5.4.5 EARTHQUAKE

This section provides a profile and vulnerability assessment for the earthquake hazard.

HAZARD PROFILE

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

Description

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

The location of an earthquake is commonly described by its focal depth and the geographic position of its epicenter. The focal depth of an earthquake is the depth from the Earth's surface to the region where an earthquake's energy originates (the focus or hypocenter). The epicenter of an earthquake is the point on the Earth's surface directly above the hypocenter (Shedlock and Pakiser, 1997). Earthquakes usually occur without warning and their effects can impact areas of great distance from the epicenter (FEMA, 2001).

According to the U.S. Geological Society (USGS) Earthquake Hazards Program, an earthquake hazard is anything associated with an earthquake that may affect resident's normal activities. This includes surface faulting, ground shaking, landslides, liquefaction, tectonic deformation, tsunamis, and seiches. A description of each of these is provided below.

- Surface faulting: Displacement that reaches the earth's surface during slip along a fault. Commonly occurs with shallow earthquakes, those with an epicenter less than 20 kilometers.
- Ground motion (shaking): The movement of the earth's surface from earthquakes or explosions. Ground motion or shaking is produced by waves that are generated by sudden slip on a fault or sudden pressure at the explosive source and travel through the earth and along its surface.
- Landslide: A movement of surface material down a slope.
- Liquefaction: A process by which water-saturated sediment temporarily loses strength and acts as a fluid, like when you wiggle your toes in the wet sand near the water at the beach. This effect can be caused by earthquake shaking.
- Tectonic Deformation: A change in the original shape of a material due to stress and strain.
- Tsunami: A sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides, or exploding volcanic islands.

- Seiche: The sloshing of a closed body of water from earthquake shaking (USGS, 2008).

Extent

Seismic waves are the vibrations from earthquakes that travel through the Earth and are recorded on instruments called seismographs. The magnitude or extent of an earthquake is a measured value of the earthquake size, or amplitude of the seismic waves, using a seismograph. The Richter magnitude scale (Richter Scale) was developed in 1932 as a mathematical device to compare the sizes of earthquakes (USGS, 1989). The Richter Scale is the most widely-known scale that measures the magnitude of earthquakes (Shedlock and Pakiser, 1997; USGS, 2004). It has no upper limit and is not used to express damage. An earthquake in a densely populated area, which results in many deaths and considerable damage, may have the same magnitude and shock in a remote area that did not cause any damage (USGS, 1989). Table 5.4.5-1 presents the Richter Scale magnitudes and corresponding earthquake effects.

Table 5.4.5-1. Richter Scale

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

Source: USGS, 2006

The intensity of an earthquake is based on the observed effects of ground shaking on people, buildings, and natural features, and varies with location. Intensity is expressed by the Modified Mercalli Scale; a subjective measure that describes how strong a shock was felt at a particular location (Shedlock and Pakiser, 1997; USGS, 2004). The Modified Mercalli Scale expresses the intensity of an earthquake's effects in a given locality in values ranging from I to XII. Table 5.4.5-2 summarizes earthquake intensity as expressed by the Modified Mercalli Scale. Table 5.4.5-3 summarizes the Modified Mercalli Intensity Scale and the PGA equivalents.

Table 5.4.5-2. Modified Mercalli Intensity Scale

Mercalli Intensity	Description
I	Felt by very few people; barely noticeable.
II	Felt by few people, especially on upper floors.
III	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	Felt by many indoors, few outdoors. May feel like passing truck.
V	Felt by almost everyone, some people awakened. Small objects moves, trees and poles may shake.
VI	Felt by everyone; people have trouble standing. Heavy furniture can move, plaster can fall off walls. Chimneys may be slightly damaged.
VII	People have difficulty standing. Drivers feel their cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built buildings.
VIII	Well-built buildings suffer slight damage. Poorly built structures suffer severe damage. Some walls collapse.

Mercalli Intensity	Description
IX	Considerable damage to specially built structures; buildings shift off their foundations. The ground cracks. Landslides may occur.
X	Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, lakes. The ground cracks in large areas.
XI	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed.
XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Source(s): Michigan Tech University, 2007; Nevada Seismological Laboratory, 1996

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

MMI	Acceleration (%g) (PGA)	Perceived Shaking	Potential Damage
I	< .17	Not Felt	None
II	.17 – 1.4	Weak	None
III	.17 – 1.4	Weak	None
IV	1.4 – 3.9	Light	None
V	3.9 – 9.2	Moderate	Very Light
VI	9.2 – 18	Strong	Light
VII	18 – 34	Very Strong	Moderate
VIII	34 – 65	Severe	Moderate to Heavy

Source: NYSDPC, 2008

Seismic hazards are often expressed in terms of Peak Ground Acceleration (PGA) and Spectral Acceleration (SA). USGS defines PGA and SA as the following: 'PGA is what is experienced by a particle on the ground. Spectral Acceleration (SA) is approximately what is experienced by a building, as modeled by a particle mass on a massless vertical rod having the same natural period of vibration as the building' (USGS, Date Unknown). Both PGA and SA can be measured in *g* (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). PGA and SA hazard maps provide insight into location specific vulnerabilities (NYSDPC, 2008).

PGA is a common earthquake measurement that shows three things: the geographic area affected, the probability of an earthquake of each given level of severity, and the strength of ground movement (severity) expressed in terms of percent of acceleration force of gravity (%g). In other words, PGA expresses the severity of an earthquake and is a measure of how hard the earth shakes (or accelerates) in a given geographic area (NYSDPC, 2008).

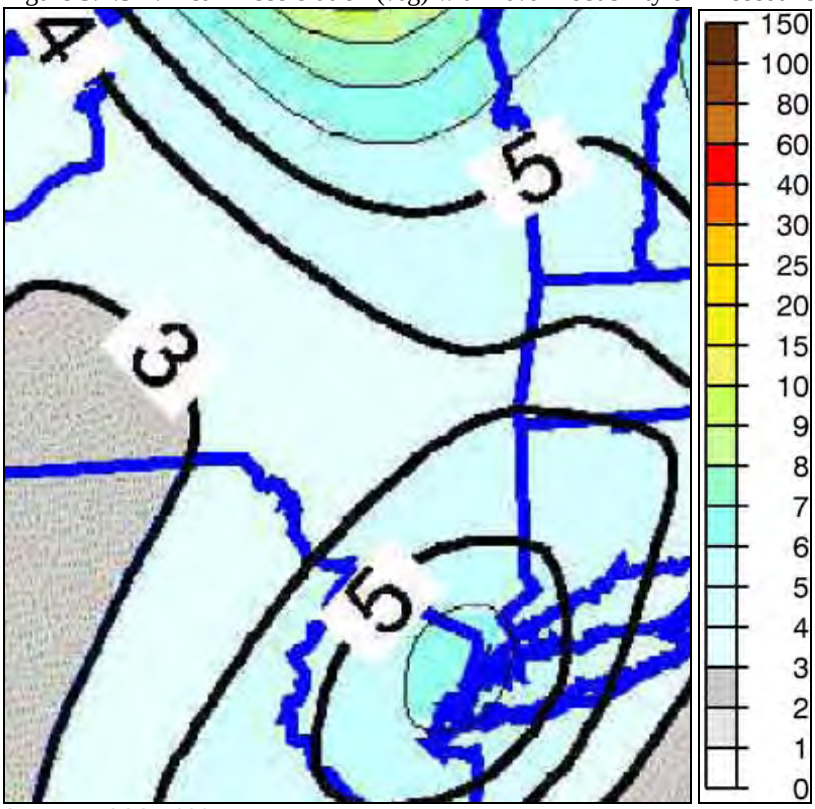
National maps of earthquake shaking hazards have been produced since 1948. They provide information essential to creating and updating the seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning used in the U.S. Scientists frequently revise these maps to reflect new information and knowledge. Buildings, bridges, highways and utilities built to meet modern seismic design requirements are typically able to withstand earthquakes better, with less damages and disruption. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes (Brown et al., 1996).

The USGS recently updated the National Seismic Hazard Maps in 2008. New seismic, geologic, and geodetic information on earthquake rates and associated ground shaking were incorporated into these

revised maps, which supersede the 1996 and 2002 versions. The 2008 map represents the best available data as determined by the USGS (USGS, 2008).

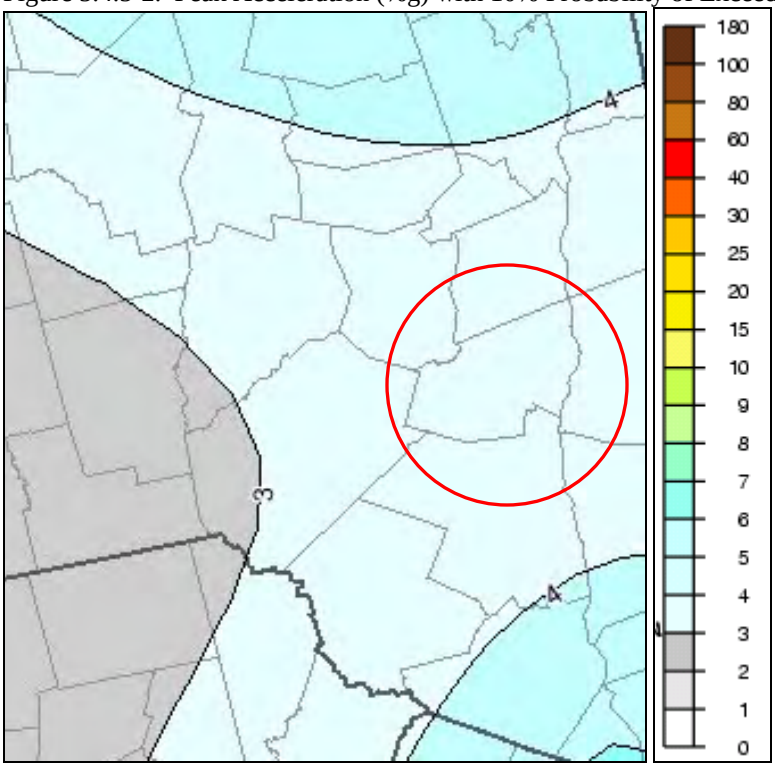
The 1996 Seismic Hazard Map shows that Greene County has a PGA between 3 and 4% (Figure 5.4.5-1). The 2002 Seismic Hazard Map shows that Greene County has a PGA of 3% (Figure 5.4.5-2). The 2008 Seismic Hazard Map shows that Greene County has a PGA of 2% (Figure 5.4.5-3). These maps are based on peak ground acceleration (%g) with 10% probability of exceedance in 50 years. The difference in PGA from the three Seismic Hazard Maps is most likely due to the incorporation of new data collected and reviewed by the USGS.

Figure 5.4.5-1. Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years (1996)



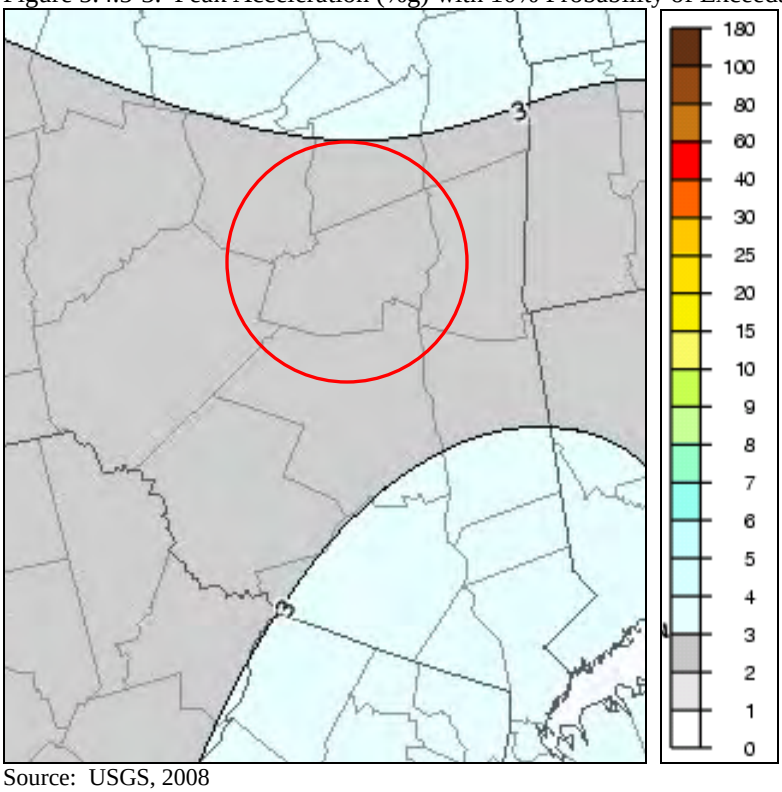
Source: USGS, 1996

Figure 5.4.5-2. Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years (2002)



