ulster	2	52	1	0	0	$50,000	$500
Warren	2	52	1	0	0	$50,000	$0
Washington	0	0	0	0	0	$0	$0
Wayne	0	0	0	0	0	$0	$0
Westchester	2	52	1	0	0	$833	$0
Wyoming	0	0	0	0	0	$0	$0
Yates	0	0	0	0	0	$0	$0

Source: Spatial Hazard Events & Losses Database for the U.S. (SHELDUS) (*Future Probability equals the number of events divided by the number of years of record [52], expressed as a percentage.)

Figure 3.14b: New York Landslide Events, by County 1960-2012

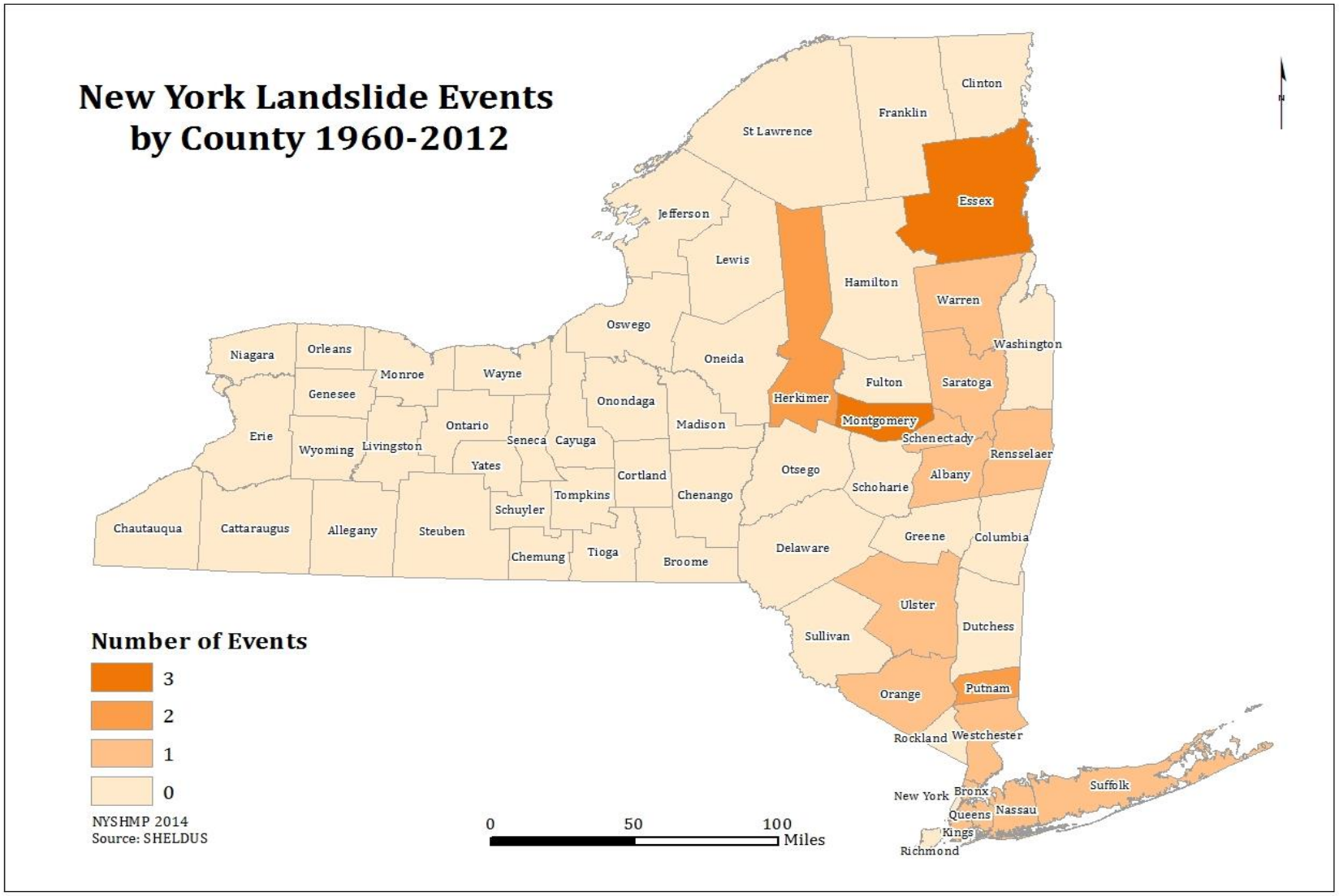


Figure 3.14c: New York Landslide Property Damage, by County 1960-2012

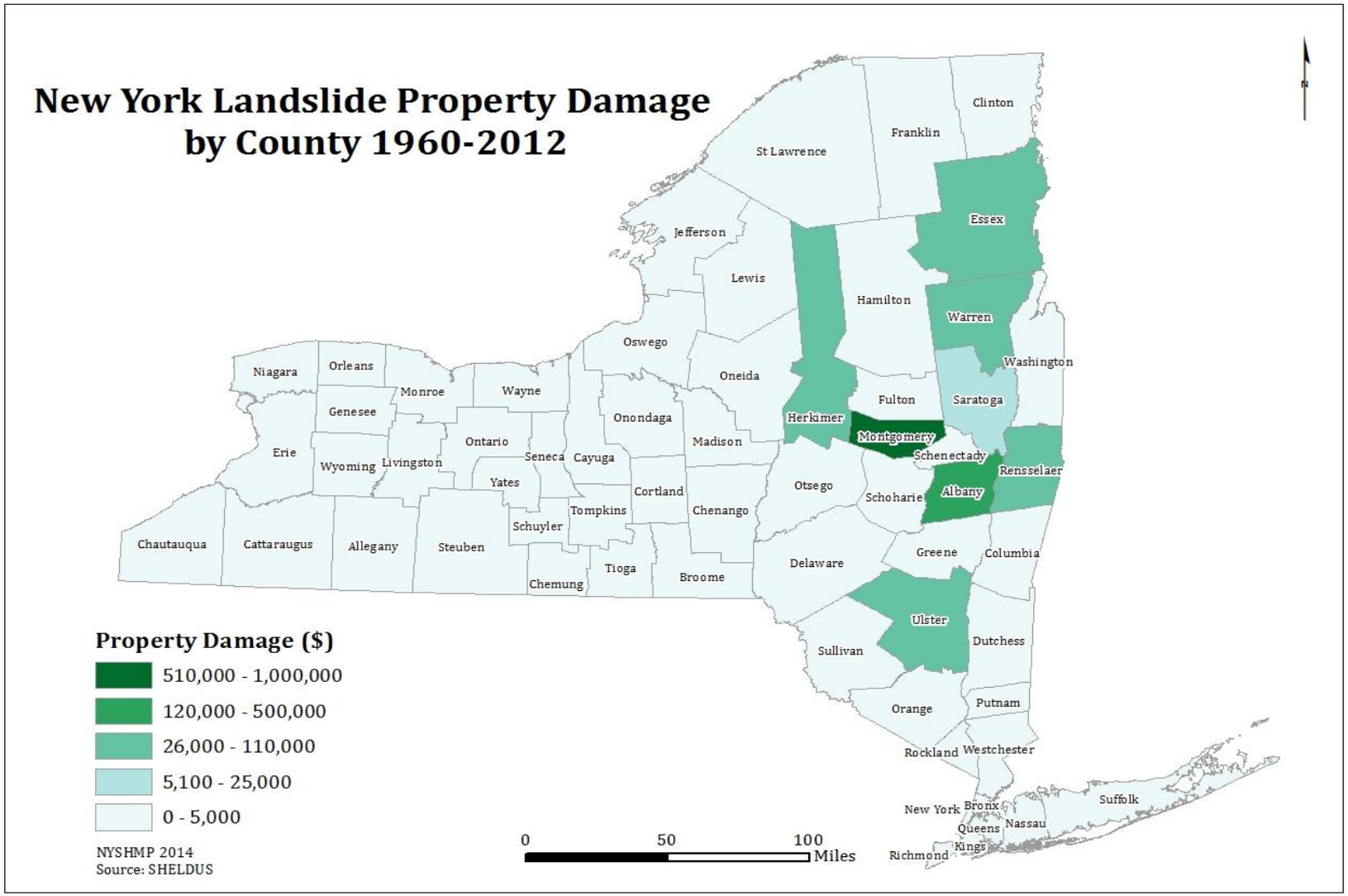
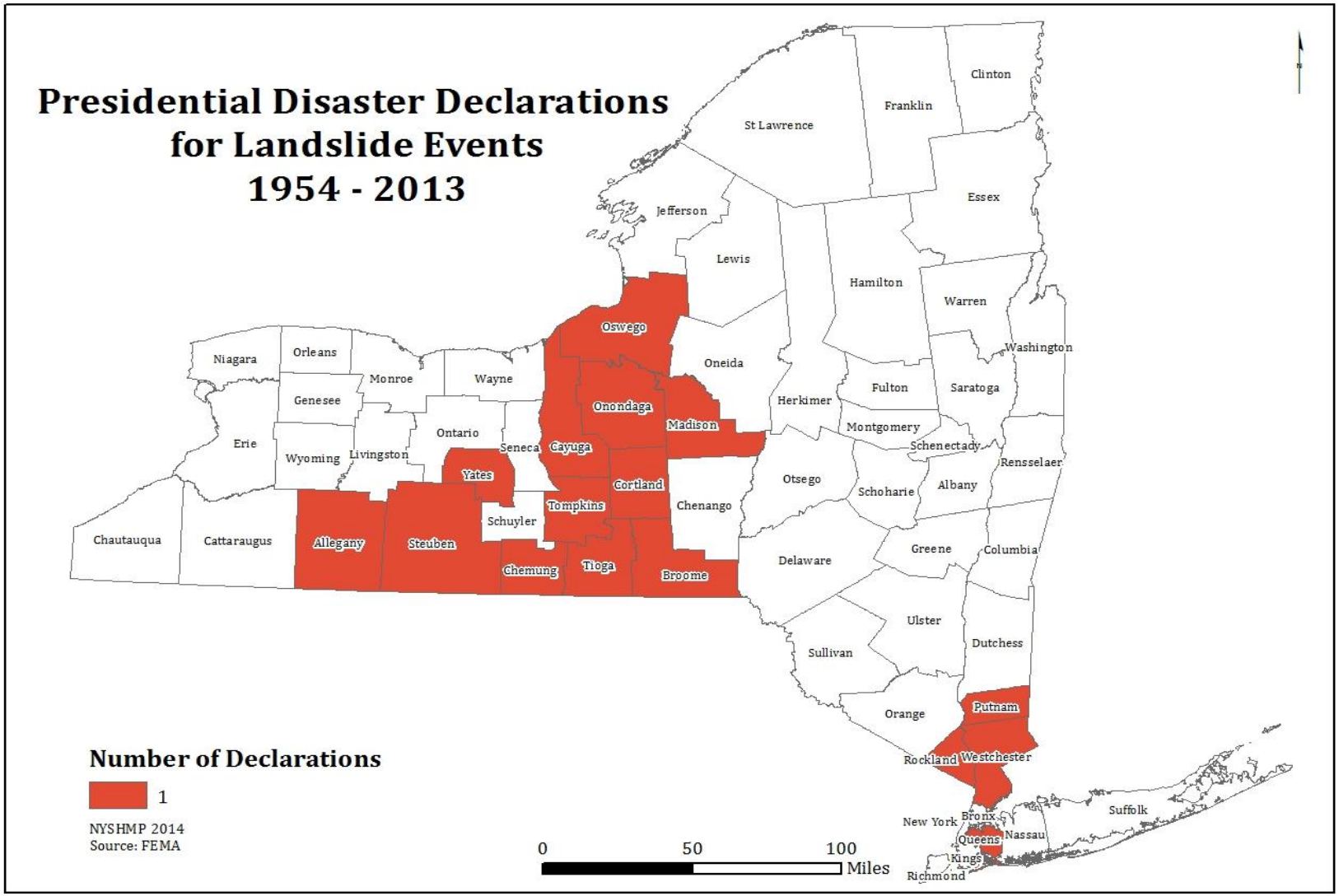