Source: USGS, 2002

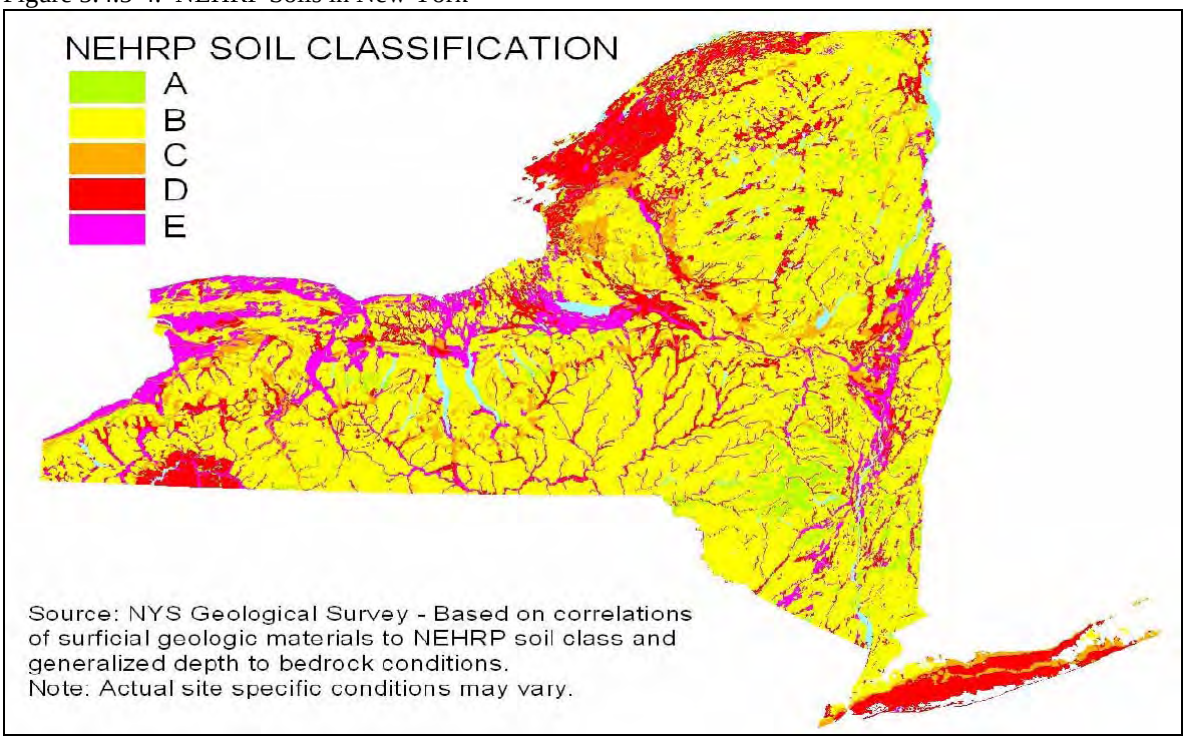
Figure 5.4.5-3. Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years (2008)



Source: USGS, 2008

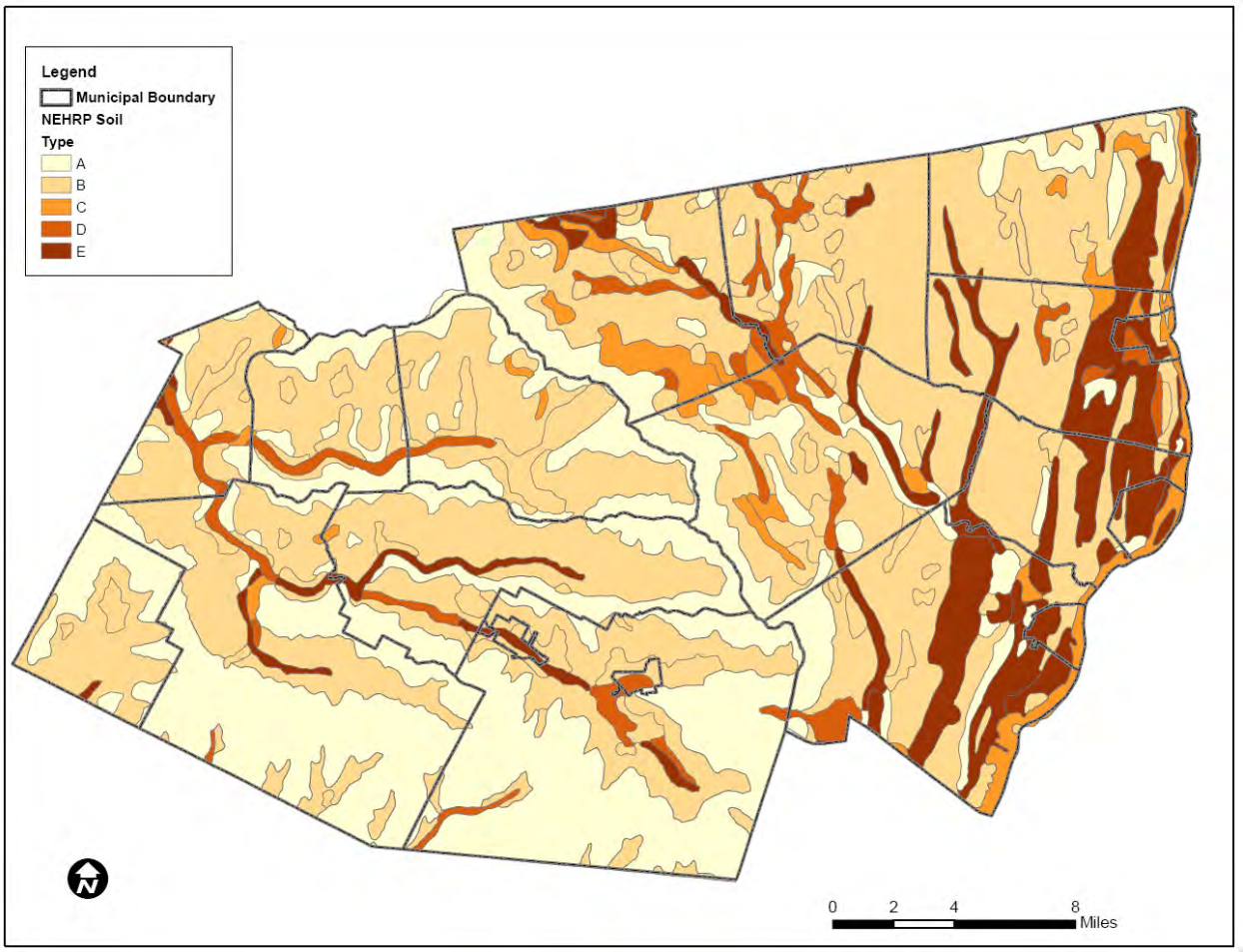
The New York State Geological Survey conducted seismic shear-wave tests of the State's surficial geology (glacial deposits). Based on these test results, the surficial geologic materials of New York State were categorized according to the National Earthquake Hazard Reduction Program's (NEHRP) Soil Site Classifications (Figure 5.4.5-4). The NEHRP developed five soil classifications that impact the severity of an earthquake. The soil classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses. Figure 5.4.5-5 illustrates the NEHRP soil classifications in Greene County, as provided by NYSEMO (O'Brien, 2008). Table 5.4.5-4 summarizes the NEHRP soil classifications shown on Figure 5.4.5-4.

Figure 5.4.5-4. NEHRP Soils in New York



Source: NYSDPC, 2008

Figure 5.4.5-5. NEHRP Soils in Greene County



Source: O'Brien, 2008

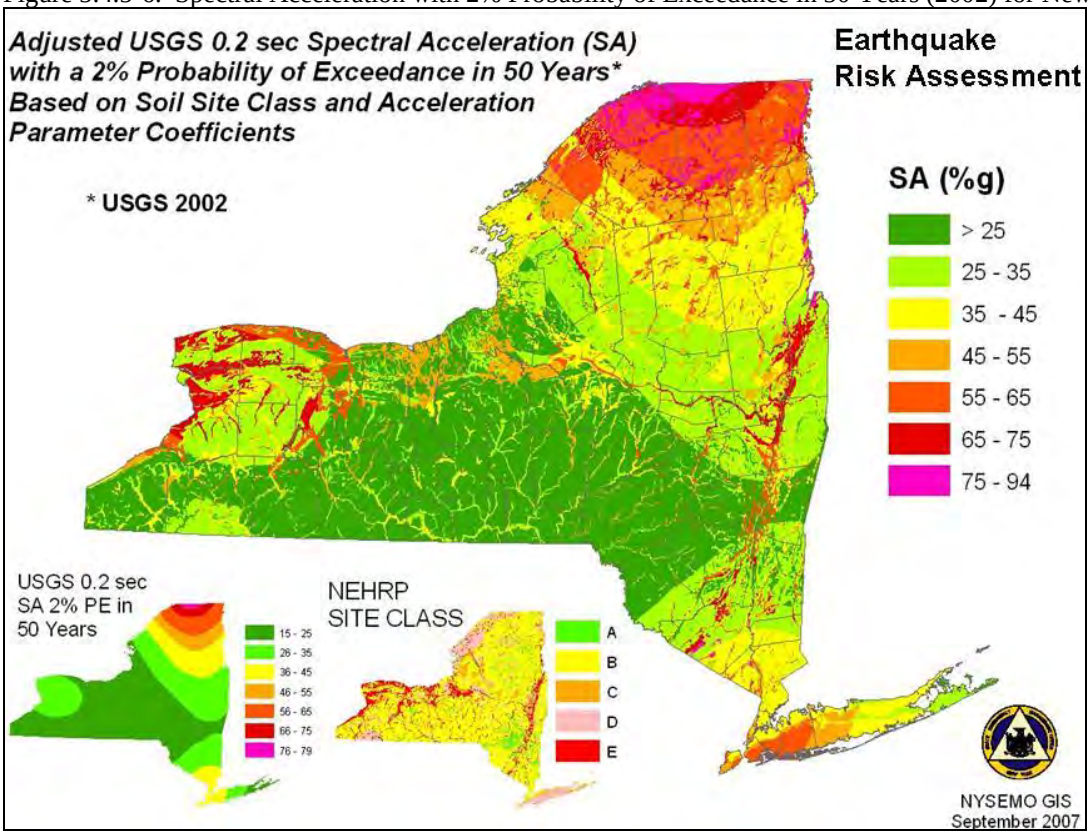
Table 5.4.5-4. NEHRP Soil Classifications

Soil Classification	Description	Map Color
A	Very hard rock (e.g., granite, gneisses)	Green
B	Sedimentary rock or firm ground	Yellow
C	Stiff clay	Orange
D	Soft to medium clays or sands	Red
E	Soft soil including fill, loose sand, waterfront, lake bed clays	Pink

Source: FEMA, 2007

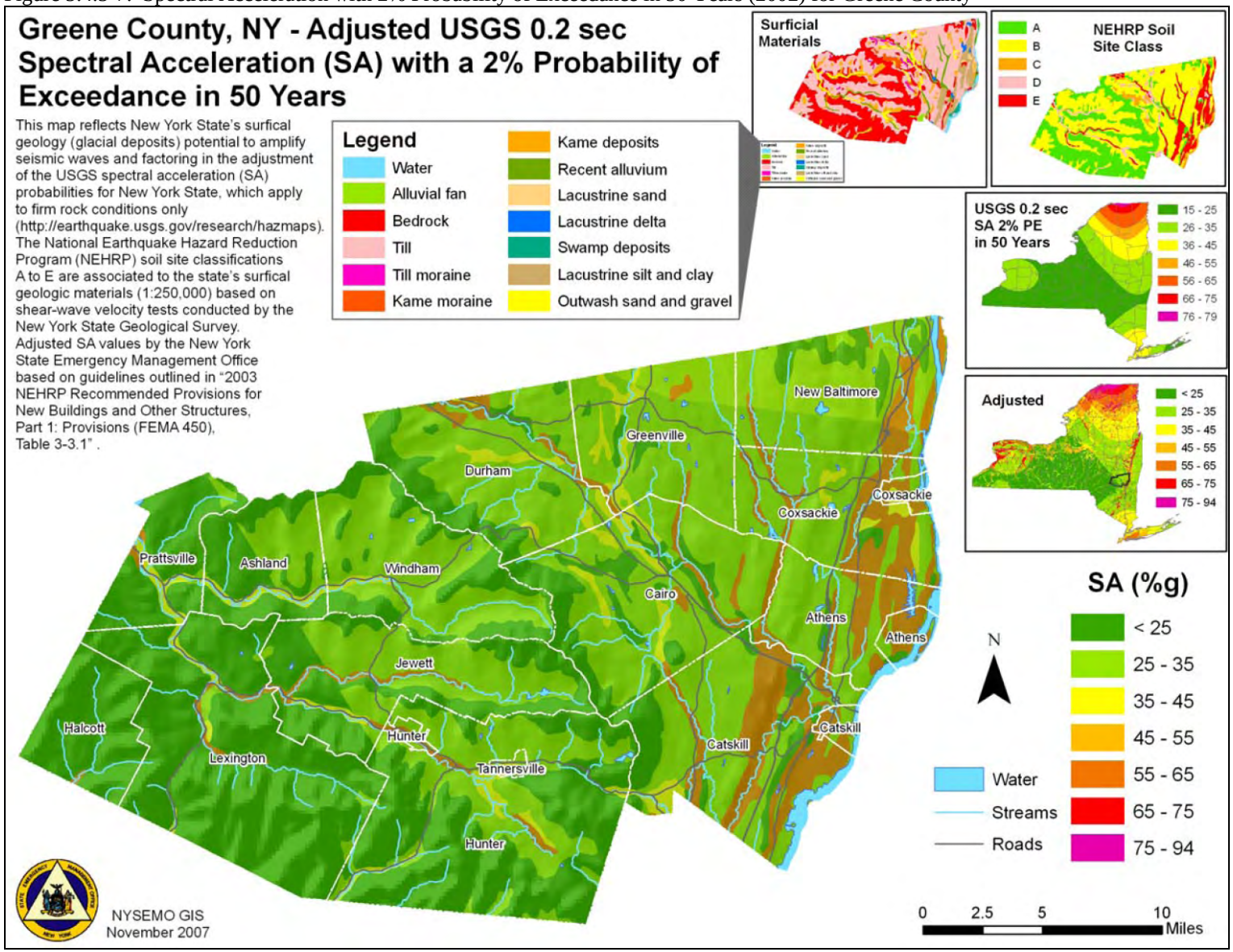
The NEHRP soil classification for the State has enabled the affect of soils to be factored with the 2002 USGS seismic hazard maps. Figure 5.4.5-6 now illustrates the State's earthquake SA hazard with local soil types factored in. This updated hazard map illustrates a significantly higher hazard for Greene County than that which is shown on the USGS national map (NYSDPC, 2008).

Figure 5.4.5-6. Spectral Acceleration with 2% Probability of Exceedance in 50 Years (2002) for New York State



Source: NYSDPC, 2008

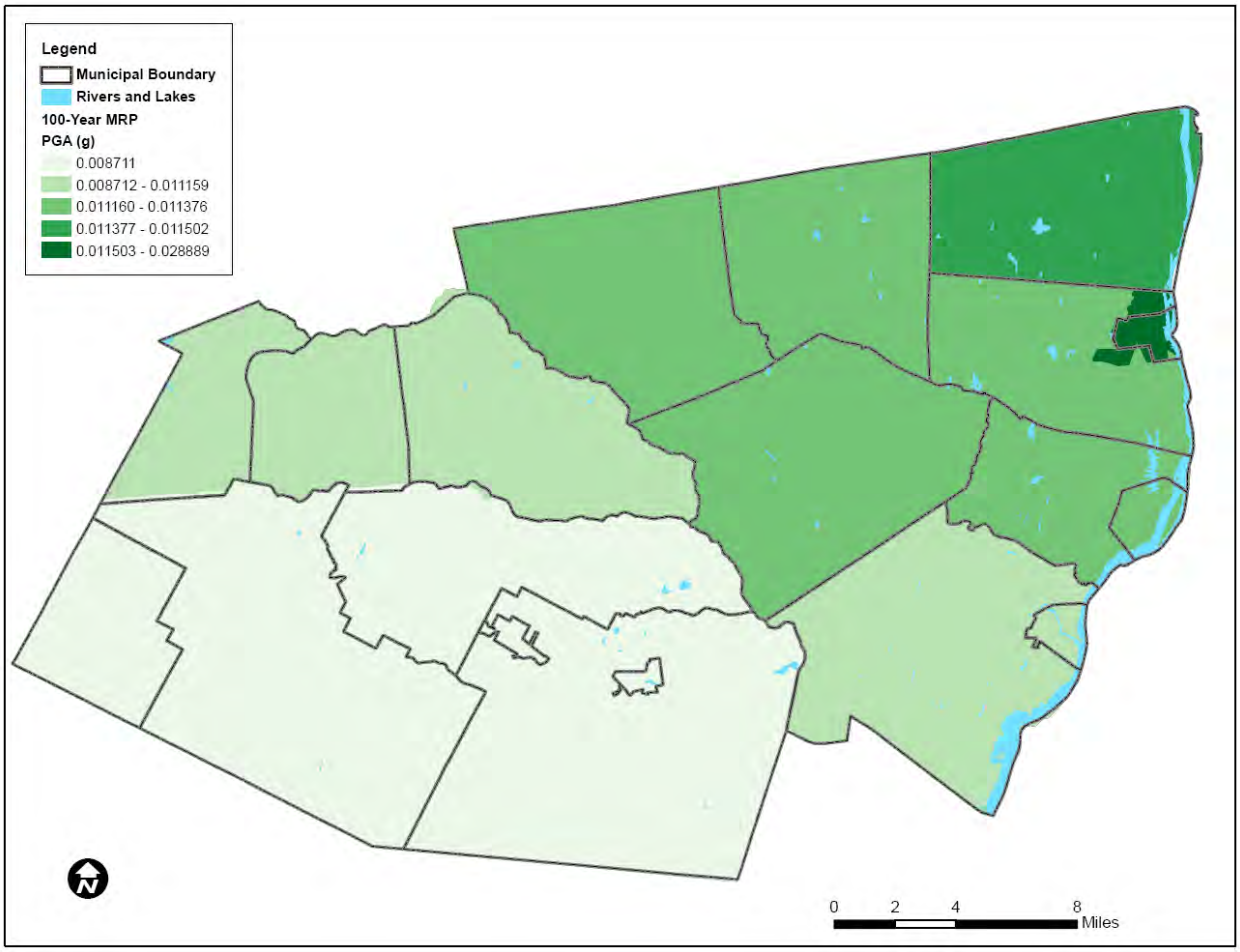
Figure 5.4.5-7. Spectral Acceleration with 2% Probability of Exceedance in 50 Years (2002) for Greene County



Source: NYSDPC, 2008

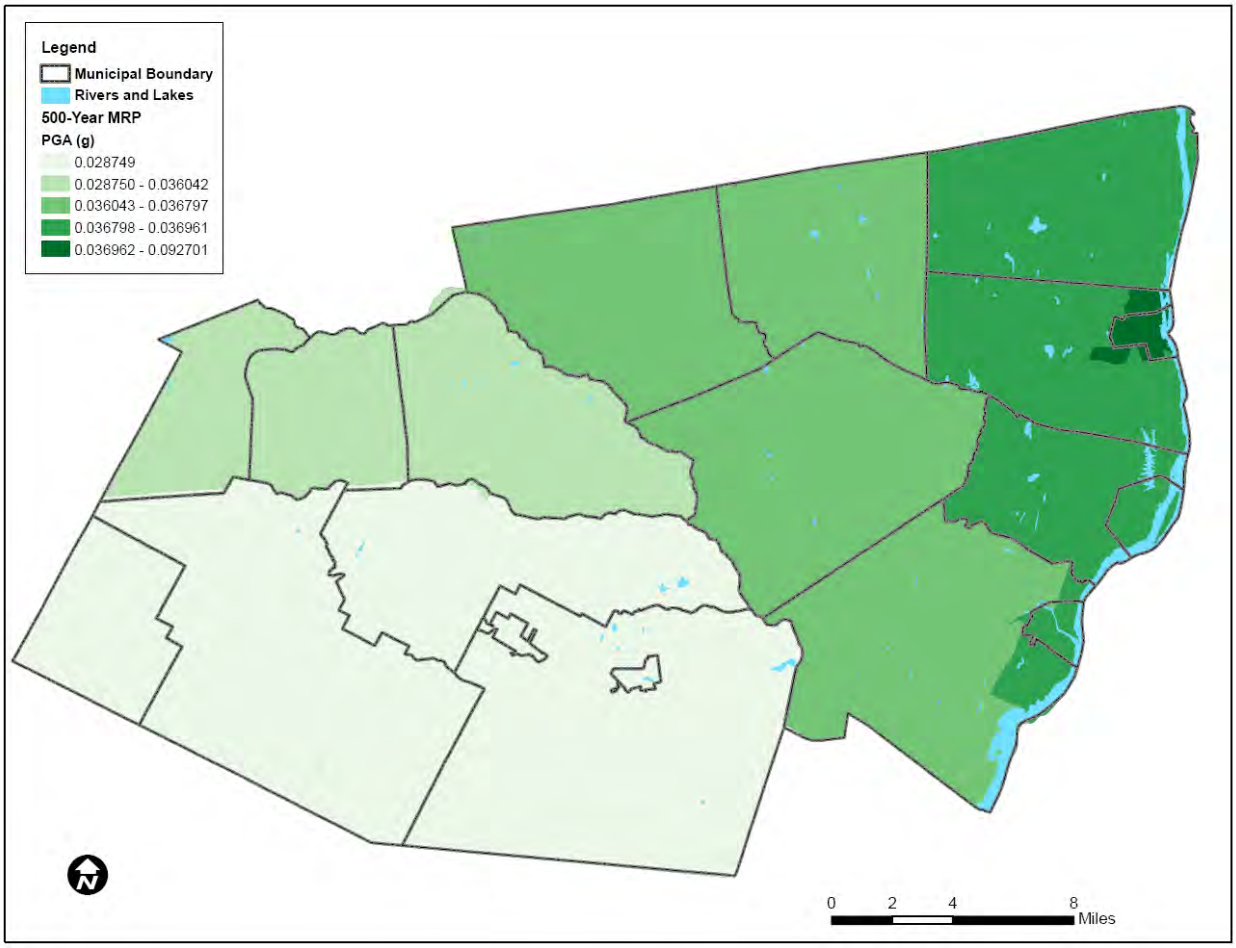
A probabilistic assessment was conducted for the 100-, 500- and 2,500-year mean return periods (MRP) through a Level 1 analysis in HAZUS-MH MR3 to analyze the earthquake hazard for the Greene County. The HAZUS-MH MR3 analysis evaluates the statistical likelihood that a specific event will occur and what consequences will occur. A 100-year MRP event is an earthquake with a 1% chance that the mapped ground motion levels (PGA) will be exceeded in any given year. For a 500-year MRP, there is a 0.2% chance the mapped PGA will be exceeded in any given year. For a 2,500-year MRP, there is a 0.04% chance the mapped PGA will be exceeded in any given year. Figures 5.4.5-8 through 5.4.5-10 illustrates the geographic distribution of PGA (*g*) across Greene County for 100-, 500- and 2,500-year MRP events at the Census-Tract level.

Figure 5.4.5-8. Peak Ground Acceleration in Greene County for a 100-Year MRP Earthquake Event by Census Tract



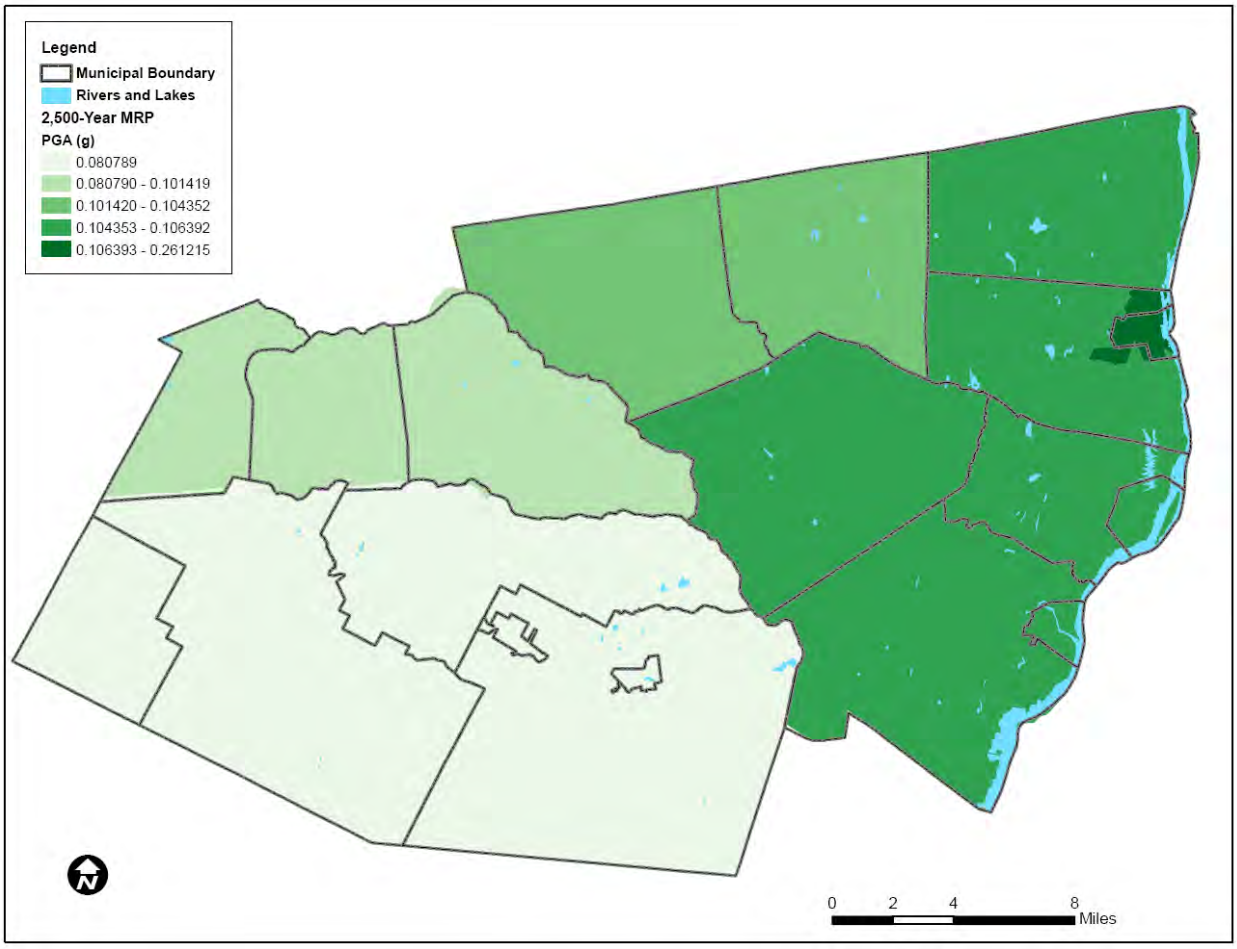
Source: HAZUS-MH MR3, 2007

Figure 5.4.5-9. Peak Ground Acceleration in Greene County for a 500-Year MRP Earthquake Event by Census Tract



Source: HAZUS-MH MR3, 2007

Figure 5.4.5-10. Peak Ground Acceleration in Greene County for a 2,500-Year MRP Earthquake Event by Census Tract



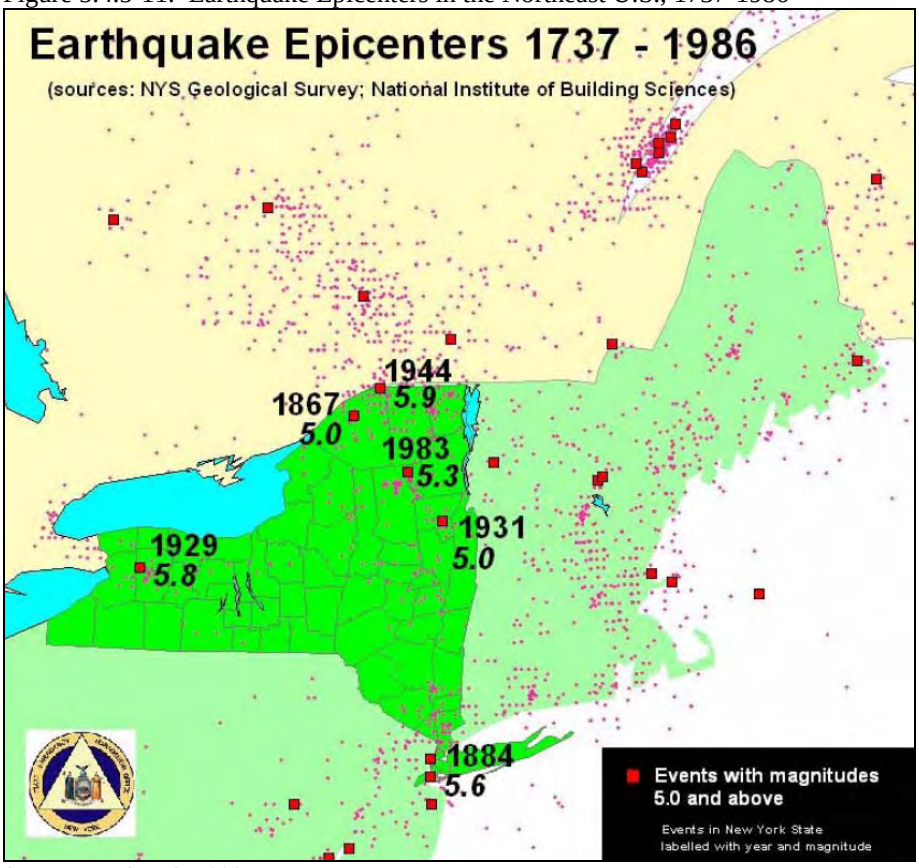
Source: HAZUS-MH MR3, 2007

Location

As noted in the NYS HMP, the importance of the earthquake hazard in New York State is often underestimated because other natural hazards (for example, hurricanes and floods) occur more frequently and because major floods and hurricanes have occurred more recently than a major earthquake event (NYSDPC, 2008). Typically areas east of the Rocky Mountains experience fewer and generally smaller earthquakes than the western U.S. However, the potential for earthquakes exists across all of New York State and the entire northeastern U.S.