Figure 3.14d: Presidential Disaster Declarations for Landslide Events from 1954-2013



Probability and Magnitude of Future Events

Given the history of occurrences in NYS, it is certain that future landslides will occur and we can express the probability of future landslides in the State as high. This Plan expresses the probability of future landslides using recognized scientific methods and simple historic landslide event frequency to project potential future occurrences.

Using documented historical occurrences from NYSGS Landslide Inventory Study to estimate the probability of future landslides, NYS can expect on average approximately two (2) major landslides each year, a greater number of smaller but still significant slides/slumps/flows each year, and at least one landslide causing a fatality is expected once every 12 years.

Although historical data indicates a high frequency of landslide occurrence, the NYSGS estimates that 80% of the State has a low susceptibility to landslides. The frequency of damaging landslides within and adjacent to NYS has been and can be classified, relative to other higher risk states, as low. However, the fact that high landslide susceptibility exists and landslides have occurred in the past suggests that the State's infrastructure and many people are at risk from damaging landslide hazards.

Justification for Minimal Vulnerability/ Loss Assessment
Although landslide received an overall "low" ranking following the HAZNY-Mitigation methodology, it was acknowledged that there are potential cost-effective and technically feasible initiatives and programs that address landslide mitigation. Consequently, it is determined that there is not sufficient evidence based on probability to justify further analysis for the 2014 plan update, but it is recommended that local hazard mitigation plans for areas that will consider addressing landslide preparedness measures in future plan updates.

3.14.2 Assessing Landslide Vulnerability by Jurisdiction

Landslide Impact Analysis

Table 3.14d presents the results of New York State's vulnerability assessment indicating counties most vulnerable to a landslide hazard as determined by a final rating score. Each county jurisdiction accumulated points based on the value of each variable indicator; the higher the indication for landslide exposure the more points assigned, resulting in a final rating score (**Table 3.14c**). The rating score's found in this table may not be applicable beyond a general indication, especially at the local level. Activities have been established in this 2014 HMP Update that mitigates strategies that utilizes hazard risk assessments based on local data gathered.

Table 3.14c: Rating Score Table

	Rating Score	*Landslide Susceptibility (Calculated)	Number of Landslide Events**	Number of Structures (HAZUS)
Rating Score - Variables Distributions and Point Values	score value 1	.01-.15	1-5	1-17K
	score value 2	.15-.50	6-10	18-24K
	score value 3	.51-1.0	11-15	25-40K
	score value 4	1-1.5	16-20	41-80K
	score value 5	1.5 – 3 +	21 +	81-462K

The results of New York State's landslide vulnerability assessment present a collective review of counties most threatened by and vulnerable to landslide hazard using readily available information.

Table 3.14d: Jurisdiction Most Threatened by Landslides and Vulnerable to Landslides Loss (Excluding population data)

County	Rating Score	*Landslide Susceptibility	Number of Landslide Events**	Number of Structures (top 3 category areas only)
Rensselaer	13	1.07	22	44,593
Suffolk	13	1.73	14	461,456
Nassau	12	1.14	11	395,748
Albany	11	1.09	6	83,117
Broome	11	1.60	7	60,079
Monroe	11	2.05	1	210,552
Erie	10	0.92	8	277,470
Niagara	10	3.04	5	66,394
Onondaga	10	0.66	10	132,013
Rockland	10	1.03	6	73,767
Wayne	10	1.37	12	30,592
Westchester	10	0.25	11	211,689
Chautauqua	9	0.21	14	45,310
Orange	9	0.58	3	92,068
Oswego	9	2.10	0	40,083