The NYCEM ranks New York State as having the third highest earthquake activity level east of the Mississippi River (Tantala et al., 2003). Figure 5.4.5-11 illustrates historic earthquake epicenters across the northeast U.S. and New York State between 1737 and 1986. Looking at Figure 5.4.5-7, the concentration of earthquakes in New York State is located in three generally regions. These regions have a seismic risk that tends to be higher than other parts of the State. These regions are: the north and northeast third of the State, which includes the North County/Adirondack region and a portion of the greater Albany-Saratoga region; the southeast cornter, which includes the greater New York City area and western Long Island; and the northwest corner, which includes Buffalo and its surrounding area. Overall, these three regions are the most seismically active areas of the State, with the north-northeast portion having the higher seismic risk and the northwest corner of the State has the lower seismic risk (NYSDPC, 2008).

Figure 5.4.5-11. Earthquake Epicenters in the Northeast U.S., 1737-1986



Source: NYSDPC, 2008

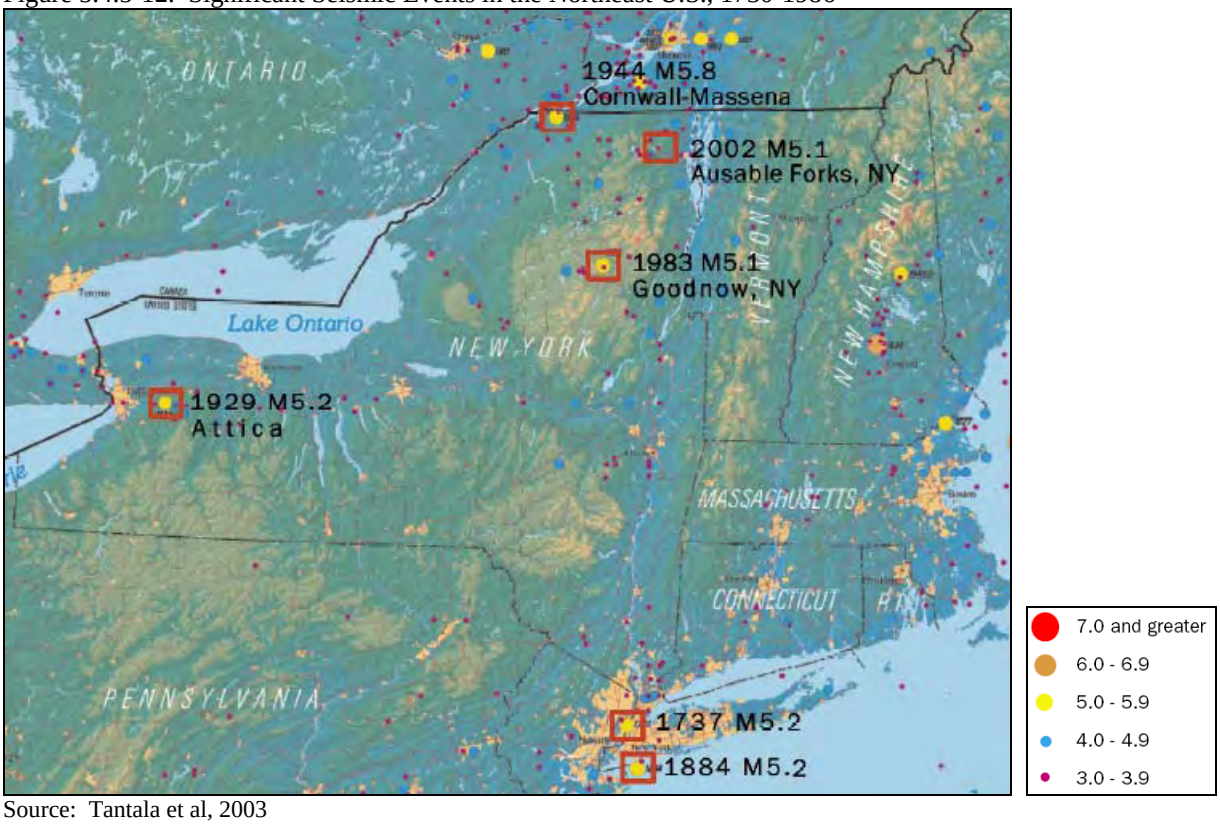
The closest plate boundary to the East Coast is the Mid-Atlantic Ridge, which is approximately 2,000 miles east of Pennsylvania. Over 200 million years ago, when the continent Pangaea rifted apart forming the Atlantic Ocean, the Northeast coast of America was a plate boundary. Being at the plate boundary,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

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with earthquakes throughout New York and Greene County. Therefore, with so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the sources.

Based on seismic records, thousands of earthquakes with magnitudes larger than 2.0, have occurred in New York State over the past few centuries. Between 1730 and 1986, more than 400 earthquakes with a magnitude of greater than 2.0 are on record in New York State, but many more have occurred unrecorded (Figure 5.4.5-12) (Tantala et al., 2003).

Figure 5.4.5-12. Significant Seismic Events in the Northeast U.S., 1730-1986



Source: Tantala et al, 2003

According to the Lamont-Doherty, the largest earthquakes to occur within the New York City or Metropolitan region are listed in Table 5.4.5-5 and identified on Figure 5.4.5-13. Although earthquake events may have not taken place directly within the County, those that occurred within surrounding counties and states may have indirectly impacted Greene County in the past.

Table 5.4.5-5. The Lamont-Doherty Earth Observatory of Columbia University - Largest Earthquakes in the New York City Area (1627 – 2001)

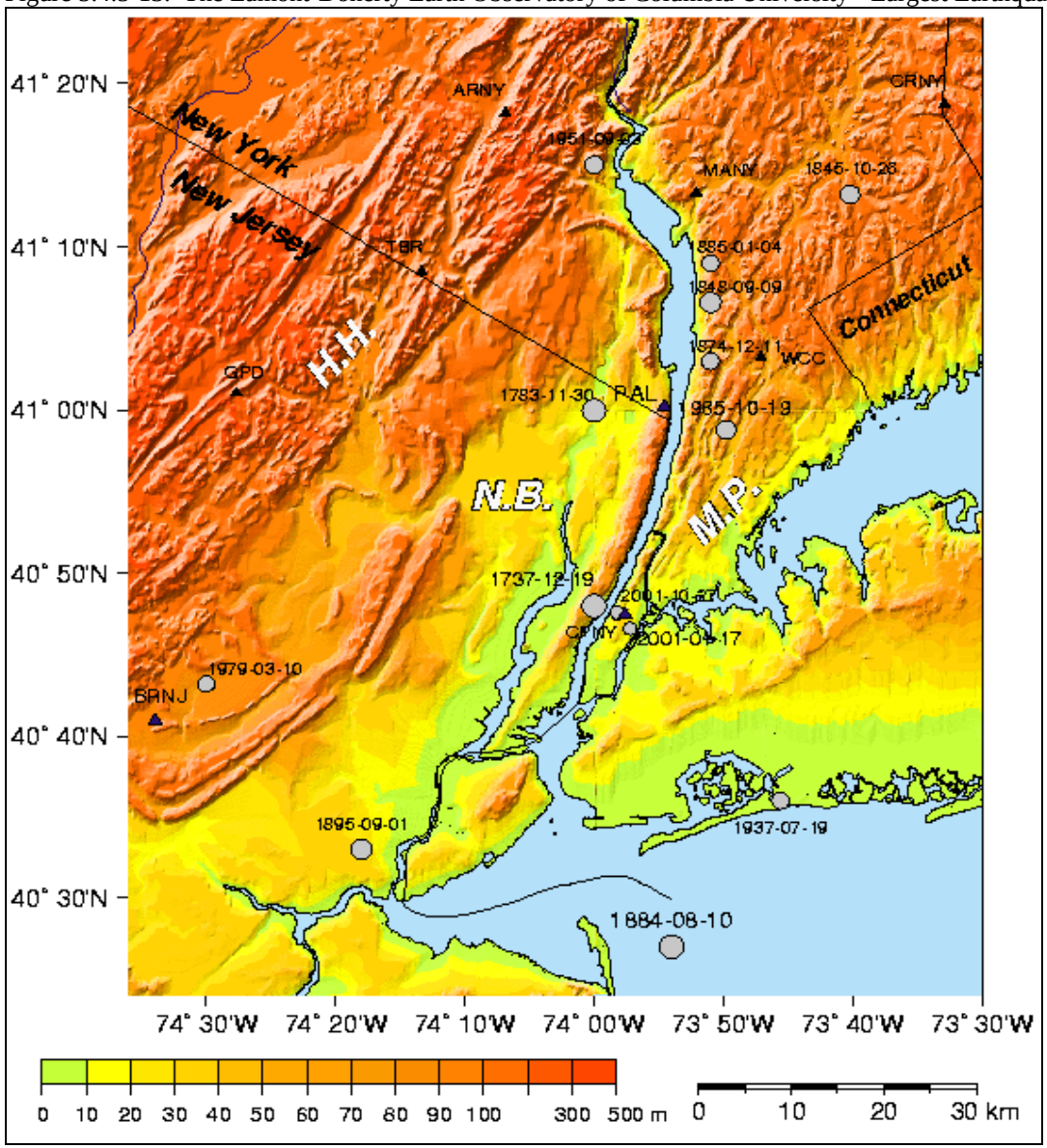
Date	Time (hh:mm:sec)	Latitude (°N)	Longitude (°W)	Location	Magnitude Richter	Max. Intensity (MMI)	Remark
December 19, 1737	3:45	40.8	74	Greater NYC area*	5.2	VII	Threw down chimneys
November 30, 1783	3:50	41	74	N. Central NJ*	4.9	VI	Threw down chimneys
October 26, 1845	23:15	41.22	73.67	Greater NYC area*	3.8	VI	NA
September 9, 1848	NA	41.11	73.85	Greater NYC area*	4.4	V	Many people in the NYC area felt the earthquake
December 11, 1874	3:25	41.05	73.85	Near Nyack and Tarrytown, NY	3.4	VI	NA
August 10, 1884	19:07	40.45	73.9	Greater NYC area	5.2	VII	Threw down chimneys - felt from Virginia to Maine;
January 4, 1885	11:06	41.15	73.85	Hudson Valley	3.4	VI	NA
September 1, 1895	11:09	40.55	74.3	N. Central NJ	4.3	VI	Location determined by fire and aftershock
January 20, 1905	NA	NA	NA	Greater NYC area*	4.5	V	Probably Offshore
June 1, 1927	12:23	40.3	74	Near Asbury Park, N.J.	3.9	VI-VII	Very high intensity in Asbury Park, NJ - perhaps shallow event
July 19, 1937	3:51	40.6	73.76	Western Long Is., NY	3.5	IV	One or few earthquakes beneath Long Island
August 23, 1938	5:04:53	40.1	74.5	Central NJ	3.8	VI	NA
September 3, 1951	21:26:24	41.25	74	Rockland Co., NY	3.6	V	NA
March 23, 1957	19:02	40.6	74.8	Central NJ	3.5	VI	NA
March 10, 1979	4:49:39	40.72	74.5	Central NJ	3.2	V-VI	Felt by some people in Manhattan (Chesequake earthquake)
October 19, 1985	10:07	40.98	73.83	Ardsley, NY	4	IV	Many people in the NYC area felt this earthquake
January 17, 2001	12:34:22	40.78	73.95	Manhattan, NYC	2.4	IV	Felt in Upper East Side of Manhattan, Long Island City and Queens, NYC
October 17, 2001	1:42:21	40.79	73.97	Manhattan, NYC	2.6	IV	Felt in Upper West Side of Manhattan, Astoria and Queens, NYC

Source: Kim,W. Lamont-Doherty Earth Observatory of Columbia University, 1999

* Location very poorly determined; may be uncertain by 50 miles.

hh	Hours	NJ	New Jersey
mm	Minutes	NY	New York
MMI	Modified Mercalli Scale	NYC	New York City
NA	Not applicable	Sec	Seconds

Figure 5.4.5-13. The Lamont-Doherty Earth Observatory of Columbia University - Largest Earthquakes in the New York City Area (1627 – 2001)



Source: Kim, Lamont-Doherty Earth Observatory of Columbia University, 1999

According to the NYSDPC, approximately 36 significant earthquakes have affected New York State between 1737 and 2005. Additional sources have noted other earthquake events within New York State as well. Table 5.4.5-6 depicts these earthquakes events. None of these events were located within the immediate vicinity of Greene County.