County	Rating Score	*Landslide Susceptibility	Number of Landslide Events**	Number of Structures (top 3 category areas only)
Putnam	9	1.85	3	32,303
Saratoga	9	1.22	5	66,122
Steuben	9	0.07	39	34,710
Ulster	9	1.49	1	58,343
Allegany	8	0.67	12	18,096
Cattaraugus	8	0.07	17	29,499
Columbia	8	0.69	14	23,405
Dutchess	8	1.35	0	79,721
Delaware	7	0.87	6	21,904
Essex	7	1.41	4	17,157
Greene	7	2.27	0	19,884
Jefferson	7	1.16	0	37,938
Schenectady	7	0.39	3	44,729
St. Lawrence	7	1.07	0	36,213
Sullivan	7	0.57	1	33,201
Tompkins	7	0.18	10	24,171
Cayuga	6	0.58	0	26,291
Chemung	6	0.00	15	26,831
Clinton	6	0.34	1	24,229
Oneida	6	0.39	0	69,590
Orleans	6	2.93	0	13,110
Tioga	6	0.13	12	17,232
Bronx	5	0.00	0	89,896
Chenango	5	0.09	6	18,194
Franklin	5	0.81	0	17,453
Genesee	5	0.83	1	17,646
Kings	5	0.00	0	258,603
Madison	5	0.22	2	21,705
New York City	5	0.00	4	56,385
Ontario	5	0.06	1	32,618
Queens	5	0.00	0	343,289
Richmond	5	0.00	0	111,561
Warren	5	0.01	1	26,234
Washington	5	0.92	0	20,361
Livingston	4	0.06	2	18,476
Montgomery	4	0.00	13	14,829
Otsego	4	0.00	7	21,815
Cortland	3	0.35	0	13,599
Fulton	3	0.00	2	20,226

County	Rating Score	*Landslide Susceptibility	Number of Landslide Events**	Number of Structures (top 3 category areas only)
Lewis	3	0.00	7	11,475
Schuyler	3	0.23	0	7,378
Seneca	3	0.01	1	11,423
Yates	3	0.11	1	9,542
Herkimer	2	0.00	0	22,928
Hamilton	1	0.00	0	6,252
Schoharie	1	0.00	0	12,026
Wyoming	1	0.00	0	12,844

Source: USGS

NYS believes the analysis methodology is sound in that it provides a reasonable assessment of vulnerability using key available indicators. NYS acknowledges its limitations for complete accuracy and recognizes some of the reasons why. Many generally recognized indicators for landslide vulnerability are not readily available and are not comprehensive and standardized enough to be easily included into our analysis at this time. Additionally, data may exist but is not practical to apply to a statewide level analysis. Gaps include building attributes and associated level of vulnerability, local or site specific conditions, building positional accuracy, local level accuracy of surficial soils information.

We also included a recent proposal written by USGS Water Science Center in the end of this section of Landslide Hazard Profile. This project of the USGS Water Science Center, if approved, has the potential to greatly advance the accuracy of landslide hazard risk assessment through collection of better data, future more detailed analysis, and continued application of GIS technology.

Local Plan Integration/ Risk Assessments

Since August 2013, 56 FEMA-approved local hazard mitigation plans (LHMP) have been reviewed for the 2014 Update. The State's planning team had the opportunity to review local county risk assessments to help the State better understand its vulnerability in terms of the jurisdictions most threatened by classified hazards. In its analysis, the State of New York reviewed the processes of local governments and how their hazards were ranked based on their jurisdictions and the potential losses (i.e., people, buildings, and dollar values) associated with the hazards of greatest concern.

Where data was available, the State extracted the ranking impact information from the LHMP hazard analysis. This ranking feature is based on a combination of probability, severity, and extent of the hazard and was determined to be the best measure of overall risk in the plans. This ranking was either numeric or described in terms of high, moderately high, moderate, or low. In cases where this information was not available,

ranking values were not determined yet considered if identified in the individual county local plans.

For the sake of the 2014 Update, a proper analysis and summary of the data was required. During the review of the local plan risk assessments, all rankings used were based on the New York HAZNY ranking system, and measured on a scale rating from 44 (low) to 400 (high). This analysis revealed that selected county-level plans did include manmade hazards in their analysis, but the State hazard mitigation plan's 2014 Update focused solely on natural hazards.