Table 5.4.5-6. Earthquake History in New York State, 1737-2008

Event Date / Name	Location	Size / General Magnitude	Losses / Impacts	Source(s)
Earthquake December 18, 1737	New York City	5.0 est.	Bells rang, chimneys down. Felt in Boston and Philadelphia.	NYSDPC
Earthquake November 18, 1755 ("Cape Ann Earthquake")	Cape Ann, MA	6 (VIII max.)	Chimneys and brick buildings down in Boston. Produced a tsunami that grounded boats in the West Indies.	NYSDPC
Earthquake November 30, 1783	West of New York City	VII max.	Felt from New Hampshire to Pennsylvania	NYSDPC
Earthquake December 16, 1811 ("New Madrid Earthquake"	New Madrid, Missouri	8.0 – 8.8	Four great earthquakes. Changed courses of the Mississippi River. Town of New Madrid destroyed. Loss of life low due to sparse settlement. Damage in Chicago.	NYSDPC
Earthquake January 16, 1840	Herkimer, NY	3.7	No reference and/or no damage reported	NYSDPC
Earthquake September 2, 1847	Offshore of New York City	3.5	No reference and/or no damage reported	NYSDPC
Earthquake September 9, 1848	Rockland Lake, NY	V	Felt by many	NYSDPC
Earthquake March 12, 1853	Lowville, NY	4.8 est.	Machinery knocked over	NYSDPC
Earthquake February 7, 1855	Saugerties, NY	VI	Frost quake occurred; caused by a sudden cracking action in frozen soil or rock saturated with water or ice	NYSDPC. Lacroix
Earthquake October 23, 1857	Buffalo, NY	4.0	Bells rang and crocks fell from shelves	NYSDPC
Earthquake December 18, 1867	Canton, NY	4.8 est.	People awaken during the night	NYSDPC
Earthquake December 11, 1874	Tarrytown, NY	4.8 est.	No reference and/or no damage reported	NYSDPC
Earthquake November 4, 1877	Lyon Mountain, NY	VII	Chimneys down, walls cracked, windows damage, crocks overturned	NYSDPC
Earthquake August 10, 1884	Rockaway Beach, NY	5.3 est.	Toppled chimneys in New York City and New Jersey. Cracked masonary from Hartford, CT to West Chester, PA. Felt from Maine to Virginia and eastern Ohio.	NYSDPC
Earthquake September 1, 1886	Charleston, South Carolina	7.7	Sixty deaths; over 10,000 chimneys down.	NYSDPC

Event Date / Name	Location	Size / General Magnitude	Losses / Impacts	Source(s)
Earthquake May 28, 1897	Plattsburgh, NY	Not Stated	No reference and/or no damage reported	NYSDPC
Earthquake February 3, 1916	Schenectady, NY	3.8	Broke windows, people thrown out of bed	NYSDPC
Earthquake March 18, 1928	Saranac Lake, NY	4.5 est.	No reference and/or no damage reported	NYSDPC
Earthquake August 12, 1920	Attica, NY	5.2	250 chimneys fell, brick buildings damaged, Attica prison walls damaged, wells went dry	NYSDPC
Earthquake April 20, 1931	Warrensburg, NY	4.8	Chimneys fell, church spire twisted	NYSDPC
Earthquake April 15, 1934	Damnemora, NY	3.9	House shifted	NYSDPC
Earthquake July 9, 1937	Brooklyn, NY	3.5	No reference and/or no damage reported	NYSDPC
Earthquake September 5, 1944	Massena, NY	4.5 - 6.0	Chimneys destroyed, homes damaged, buildings damaged, $2 M in damages	NYSDPC
Earthquake September 3, 1951	Rockland County	3.6	No reference and/or no damage reported	NYSDPC
Earthquake January 1, 1966	Attica, NY	4.6	Chimneys and walls damaged	NYSDPC
Earthquake June 13, 1967	Attica, NY	4.4	Chimneys and walls damaged	NYSDPC
Earthquake May 23, 1971	Blue Mountain Lake, NY	3.5 - 4.1	No reference and/or no damage reported	NYSDPC
Earthquake June 7, 1974	Wappingers Falls, NY	3.0	Windows broken	NYSDPC
Earthquake June 9, 1975	Plattsburgh, NY	3.5	Chimneys and fireplaces cracked	NYSDPC
Earthquake November 3, 1975	Raquette Lake, NY	4.0	No reference and/or no damage reported	NYSDPC
Earthquake February 2, 1983	Scarsdale-Livingston, NY	3.0	Chimneys cracked	NYSDPC
Earthquake October 7, 1983	Newcomb, NY	5.1	Tombstones rotated, some cracked chimneys, windows broken, walls damaged	NYSDPC
Earthquake October 19, 1985	White Plains, NY	4.0	Windows broken, walls damaged	NYSDPC
Earthquake June 17, 1991	Summit, NY	4.1	No reference and/or no damage reported	NYSDPC
Earthquake March 10, 1992	East Hampton, NY	4.1	No reference and/or no damage reported	NYSDPC
Earthquake March 22, 1994	Cuylerville, NY	3.6	No reference and/or no damage reported	NYSDPC

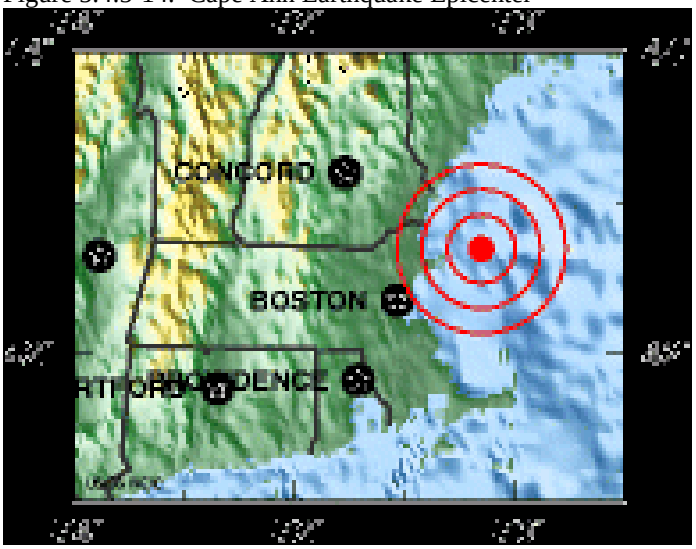
Event Date / Name	Location	Size / General Magnitude	Losses / Impacts	Source(s)
Earthquake April 20, 2000	Newcomb, NY	3.8	Aftershock of the 1983 event; no damage reported	NYSDPC
Earthquake April 20, 2002 (FEMA DR-1415)	Au Sable Forks, NY	5.1	Largest earthquake to hit New York State in 20 years. People felt the earthquake from Washington, D.C. to Bangor, Maine. A state of emergency was declared in Essex and Clinton Counties.	NYSDPC, USGS
Earthquake May 24, 2002	Au Sable Forks, NY	3.1	Aftershock of the 4/20/2002 event; no damage reported	NYSDPC, USGS
Earthquake February 27, 2008	Amsterdam, NY	2.7		USGS
Earthquake May 28, 2008	Saratoga Springs, NY	1.8		USGS

Source(s): NYSDPC, 2008; USGS, 2008

Earthquakes in Greene County are not common, with documented information on earthquake events and their location is being relatively scarce. According to County officials, there is no record of earthquake occurrences within the County. However, depending on the magnitude, the impacts of earthquake events can be far-reaching; therefore, reported incidences within the surrounding counties or states could have created indirect impacts upon the County. The following events described below may or may not have created indirect impacts upon Greene County.

November 18, 1755 ("Cape Ann Earthquake"): This earthquake, also known as the "Cape Ann Earthquake" impacted areas from Halifax, Nova Scotia, south to the Chesapeake Bay in Maryland and from Lake George, New York, east to a ship 320 kilometers east of Cape Ann. The largest impact was felt in Massachusetts, particularly in Cape Ann and Boston. In Boston, much of the damage was confined to areas near the wharfs. Many homes were damaged, with fallen chimneys and roof damage. Homes outside of the Boston area reported their stone fences were thrown down. Many temporary springs were formed that dried up. The ground was cracked in various locations throughout Massachusetts. Additionally, several aftershocks occurred throughout the area resulting in minimal damage (Stover and Coffman, 1993). Figure 5.4.5-14 illustrates the epicenter of the Cape Ann Earthquake. Details regarding the impact of the earthquake in Greene County were unavailable in the materials reviewed to develop this plan.

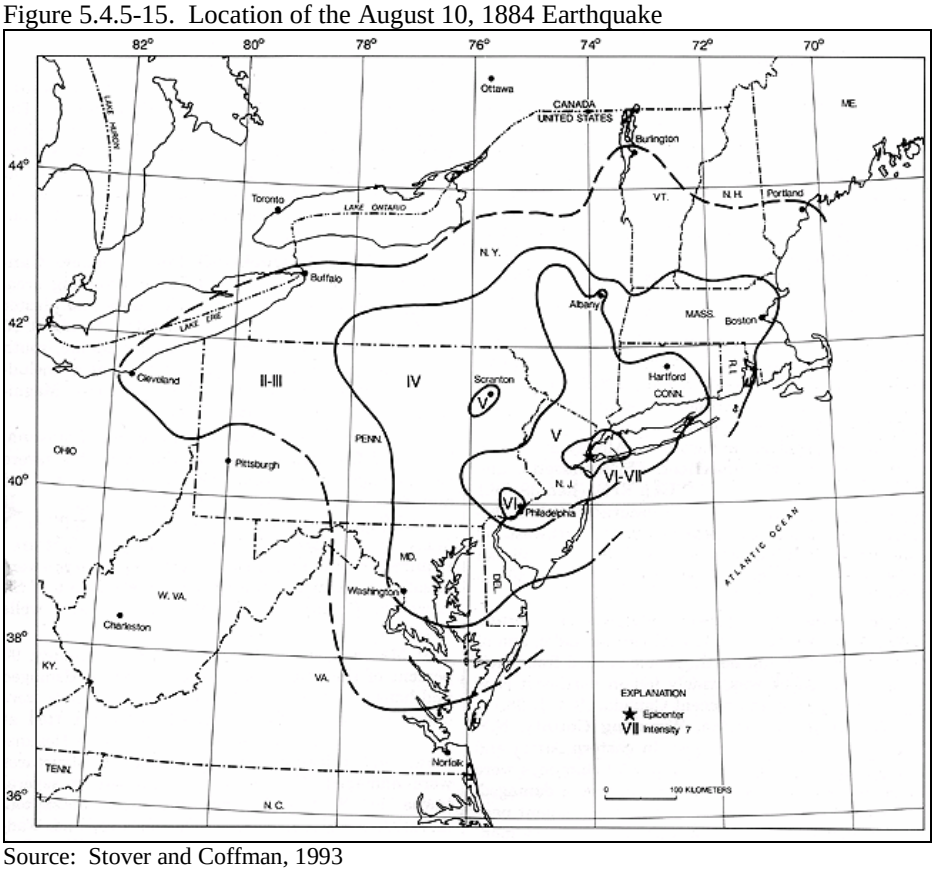
Figure 5.4.5-14. Cape Ann Earthquake Epicenter



Source: USGS, 2007

August 10, 1884: The August 10, 1884 earthquake was felt over 70,000 square miles, extending along the Atlantic Coast from southern Maine to central Virginia and westward to Cleveland, Ohio. It was a strong earthquake, with the epicenter located at a distance of approximately 17 miles from New York City (Figure 5.4.5-15) (NYCEM, 2003)

Figure 5.4.5-15. Location of the August 10, 1884 Earthquake



Source: Stover and Coffman, 1993
Note: In Greene County, the August 10, 1884 earthquake had an intensity of V.

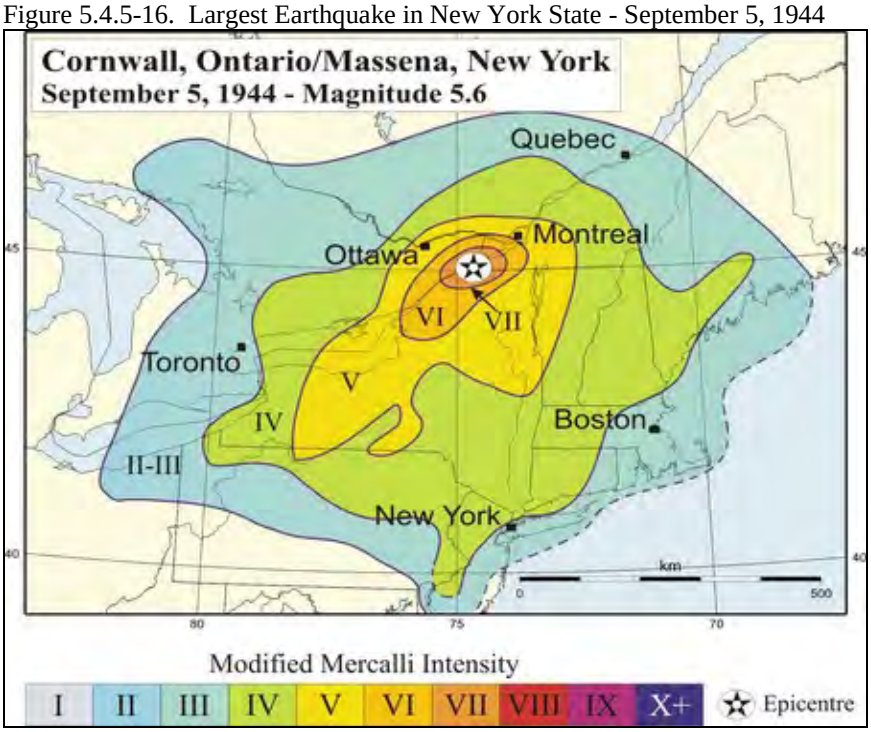
Property damage was severe at Amityville and Jamaica, New York, where several chimneys were overturned and large cracks formed in walls. Two chimneys were thrown down and bricks were shaken from other chimneys at Stratford (Fairfield County), Connecticut; water in the Housatonic River was agitated violently. Many other chimneys and walls were downed or damaged in Bloomfield, New Jersey; Mount Vernon, New York; and Allentown, Chester Easton, and Philadelphia Pennsylvania,

Three aftershocks occurred on August 10th, the second of which was most violent. Several slight aftershocks were also reported on August 11, 1884 (Stover and Coffman, 1993). According to NYCEM, this earthquake remains the best documented earthquake for the New York City region. Details regarding the impact of the earthquake in Greene County were unavailable in the materials reviewed to develop this plan.