The local risk assessment summary allowed for an analysis of which hazards are of high concern to particular counties. **Table 3.2a** in **Section 3.2** lists all the hazards and the number of counties that ranked them at each of the scale levels: High, Moderately High, Moderate, Moderately Low, and Low. According to the plans reviewed, 34 counties recognized landslide as a hazard. Albany, Allegany "Western & Eastern Region", Essex, and Rensselaer Counties identified landslide as a moderately high hazard, no counties ranked it as a high hazard, two ranked it a moderate hazard, ten ranked it moderately low, and seven considered it a low hazard. **Table 3.14e** displays the highest ranked county hazards. , however due to low ranking there is no data available at the local level.

Table 3.14e: Summary of Landslide Hazard Impacts and Rankings by County

Local County Landslide Hazard Impacts		
Highest Occurrences	**Highest Fatalities**	**Highest Property Damage**
Montgomery	N/A	Montgomery
Essex	N/A	Albany
Herkimer	N/A	Herkimer
Putnam	N/A	Essex
Albany	N/A	Ulster

Source: SHELDUS

Local County Landslide Hazard Rankings	
High	**Moderately High**
N/A	Albany, Allegany "Western & Eastern Region", Essex, and Rensselaer

Source: LHMP

A pilot study has been conducted focusing on landslide susceptibility in Schenectady County. The proposal outlined an approach that generated a map demonstrating landslide susceptibility in the State in addition to a fact sheet that targeted government officials.

More information on this study can be found in the data appendix section of this 2014 Update Plan.

Development in Hazard Prone Areas

The areas that have previous occurrences and severity of impact, there are no significant state facilities considered to be vulnerable to landslides.

3.14.3 Assessing Landslide Vulnerability of State Facilities

The State of New York has an interest in protecting facilities and property owned by the State. Disasters can damage not only personal property, but government property as well, producing a financial and operational liability for the State. Losses range from structures and contents, disruption of services, and possibly the general economy.

The analysis involved creation of a GIS layer for State facilities using the coordinate information and an overlay onto a landslide hazard layer developed using a USGS landslide risk value map. In this plan we acknowledge the limitations of this analysis to provide site specific accuracy and that its applicability may not be appropriate beyond a general indication. Instead the analysis results may be best used as a guide to help target facilities that would benefit from further analysis. We have established activities in our mitigation strategy that will advance the accuracy of the State facilities risk assessment through further analysis. Future analysis may include expressing potential loss based on historical landslide loss information, continued application of GIS technology, and use of site specific data such as percent slope and soil type and building attribute information which will allow targeting of the most vulnerable facilities.

3.14.4 Estimating Potential Losses by Jurisdiction- Overview

This version of the NYS Hazard Mitigation Plan does not include a description of potential dollar loss estimations by jurisdiction for the landslide hazard because of the absence of certain essential information. Additionally, unlike landslide or earthquake hazard, there are not any standard loss estimation models or methodologies for the landslide hazard.

A preliminary dollar loss estimate could have been calculated based on known information such as total structures for general occupancy class, indicated higher landslide hazard areas (USGS landslide hazard susceptibility map) as determined earlier in this plan, and residential structure dollar value estimates. However, many assumptions and generalizations would need to be made for unknowns. Unknowns or available data that has not been gathered or analyzed includes: inventory estimates of the more vulnerable structures such as those near steep slopes, steep slopes prone to erosion, or structures near previous landslide occurrence areas, as well as historical, or critical structures and the type of damage and dollar damage figures. The many generalizations and guess work would result in figures with little accuracy and potentially misleading indications of a

Jurisdiction's vulnerability and potential loss to the landslide hazard. Therefore, this version of the NYS risk assessment will instead include an identification of needed data and establish actions necessary to estimate potential losses.