September 5, 1944: An intensity VII earthquake was felt over 172,000 square miles in the U.S., including all of the New England states, Delaware, Maryland, New Jersey, New York, Pennsylvania, and parts of Michigan and Ohio. Parts of Illinois, Indiana, Virginia, West Virginia, and Wisconsin all reported feeling tremors (Stover and Coffman, 1993).

As identified in Figure 5.4.5-16, the epicenter was located between Massena, New York and Cornwall, Ontario, Canada. It caused an estimated $2 million in damaged between the two cities. With an intensity of VIII (Figure 5.4.5-16), the shock damaged (or destroyed) about 90-percent of the chimneys in Massena. The damage effects were similar in Cornwall as well (Lamantagne and Halchuck, 2001). Although Greene County was located within the earthquakes range; details regarding the impact of the earthquake in the County were unavailable in the materials reviewed to develop this plan.

Figure 5.4.5-16. Largest Earthquake in New York State - September 5, 1944



Source: Lamantagne and Halchuck, 2001
Note: The September 5, 1944 earthquake had an intensity of IV in Greene County.

April 20, 2002 (FEMA DR-1415): A moderate earthquake occurred about 15 miles southwest of Plattsburgh, New York. The earthquake was felt widely across the northeastern U.S., Mid-Atlantic States and southern Canada, including Montreal, Quebec (USGS, 2002). Boston, Massachusetts; Bangor, Maine; Washington, D.C.; Cleveland, Ohio; and Baltimore, Maryland were among the cities that experienced indirect impacts from this event (Cappiello and Tilghman, 2002).

In New York State, this was the largest earthquake in nearly 20 years with an intensity of 5.1 on the Richter scale and resulted in widespread impacts. Governor George Pataki declared a state of emergency in Clinton and Essex Counties, after feeling the earthquake in Albany (Cappiello and Tilghman, 2002). Overall damage within the State included tipped chimneys and cracked roads; however, no injuries were reported. Road damage and closures were reported at Keeseville and Au Sable Forks (Essex County). Chimney damage was reported in Lake Placid (Essex County). The Township of Jay (Essex County), there was bridge damage and a reported landslide. Slight damage was reported at Blue Mountain Lake, Indian Lake, Minerva, and North River. The earthquake was also felt in Adirondack, Childwold, Moriah Center, Newcomb, North Creek, Old Forge, Olmstedville, Piercefield, Severance, Wanakena, and many other locailities of upstate New York, most reporting at an intensity of V (USGS, 2002).

In Greene County, reports of having felt the earthquake were noted in Athens, Coxsackie, and Catskill (USGS, 2002). Details regarding the impact of the earthquake in Greene County were unavailable in the materials reviewed to develop this plan. Additionally, two aftershocks were felt the morning of the earthquake, which registered 2.2 on the Richter scale. Seven seismographs were set up around the epicenter of the earthquake to gauge activity and pick up data that could help seismologists gain a better understanding of earthquakes (Hughes, 2002).

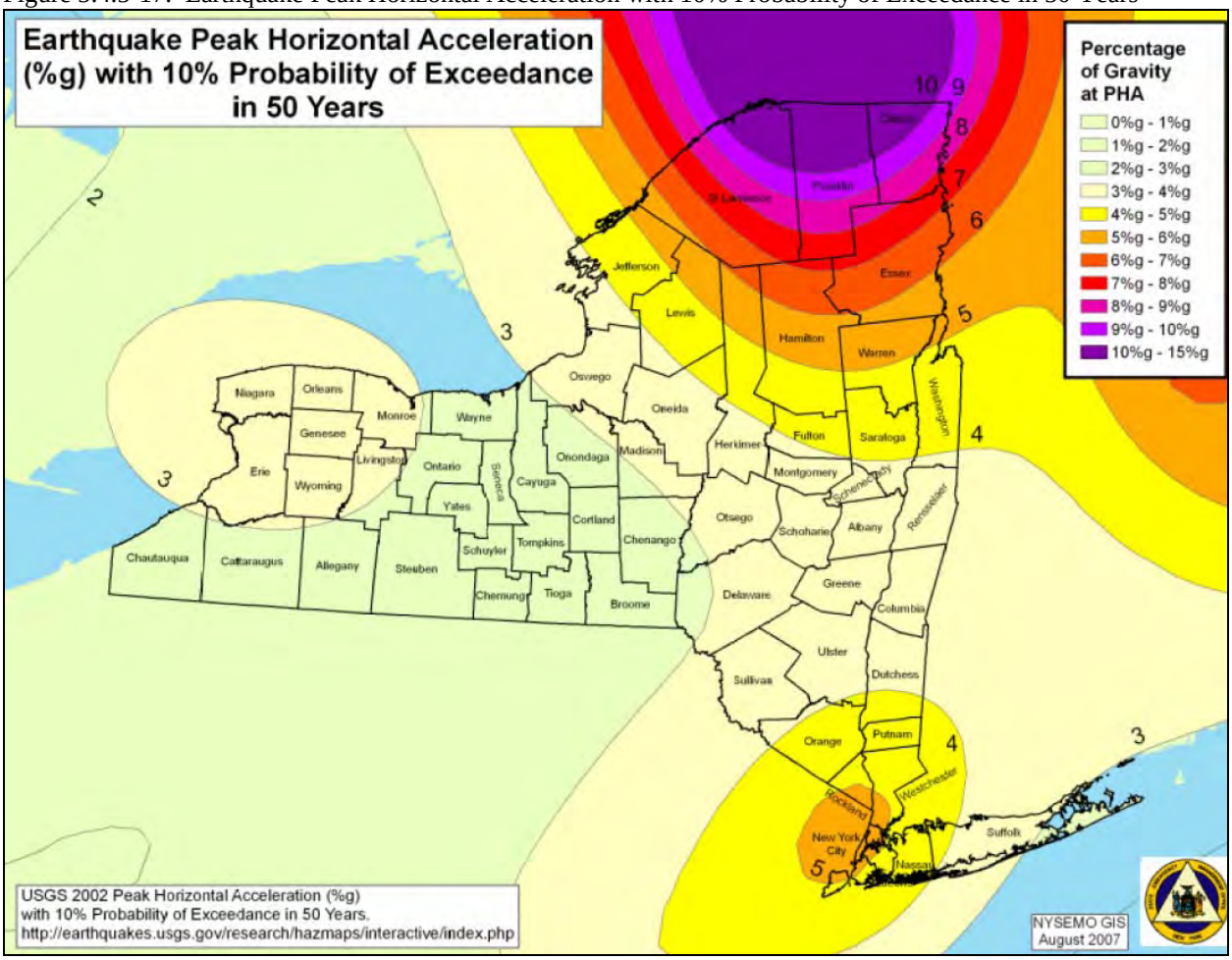
This earthquake resulted in a FEMA Disaster Declaration (FEMA DR-1415) on May 16, 2002. Through this declaration, the following Counties were declared eligible for federal and State disaster public

assistance funds: Clinton, Essex, Franklin, Hamilton, Warren and Washington. Greene County was not declared eligible for assistance from this FEMA disaster.

Probability of Future Events

Earthquake hazard maps illustrate the distribution of earthquake shaking levels that have a certain probability of occurring over a given time period. Figure 5.4.5-17 illustrates that Greene County has a PGA of 3-4%g for earthquakes with a 10-percent probability of occurring within 50 years. Moderate shaking and very light damage is generally associated with a 3-4%g earthquake.

Figure 5.4.5-17. Earthquake Peak Horizontal Acceleration with 10% Probability of Exceedance in 50 Years



Source: NYSDPC, 2008

The NYSDPC indicates that the earthquake hazard in New York State is often understated because other natural hazards occur more frequently (for example: hurricanes, tornadoes and flooding) and are much more visible. However, the potential for earthquakes does exists across the entire northeastern U.S. (NYSDPC, 2008), and New York State is no exception.

Earlier in this section, the identified hazards of concern for Greene County were ranked. NYSEMO conducts a similar ranking process for hazards that affect the State. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for earthquakes in Greene County is

considered 'rare' (not likely to occur within 100 years, as presented in Table 5.3-6). Although no reported incidences have occurred within the County, it is anticipated that Greene County and all of its jurisdictions, will continue to experience indirect impacts from earthquakes that may affect the general building stock, local economy and may induce secondary hazards such ignite fires and cause utility failure.

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the earthquake hazard, the entire County has been identified as the exposed hazard area. Therefore, all assets in Greene County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are vulnerable. The following section includes an evaluation and estimation of the potential impact of the earthquake hazard on Greene County including the following:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, safety and health of County residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time
- Overall vulnerability conclusion

Overview of Vulnerability

Earthquakes usually occur without warning and can impact areas a great distance from their point of origin. The extent of damage depends on the density of population and building and infrastructure construction in the area shaken by the quake. Some areas may be more vulnerable than others based on soil type, the age of the buildings and building codes in place. Compounding the potential for damage – historically, Building Officials Code Administration (BOCA) used in the Northeast were developed to address local concerns including heavy snow loads and wind; seismic requirements for design criteria are not as stringent compared to the west coast's reliance on the more seismically-focused Uniform Building Code). As such, a smaller earthquake in the Northeast can cause more structural damage than if it occurred out west.

The entire population and general building stock inventory of the County is at risk of being damaged or experiencing losses due to impacts of an earthquake. Potential losses associated with the earth shaking were calculated for Greene County for three probabilistic earthquake events, the 100-year, 500- and 2,500-year mean return periods (MRP). The impacts on population, existing structures, critical facilities and the economy are presented below, following a summary of the data and methodology used.

Data and Methodology

After reviewing the historic data, a probabilistic assessment was conducted for the 100-, 500- and 2,500-year mean return periods (MRP) through a Level 1 analysis in HAZUS-MH MR3 to analyze the earthquake hazard and provide a range of loss estimates for Greene County. The probabilistic method uses information from historic earthquakes and inferred faults, locations and magnitudes, and computes the probable ground shaking levels that may be experienced during a recurrence period by Census tract. According to NYCEM, probabilistic estimates are best for urban planning, land use, zoning and seismic building code regulations (NYCEM, 2003). The default assumption is a magnitude 7 earthquake for all return periods.

As discussed in Section 5.4.2, a Level 1 analysis is a basic estimate of earthquake losses based on national databases and using the default data in the model. Default demographic and general building stock data in HAZUS-MH MR3 was used for the earthquake analysis. However, critical facilities (essential facilities, transportation features, utilities and user-defined facilities) were updated and used in place of the HAZUS-MH MR3 defaults. Additionally, a local soil map provided by NYSEMO with Greene

County's NEHRP soil classes was entered into HAZUS-MH MR3 to replace default soil conditions (Figure 5.4.5-6). Please note, according to the HAZUS-MH MR3 technical manual, there is considerable uncertainty related to the characteristics of ground motion in the eastern U.S. Therefore, loss estimates may be overestimated.

The occupancy classes available in HAZUS-MH MR3 were condensed into the following categories (residential, commercial, industrial, agricultural, religious, government, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single family dwellings. Impacts to critical facilities were also evaluated.

Data used to assess this hazard include data available in the HAZUS-MH MR3 earthquake model, USGS data, data provided by NYSEMO, professional knowledge, and information provided by the County's Planning Committee. The results of this assessment are discussed below.

Impact on Life, Health and Safety

Overall, the entire population of 48,195 in Greene County, based on the 2000 U.S. Census, is exposed to the earthquake hazard event. The impact of earthquakes on life, health and safety is dependent upon the severity of the event. Risk to public safety and loss of life from an earthquake in Greene County is minimal with higher risk occurring in buildings as a result of damage to the structure, or people walking below building ornamentation and chimneys that may be shaken loose and fall as a result of the quake.

Populations considered most vulnerable include the elderly (persons over the age of 65) and individuals living below the Census poverty threshold. These socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 5.4.5-7 summarizes the County population over the age of 65 and individuals living below the Census poverty threshold.

Table 5.4.5-7. Vulnerable Population to Earthquake Events in Greene County

Population Category	Number of Persons Exposed	Percent of Total County Population (1)
Elderly (Over 65 years of age)	7,544	15.7
Persons living below Census poverty threshold*	5,432	12.2
Elderly (Over 65 years of age) living below Census poverty threshold	751	1.6

Source: U.S. Census 2000
Notes: * Individuals below poverty level (Census poverty threshold for a 3-person family unit is approximately $15,000)

Residents may be displaced or require temporary to long-term sheltering due to the event. For the 100-year MRP, HAZUS-MH estimates that zero households will be displaced and zero people will seek temporary shelter. For the 500-year MRP, HAZUS-MH estimates 5 households will be displaced and of these, 1 person will seek temporary shelter. For the 2,500-year MRP, HAZUS-MH estimates 76 households will be displaced due to the earthquake event and of these, 19 people will seek temporary shelter in public shelters. The number of people requiring shelter is generally less than the number displaced as some displaced persons use hotels or stay with family or friends following a disaster event.

Table 5.4.5-8 summarizes the population HAZUS-MH MR3 estimates will be displaced or will require short-term sheltering as a result of 500- and 2,500-year MRP earthquake events by jurisdiction. In HAZUS-MH MR3, estimated sheltering needs are summarized at the Census-Tract level; therefore, a total is reported for multiple jurisdictions.

Table 5.4.5-8. Estimated Sheltering Needs for the 500- and 2,500-year MRP Earthquake Events for Greene County

Jurisdiction	500-Year MRP		2,500-Year MRP	
	Displaced House-holds	People Requiring Short-Term Shelter	Displaced House-holds	People Requiring Short-Term Shelter
Ashland (T), Prattsville (T) and Windham (T)	0	0	2	0
Athens (T) and Athens (V)	0	0	3	1
Cairo (T)	0	0	5	1
Catskill (T)	0	0	4	1
Catskill (V)	1	0	8	2
Coxsackie (T)	0	0	1	0
Coxsackie (V)	4	1	48	13
Durham (T) and Greenville (T)	0	0	3	1
Halcott (T), Lexington (T), Jewett (T), Hunter (T), Hunter (V), Tannersville (V)	0	0	2	0
New Baltimore (T)	0	0	1	0
Greene County (Total)	**5**	**1**	**76**	**19**

Source: HAZUS-MH MR3
Notes: Calculated on a Census-Tract level
RV = Replacement Value. T = Town. V = Village

HAZUS-MH estimates the number of people that may potentially be injured and/or killed by an earthquake depending upon the time of day the event occurs. These estimates are provided for three times of day (2:00am, 2:00pm and 5:00pm), representing the periods of the day that different sectors of the community are at their peak. The 2:00am estimate considers the residential occupancy at its maximum, the 2:00pm estimate considers the educational, commercial and industrial sector at their maximum and the 5:00pm estimate represents peak commuter time.

No injuries or casualties are estimated for the 100-year event. For the 500-year event, no injuries or casualties are estimated for 2:00pm and 5:00pm. At 2:00am, there are 3 injuries estimated that will require medical attention but not hospitalization, there are no injuries that will require hospitalization and no casualties estimated.

Table 5.4.5-9 summarizes the injuries and casualties estimated for the 2,500-year MRP earthquake event.

Table 5.4.5-9. Estimated Number of Injuries and Casualties from the 2,500-Year MRP Earthquake Event

Level of Severity	Time of Day		
	2:00 AM	2:00 PM	5:00 PM
Injuries	33	22	20
Hospitalization	8	5	5
Casualties	2	1	1

Source: HAZUS-MH MR3, 2007

Earthquakes can cause secondary hazard events such as fires. No fires are anticipated as a result of a 100- or 500-year MRP event. For the 2,500-year MRP event, the HAZUS-MH model estimates that there will be one ignition but will not displace any people.

Impact on General Building Stock

After considering the population exposed to the earthquake hazard, the value of general building stock exposed to and damaged by 100-, 500- and 2,500-year MRP earthquake events was evaluated. The entire study area's general building stock is considered at risk and exposed to this hazard. The HAZUS-MH MR3 model estimates the value of the exposed building stock and the loss (in terms of damage to the exposed stock). Refer to Table 4-3 in the County Profile (Section 4) for general building stock data replacement value statistics (structure and contents) for each jurisdiction.

According to the New York City Area Consortium for Earthquake Loss Mitigation (NYCEM), where earthquake risks and mitigation were evaluated in the New York, New Jersey and Connecticut region, most damage and loss caused by an earthquake is directly or indirectly the result of ground shaking (NYCEM, 2003). NYCEM indicates there is a strong correlation between PGA and the damage a building might experience. The HAZUS-MH M3 model is based on the best available earthquake science and aligns with these statements. HAZUS-MH MR3 methodology and model were used to analyze the earthquake hazard for the general building stock for Greene County. See Figures 5.4.5-2 through 5.4.5-4 earlier in this profile that illustrates the geographic distribution of PGA (g) across Greene County for 100-, 500- and 2,500-year MRP events at the Census-Tract level.

According to NYCEM, a building's construction determines how well it can withstand the force of an earthquake. The NYCEM report indicates that un-reinforced masonry buildings are most at risk during an earthquake because the walls are prone to collapse outward, whereas steel and wood buildings absorb more of the earthquake's energy. Additional attributes that contribute to a building's capability to withstand an earthquake's force include its age, number of stories and quality of construction. HAZUS-MH considers building contruction and the age of buildings as part of the analysis. Because the default general building stock was used for this Level 1 HAZUS-MH analysis, the default building ages and building types already incorporated into the inventory were used.

Potential building damage was evaluated by HAZUS-MH MR3 across the following damage categories (none, slight, moderate, extensive and complete). Table 5.4.5-10 provides definitions of these five categories of damage for a light wood-framed building; definitions for other building types are included in HAZUS-MH technical manual documentation. General building stock damage for these damage categories by occupancy class and building type on a County-wide basis is summarized for the 100-, 500- and 2,500-year events in Tables 5.4.5-11 and 5.4.5-12.

Table 5.4.5-10. Example of Structural Damage State Definitions for a Light Wood-Framed Building

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

Source: HAZUS-MH MR3 Technical Manual

HAZUS-MH MR3 estimates minimal damage to Greene County's general building stock as a result of a 100-year MRP event. Table 5.4.5-13 summarizes the damage estimated for the 500- and 2,500-year MRP earthquake events by Census Tract. Damage loss estimates include structural and non-structural damage to the building and loss of contents.

Table 5.4.5-11. Estimated Number of Buildings Damaged by General Occupancy for 100-year, 500-year and 2,500-year MRP Earthquake Events

Category	Average Damage State														
	100-Year MRP					500-Year MRP					2,500-Year MRP				
	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete
Residential (Single and Multi-Family Dwellings)	27,495	13	3	0	0	26,751	577	167	15	1	23,462	2,789	1,069	165	25
Commercial	1,036	1	0	0	0	993	32	12	2	0	838	113	67	17	3
Industrial	319	0	0	0	0	307	9	3	0	0	261	32	20	5	1
Education, Government, Religious and Agricultural	291	0	0	0	0	278	8	3	0	0	237	31	16	4	0
TOTAL	**29,141**	**14**	**3**	**0**	**0**	**28,329**	**626**	**185**	**17**	**1**	**24,798**	**2,965**	**1,172**	**191**	**29**

Source: HAZUS-MH MR3, 2007

Table 5.4.5-12. Estimated Number of Buildings Damaged by Building Type for 100-year, 500-year and 2,500-year MRP Earthquake Events

Category	Average Damage State														
	100-Year MRP					500-Year MRP					2,500-Year MRP				
	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete
Wood	19,589	4	0	0	0	19,371	200	21	1	0	17,646	1,607	313	27	1
Steel	909	1	0	0	0	880	21	8	1	0	762	82	52	12	2
Concrete	565	0	0	0	0	544	16	5	0	0	452	63	40	9	1
Reinforced Masonry	579	0	0	0	0	560	12	6	1	0	481	46	39	12	1
Un-reinforced Masonry	4,093	7	2	0	0	3,809	198	81	13	2	2,986	610	377	106	23
Mobile Homes	3,407	2	0	0	0	3,166	180	62	2	0	2,471	557	351	27	2
TOTAL	**29,141**	**14**	**2**	**0**	**0**	**28,330**	**627**	**183**	**18**	**2**	**24,798**	**2,965**	**1,172**	**193**	**30**

Source: HAZUS-MH MR3, 2007

Table 5.4.5-13. Estimated Building Value (Building and Contents) Damaged by Jurisdiction for the 500- and 2,500-Year MRP Earthquake Events

Jurisdiction	Estimated Total Damages*		Percent of Total Building and Contents RV		Estimated Residential Damage		Estimated Commercial Damage	
	500-Year	2,500-Year	500-Year	2,500-Year	500-Year	2,500-Year	500-Year	2,500-Year
Ashland (T), Prattsville (T) and Windham (T)	$293,667	$3,550,865	0.04	0.5	$234,335	$2,818,137	$41,559	$508,268
Athens (T) and Athens (V)	$245,596	$2,892,642	0.05	0.6	$184,765	$2,157,074	$32,779	$382,189
Cairo (T)	$339,455	$3,979,208	0.05	0.6	$275,261	$3,209,374	$39,175	$458,009
Catskill (T)	$467,127	$5,560,324	0.05	0.5	$338,633	$3,948,750	$95,312	$1,154,925
Catskill (V)	$320,343	$3,927,518	0.05	0.7	$198,132	$2,434,948	$87,911	$1,060,498
Coxsackie (T)	$496,461	$4,834,752	0.12	1.2	$459,827	$4,392,031	$26,750	$311,485
Coxsackie (V)	$2,369,747	$20,901,871	0.59	5.2	$1,277,450	$11,332,735	$494,340	$4,276,207
Durham (T) and Greenville (T)	$383,534	$4,381,404	0.05	0.6	$285,942	$3,221,696	$61,073	$700,343
Halcott (T), Lexington (T), Jewett (T), Hunter (T), Hunter (V), Tannersville (V)	$254,731	$3,472,641	0.02	0.3	$213,847	$2,887,368	$24,764	$347,108
New Baltimore (T)	$184,445	$2,093,222	0.05	0.6	$142,249	$1,584,777	$22,408	$259,390
Greene County (Total)	**$5,355,106**	**$55,594,445**	**0.08**	**0.9**	**$3,610,440**	**$37,986,890**	**$926,070**	**$9,458,421**

Source: HAZUS-MH MR3, 2007
Notes: RV = Replacement Value. T = Town. V = Village.
* Total is sum of damages for all occupancy classes (residential, commercial, industrial, agricultural, educational, religious and government).
The Sleepy Hollow Lake community is located within the Town of Coxsackie, Town of Athens and Village of Athens. The Town of Coxsackie, Town of Athens and Village of Athens estimated damages include the community of Sleepy Hollow Lake.

It is estimated that there would be nearly $5.5 million in building damages during a 500-year earthquake event. This includes structural damage, non-structural damage and loss of contents, representing less than one-percent of the total replacement value for general building stock in Greene County. For a 2,500-year MRP earthquake event, the estimated total building damage is greater than $55.6 million or approximately one-percent of the total general building stock replacement value. Residential buildings account for most of the damage for earthquake events. This is likely because they comprise the majority of the building inventory.

Impact on Critical Facilities

After considering the general building stock exposed to, and damaged by, 100-, 500- and 2,500-year MRP earthquake events, critical facilities were evaluated. All critical facilities (essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities and user-defined facilities) in Greene County are considered exposed and vulnerable to the earthquake hazard. Refer to subsection "Critical Facilities" in Section 4 (County Profile) of this Plan for a complete inventory of critical facilities in the County.

HAZUS-MH MR3 estimates the probability that critical facilities may sustain damage as a result of 100-, 500- and 2,500-year MRP earthquake events. Additionally, HAZUS-MH estimates percent functionality for each facility days after the event. For the 100-Year MRP event, HAZUS-MH MR3 estimates it is greater than 97% probable that emergency facilities (police, fire, EMS and medical facilities), schools and specific facilities identified by Greene County as critical (i.e., user-defined facilities such as senior centers, shelters, municipal buildings and Departments of Public Works) will not experience any structural damage. These facilities are estimated to be nearly 100% functional on day one of the 100-year MRP earthquake event. Therefore, the impact to critical facilities is not significant for the 100-year event.

Tables 5.4.5-14 and 5.4.5-15 list the probability of critical facilities sustaining the damage category as defined by the column heading and percent functionality after the event for the 500-year and 2,500-year MRP earthquake events.

Table 5.4.5-14. Estimated Damage and Loss of Functionality for Critical Facilities in Greene County for the 500-Year MRP Earthquake Event

500-Year MRP Event									
			Percent Probability of Sustaining Damage					Percent Functionality	
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Ashland Fire Dept	Ashland (T)	Fire/EMS	91.7	5.8	2.1	0.3	0	91.7	97.3
Post Office	Ashland (T)	User Defined	91.7	5.8	2.1	0.3	0	91.7	97.5
Town Highway Garage	Ashland (T)	User Defined	96.8	2.4	0.7	0.1	0	96.8	99.1
Greene County Highway Garage	Ashland (T)	User Defined	91.7	5.8	2.1	0.3	0	91.7	97.5
West-Athens Limestreet Fire Co.	Athens (T)	Fire/EMS	96.6	2.5	0.8	0.1	0	96.5	99
West-Athens Limestreet Station #2	Athens (T)	Fire/EMS	96.6	2.5	0.8	0.1	0	96.5	99
Village of Athens Police Department	Athens (V)	Police	81.7	11.7	5.5	1	0	81.7	93.1
Athens Fire Dept	Athens (V)	Fire/EMS	81.7	11.7	5.5	1	0	81.7	93.1
Edward J. Arthur Elementary School	Athens (V)	School	81.7	11.7	5.5	1	0	81.7	93.1
Senior Living Facility	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Rivertown Apartments	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Home for Developmentally Disabled Adults	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Athens Fire Department	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Athens Community Center	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Town of Cairo Police Department	Cairo (T)	Police	96.6	2.5	0.8	0.1	0	96.6	99
NYS Police Troop F Zone 3 Catskill Barra	Cairo (T)	Police	96.6	2.5	0.8	0.1	0	96.6	99
Cairo Hose Company	Cairo (T)	Fire/EMS	82	11.6	5.4	1	0	81.9	93.2
Round Top Volunteer Fire Co.	Cairo (T)	Fire/EMS	98	1.5	0.4	0.1	0	97.9	99.4
County Emergency Services	Cairo (T)	Fire/EMS	96.6	2.5	0.8	0.1	0	96.6	99
Cairo-Durham High School	Cairo (T)	School	95.1	3.6	1.2	0.1	0	95	98.5
Cairo Elementary School	Cairo (T)	School	82	11.6	5.4	1	0	81.9	93.2
Cairo-Durham Middle School	Cairo (T)	School	95.1	3.6	1.2	0.1	0	95	98.5
Cairo Senior Housing	Cairo (T)	User Defined	98	1.5	0.4	0.1	0	97.9	99.5
County Annex	Cairo (T)	User Defined	96.6	2.5	0.8	0.1	0	96.6	99.1
Cairo Town Hall	Cairo (T)	User Defined	96.6	2.5	0.8	0.1	0	96.6	99.1
Resurrection Lutheran Church	Cairo (T)	User Defined	82	11.6	5.4	1	0	81.9	93.5
Catskill United Methodist Church	Catskill	User Defined	96.7	2.5	0.7	0.1	0	96.6	99.1
Kiskatom Volunteer Fire Dept.	Catskill (T)	Fire/EMS	82.3	11.4	5.3	0.9	0	82.2	93.4
Leeds Hose Company #1	Catskill (T)	Fire/EMS	96.6	2.5	0.8	0.1	0	96.5	99