As local mitigation plans with landslide hazard risk assessments data becomes available, it will be incorporated into a state risk assessment repository for integration into risk assessment. Additionally, application of GIS technology will continue, including exploring the possibility of incorporating certain characteristics that lend to landslide occurrence such as slope, surficial soils, and real property data layers in support of future landslide hazard vulnerability analysis.

3.14.5 Estimating Potential Losses of State Facilities

The results depict a gross estimate of potential landslide losses to those identified vulnerable state facilities in terms of dollar value of exposed property. For this plan, landslide hazard vulnerability analysis and loss estimation methodology was supported by GIS technology and involved collaboration with key State agencies. Collaboration resulted in the identification of two State databases that provided key facility information. The NYS Office of General Services (OGS) fixed asset data base and Office of Cyber Security (OCS) database included fields that provide facility location data and replacement value in dollars.

Table 3.14f shows the result of the landslide hazard vulnerability assessment and loss analysis for state facilities.

Table 3.14f: Landslide Hazard Exposure (by incidence and susceptibility)

Agency	Total Facilities	Total Replacement Cost	High Incidence	High Susceptibility/Moderate Incidence	High Susceptibility/Low Incidence	Moderate Susceptibility/Low Incidence	Moderate Incidence	Low Incidence	TOTAL
Office of General Services (OGS)	2,046	$7,269,621,781	$2,844,403,215			$9,192,907	$16,854,179	$233,164,115	$3,103,614,416
Department of Health (DOH)	468	$494,168,461	$62,073,239					$74,853,144	$136,926,383
Department of Corrections and Community Supervision (DOCCS)	19,972	$9,111,425,045	$247,697,722	$146,218,944	$52,449,873	$106,412,249	$41,972,590	$2,019,781,447	$2,614,532,825
Office of Parks, Recreation, and Historic Preservation (OPRHP)	10,325	$2,073,612,475	$71,318,456	$390,794	$251,490,571	$68,905,464	$26,612,946	$514,496,515	$933,214,746
Department of Environmental Conservation (DEC)	3,144	$270,643,840	$3,607,784	$15,675,159	$6,690,737	$10,646,571	$720,571	$128,295,863	$165,636,685
Office of Mental Health (OMH)	4,497	$6,287,808,931	$82,963,495		$103,463,231	$106,689,034	$110,904,478	$854,748,186	$1,258,768,424
Office For People With Developmental Disabilities (OPWDD)	7,438	$2,755,709,522	$31,668,457	$2,574,099	$21,445,096	$94,740,049	$65,377,576	$695,486,465	$911,291,742
Department of State Police (DSP)	267	$164,142,582	$7,987,505	$3,883,722		$32,486		$35,246,232	$47,149,945
Department of Military and Naval Affairs (DMNA)	1,186	$735,644,622	$10,140,619	$1,101,265	$1,901,681	$42,466,115	$5,493,661	$169,475,180	$230,578,521

Agency	Total Facilities	Total Replacement Cost	High Incidence	High Susceptibility/Moderate Incidence	High Susceptibility/Low Incidence	Moderate Susceptibility/Low Incidence	Moderate Incidence	Low Incidence	TOTAL
Department of Transportation (DOT)	4,242	$691,748,381	$12,122,035	$3,518,889	$14,927,757	$39,346,657	$18,978,218	$239,996,128	$328,889,684
Office of Child and Family Services (OCFS)	1,800	$424,633,865	$367,312			$1,693,676		$131,015,331	$133,076,319
Other Agencies	22	$9,809,970						$1,308,551	$1,308,551
Dormitory Authority of the State of New York (DASAS)	46	$33,880,238						$9,663,947	$9,663,947
New York State Unified Court System (COURTS)	42	$31,856,013	$5,132,214						$5,132,214
Department of Labor (DOL)	81	$146,468,249	$35,293,667					$7,448,928	$42,742,595
New York State Education Department (NYSED)	408	$530,134,651	$205,482,067		$2,051,432			$29,078,384	$236,611,883
Adirondack Park Agency (APA)	20	$4,026,713		$550,696					$550,696
Agriculture & Markets (AG&MKTS)	634	$179,474,412						$70,624,039	$70,624,039
Department of State (DOS)	69	$22,851,819						$6,308,976	$6,308,976
TOTAL	**56,707**	**$31,237,661,570**	**$3,620,257,787**	**$173,913,568**	**$454,420,378**	**$480,125,208**	**$286,914,219**	**$5,220,991,431**	**$10,236,622,591**

Source: NYS Fixed Asset information – Offices of General Services and USGS Landslide Hazard Susceptibility Map. Analysis supported by GIS technology.

3.14.6 Data Limitations and Other Key Documents

The contents of this section result from research and outreach including, but not limited to, the following sources:

- *United States Geological Survey and New York State Geological Survey* – a review of technical information, graphics presenting historical, probability indicators;
- *United States Geological Survey New York Water Science Center Ithaca NY Hydro geologist Bill Kappel* - a review of the landslide profile and possible future program on landslide susceptibility in New York State;
- *New York State Geological Survey* – Outreach to the New York State Geologist Bill Kelly and Glacial Geologist Andy Kozlowski;
- *New York State Emergency Management Office* situation report archives for historical events.
- Howard, Z. (2001, July 1). *Reuters Reprints*. Retrieved August 15, 2013, from Reuters: http://www.reuters.com/assets/print?aid=USTRE7605F320110701
- Ready.gov. Landslides & Debris Flow. http://www.ready.gov/landslides-debris-flow

Please note: *data obtained from the Spatial Hazard Events and Losses Database for the United States (SHELDUS™) is a county-level hazard data set for the U.S. for 18 different natural hazard event types such thunderstorms, hurricanes, floods, and tornados. For each event the database includes the beginning date, location (county and state), property losses, crop losses, injuries, and fatalities that affected each county. The data derives from the national data source, National Climatic Data Center's monthly Storm Data publications. Using the latest release of SHELDUS™ 12.0, the database includes every loss causing and/or deadly event between 1960 through 1992 and from 1995 onward. Between 1993 and 1995, SHELDUS™ reflects only events that caused at least one fatality or more than $50,000 in property or crop damages.*

Case Study

A pilot study in Schenectady County, on July 2007, was presented to find more effective migration strategies in determining landslide susceptibility in that area and potentially for other areas of the State. A major issue with detecting landslide susceptibility is the lack of mapping that identifies slopes most susceptible to this specific hazard. As a result there is a great deal of uncertainty of how to focus on mitigation actions and land use planning for this hazard.

Opportunities to take mitigative action such as slope stabilization are missed as hazardous areas go unidentified. Worsening conditions such as leaking water lines that drain into vulnerable slopes fail to get the appropriate maintenance priority that is necessary and routinely go unchecked. Best practices are rarely presented in clear and consistent messages to the public; as a result property owners are often taken by surprise and commonly find themselves uninsured during times when damaging events occur.

Key developments in the area of GIS have provided an opportunity to use the power of the computer to analyze and map what was previously done by hand. In addition, key datasets critical to landside analysis have been converted into digital formats – particularly slope and soils. These datasets can be overlaid on a GIS with the ability to map locations of areas that have the coinciding soil properties and slope conditions that are most susceptible to sliding.

While the pilot demonstrates that landslide susceptibility maps can be generated in a more cost effective manner than was previously possible, it does not imply that resources will not be needed to expand the work into other Counties and eventually Statewide. Of particular need is staffing. The enhancement of staffing and resources at the NYSGS would enable this agency to better serve its traditional role and responsibilities with landslides and serve as lead for a multi-agency program focusing on landslide evaluation and susceptibility mapping. This program should include at a minimum DOT, DHSES and possibly OITS, which may be in the best position to serve as an interactive clearinghouse for reporting and mapping landslide occurrences.

At this time, the 2014 Hazard Mitigation Plan Update is underway. This plan lays out a strategic direction to mitigating the impacts of natural disasters, including identifying specific activities that are needed to advance understanding of risk and the framework of mitigation. Found within the *Data Appendix* is a more in depth overview of the pilot study in Schenectady County and all of the supporting information.