500-Year MRP Event									
			Percent Probability of Sustaining Damage					Percent Functionality	
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Palenville Fire Dept.	Catskill (T)	Fire/EMS	91.5	6	2.2	0.3	0	91.4	97.3
Catskill Elementary School	Catskill (T)	School	96.7	2.5	0.7	0.1	0	96.6	99.1
Grapeville Baptist School	Catskill (T)	School	81.5	11.8	5.5	1	0	81.5	93
Catskill Masonic Lodge 468	Catskill (T)	User Defined	96.6	2.5	0.8	0.1	0	96.5	99.1
Village of Catskill Police Department	Catskill (V)	Police	82.2	11.5	5.3	0.9	0	82.1	93.3
Greene County Sheriff Department Headqua	Catskill (V)	Police	96.7	2.5	0.7	0.1	0	96.6	99.1
Catskill East Side Station	Catskill (V)	Fire/EMS	82.2	11.5	5.3	0.9	0	82.1	93.3
Catskill Fire Company	Catskill (V)	Fire/EMS	82.2	11.5	5.3	0.9	0	82.1	93.3
Catskill Senior High School	Catskill (V)	School	82.2	11.5	5.3	0.9	0	82.1	93.3
Catskill Middle School	Catskill (V)	School	82.2	11.5	5.3	0.9	0	82.1	93.3
Catskill DPW	Catskill (V)	User Defined	82.2	11.5	5.3	0.9	0	82.1	93.5
Catskill Correctional Facility	Catskill (V)	User Defined	96.7	2.5	0.7	0.1	0	96.6	99.1
EMS/Shelter Facilities	Catskill (V)	User Defined	82.2	11.5	5.3	0.9	0	82.1	93.5
NYS Police Town of Coxsackie Satellite S	Coxsackie (T)	Police	81.7	11.7	5.5	1	0	81.7	93.1
Earlton Fire Dept.	Coxsackie (T)	Fire/EMS	81.5	11.8	5.5	1	0	81.5	93
Coxsackie Correctional Facility	Coxsackie (T)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Greene Correctional Facility	Coxsackie (T)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Village of Coxsackie Police Department	Coxsackie (V)	Police	81.4	11.9	5.6	1	0	81.4	93
D.M. Hamilton Steamer #2	Coxsackie (V)	Fire/EMS	81.4	11.9	5.6	1	0	81.4	93
Coxsackie Hose #3	Coxsackie (V)	Fire/EMS	81.4	11.9	5.6	1	0	81.4	93
Coxsackie-Athens Middle School	Coxsackie (V)	School	81.4	11.9	5.6	1	0	81.4	93
Coxsackie-Athens High School	Coxsackie (V)	School	91	6.3	2.4	0.3	0	90.9	97.1
Coxsackie Elementary School	Coxsackie (V)	School	81.4	11.9	5.6	1	0	81.4	93
Coxsackie Campus	Coxsackie (V)	User Defined	81.4	11.9	5.6	1	0	81.4	93.2
Town of Durham Police Department	Durham (T)	Police	98	1.6	0.4	0.1	0	97.9	99.4
East Durham Volunteer Fire Co.	Durham (T)	Fire/EMS	96.6	2.5	0.8	0.1	0	96.5	99
Oak Hill-Durham Volunteer Fire Co.	Durham (T)	Fire/EMS	82	11.6	5.4	1	0	82	93.2
Durham Elementary School	Durham (T)	School	96.6	2.5	0.8	0.1	0	96.6	99
Oak Hill-Durham Volunteer Fire Company	Durham (T)	User Defined	82	11.6	5.4	1	0	82	93.5
Town of Durham Volunteer Ambulance Squad	Durham (T)	User Defined	96.6	2.5	0.8	0.1	0	96.5	99.1

500-Year MRP Event									
			Percent Probability of Sustaining Damage					Percent Functionality	
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
NYS Police Town of Greenville Satellite	Greenville (T)	Police	96.5	2.6	0.8	0.1	0	96.5	99
Freehold Volunteer Fire Co.	Greenville (T)	Fire/EMS	91.1	6.2	2.3	0.3	0	91.1	97.1
Greenville Volunteer Fire District #1	Greenville (T)	Fire/EMS	96.5	2.6	0.8	0.1	0	96.5	99
Greenville Fire District - Norton Hill	Greenville (T)	Fire/EMS	98	1.6	0.4	0.1	0	97.9	99.4
Scott M. Ellis ES	Greenville (T)	School	91.1	6.2	2.3	0.3	0	91.1	97.1
Greenville Middle School	Greenville (T)	School	91.1	6.2	2.3	0.3	0	91.1	97.1
Greenville High School	Greenville (T)	School	91.1	6.2	2.3	0.3	0	91.1	97.1
Greenville Christian Life Center	Greenville (T)	User Defined	96.5	2.6	0.8	0.1	0	96.5	99.1
Town of Hunter Police Department	Hunter (T)	Police	96.8	2.4	0.7	0.1	0	96.7	99.1
NYS Police Town of Hunter Satellite Stat	Hunter (T)	Police	96.8	2.4	0.7	0.1	0	96.7	99.1
H.D. Lane Volunteer Fire Co.	Hunter (T)	Fire/EMS	96.9	2.3	0.7	0.1	0	96.9	99.1
Haines Falls Volunteer Fire Co.	Hunter (T)	Fire/EMS	96.8	2.4	0.7	0.1	0	96.7	99.1
Hunter-Tannersville Middle and High School	Hunter (T)	School	96.8	2.4	0.7	0.1	0	96.7	99.1
Hunter Fire Co. #1	Hunter (V)	Fire/EMS	82.7	11.2	5.1	0.9	0	82.7	93.6
Hunter Elementary School	Hunter (V)	School	82.7	11.2	5.1	0.9	0	82.7	93.6
East Jewett Fire Dept.	Jewett (T)	Fire/EMS	96.8	2.4	0.7	0.1	0	96.7	99.1
Jewett Fire Dept.	Jewett (T)	Fire/EMS	96.8	2.4	0.7	0.1	0	96.8	99.1
Salt Shed	Jewett (T)	User Defined	96.7	2.4	0.7	0.1	0	96.7	99.1
Town Building	Jewett (T)	User Defined	96.7	2.4	0.7	0.1	0	96.7	99.1
Highway Building	Jewett (T)	User Defined	96.8	2.4	0.7	0.1	0	96.8	99.2
Town of Lexington Fire co.	Lexington (T)	Fire/EMS	83.3	10.9	4.9	0.9	0	83.2	93.8
Town of Lexington Fire Station #2	Lexington (T)	Fire/EMS	97	2.3	0.7	0.1	0	96.9	99.1
Town Hall	Lexington (T)	User Defined	83.3	10.9	4.9	0.9	0	83.2	94.1
Town Highway	Lexington (T)	User Defined	92.1	5.6	2	0.3	0	92	97.6
Cornell H&L Fire Co.	New Baltimore (T)	Fire/EMS	97.9	1.6	0.4	0.1	0	97.8	99.4
Medville-Grapeville Vol. Fire Co.	New Baltimore (T)	Fire/EMS	96.5	2.6	0.8	0.1	0	96.5	99
Cornell H&L Fire Co. Station #2	New Baltimore (T)	Fire/EMS	97.9	1.6	0.4	0.1	0	97.8	99.4
Circle of Friends	New Baltimore (T)	School	96.5	2.6	0.8	0.1	0	96.4	99
Highway Garage	New Baltimore (T)	User Defined	96.5	2.6	0.8	0.1	0	96.4	99
Town Hall	New Baltimore (T)	User Defined	97.9	1.6	0.4	0.1	0	97.8	99.4

500-Year MRP Event									
			Percent Probability of Sustaining Damage					Percent Functionality	
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Greene County Sheriff Prattsville SubSta	Prattsville (T)	Police	91.9	5.7	2.1	0.3	0	91.8	97.4
Prattsville Hose Co.	Prattsville (T)	Fire/EMS	91.9	5.7	2.1	0.3	0	91.8	97.4
Greene County Head Start	Prattsville (T)	School	82.9	11.1	5	0.9	0	82.9	93.7
New York State Aqueduct Shaft	Prattsville (T)	User Defined	94.3	4.1	1.4	0.2	0	94.3	98.4
Tannersville Fire Dept.	Tannersville (V)	Fire/EMS	96.8	2.4	0.7	0.1	0	96.7	99.1
Village Hall/Court	Tannersville (V)	User Defined	96.8	2.4	0.7	0.1	0	96.7	99.1
Village Garage	Tannersville (V)	User Defined	91.6	5.9	2.2	0.3	0	91.6	97.4
Tannersville Fire and Rescue	Tannersville (V)	User Defined	96.8	2.4	0.7	0.1	0	96.7	99.1
Town of Windham Police Department	Windham (T)	Police	96.7	2.4	0.7	0.1	0	96.7	99.1
Hensonville Hose Co.	Windham (T)	Fire/EMS	96.7	2.4	0.7	0.1	0	96.7	99.1
Windham Hose Co. #1	Windham (T)	Fire/EMS	91.7	5.8	2.1	0.3	0	91.7	97.3
Windham Ambulance	Windham (T)	Fire/EMS	96.7	2.4	0.7	0.1	0	96.7	99.1
Windham-Ashland Central School	Windham (T)	School	91.7	5.8	2.1	0.3	0	91.7	97.3
School Bus Garage	Windham (T)	User Defined	91.5	5.9	2.2	0.3	0	91.5	97.4
Town Hall	Windham (T)	User Defined	96.7	2.4	0.7	0.1	0	96.7	99.1
Main Car Fuel Storage Center	Windham (T)	User Defined	96.7	2.4	0.7	0.1	0	96.7	99.1
Ashland Fire Dept	Ashland (T)	Fire/EMS	91.7	5.8	2.1	0.3	0	91.7	97.3
Post Office	Ashland (T)	User Defined	91.7	5.8	2.1	0.3	0	91.7	97.5
Town Highway Garage	Ashland (T)	User Defined	96.8	2.4	0.7	0.1	0	96.8	99.1
Greene County Highway Garage	Ashland (T)	User Defined	91.7	5.8	2.1	0.3	0	91.7	97.5
West-Athens Limestreet Fire Co.	Athens (T)	Fire/EMS	96.6	2.5	0.8	0.1	0	96.5	99
West-Athens Limestreet Station #2	Athens (T)	Fire/EMS	96.6	2.5	0.8	0.1	0	96.5	99
Village of Athens Police Department	Athens (V)	Police	81.7	11.7	5.5	1	0	81.7	93.1
Athens Fire Dept	Athens (V)	Fire/EMS	81.7	11.7	5.5	1	0	81.7	93.1
Edward J. Arthur Elementary School	Athens (V)	School	81.7	11.7	5.5	1	0	81.7	93.1
Senior Living Facility	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Rivertown Apartments	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Home for Developmentally Disabled Adults	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Athens Fire Department	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3
Athens Community Center	Athens (V)	User Defined	81.7	11.7	5.5	1	0	81.7	93.3

500-Year MRP Event									
			Percent Probability of Sustaining Damage					Percent Functionality	
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Town of Cairo Police Department	Cairo (T)	Police	96.6	2.5	0.8	0.1	0	96.6	99
NYS Police Troop F Zone 3 Catskill Barra	Cairo (T)	Police	96.6	2.5	0.8	0.1	0	96.6	99
Cairo Hose Company	Cairo (T)	Fire/EMS	82	11.6	5.4	1	0	81.9	93.2
Round Top Volunteer Fire Co.	Cairo (T)	Fire/EMS	98	1.5	0.4	0.1	0	97.9	99.4

Source: HAZUS-MH MR3
Notes:
T = Town.
User Defined = The Planning Committee identified additional facilities as critical including municipal buildings and Department of Public Works facilities.
V = Village.

Table 5.4.5-15. Estimated Damage and Loss of Functionality for Critical Facilities in Greene County for the 2,500-Year MRP Earthquake Event

2,500-Year MRP Event										
Name	Town	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Ashland Fire Dept	Ashland (T)	Fire/EMS	66.8	18.8	11.3	2.7	0.4	66.8	85.6	96.8
Post Office	Ashland (T)	User Defined	66.8	18.8	11.3	2.7	0.4	66.8	85.5	96.8
Town Highway Garage	Ashland (T)	User Defined	81.1	12.1	5.7	1	0.1	81	93.1	98.8
Greene County Highway Garage	Ashland (T)	User Defined	66.8	18.8	11.3	2.7	0.4	66.8	85.5	96.8
West-Athens Limestreet Fire Co.	Athens (T)	Fire/EMS	80.3	12.5	6	1.1	0.1	80.3	92.7	98.7
West-Athens Limestreet Station #2	Athens (T)	Fire/EMS	80.3	12.5	6	1.1	0.1	80.3	92.7	98.7
Village of Athens Police Department	Athens (V)	Police	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Athens Fire Dept	Athens (V)	Fire/EMS	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Edward J. Arthur Elementary School	Athens (V)	School	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Senior Living Facility	Athens (V)	User Defined	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Rivertown Apartments	Athens (V)	User Defined	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Home for Developmentally Disabled Adults	Athens (V)	User Defined	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Athens Fire Department	Athens (V)	User Defined	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Athens Community Center	Athens (V)	User Defined	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Town of Cairo Police Department	Cairo (T)	Police	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
NYS Police Troop F Zone 3 Catskill Barra	Cairo (T)	Police	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
Cairo Hose Company	Cairo (T)	Fire/EMS	35.8	26.1	25.3	10.1	2.7	35.7	61.8	87.1
Round Top Volunteer Fire Co.	Cairo (T)	Fire/EMS	86	9.3	4	0.6	0.1	85.9	95.3	99.2
County Emergency Services	Cairo (T)	Fire/EMS	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
Cairo-Durham High School	Cairo (T)	School	75.2	15.1	7.9	1.6	0.2	75.2	90.2	98.1
Cairo Elementary School	Cairo (T)	School	35.8	26.1	25.3	10.1	2.7	35.7	61.8	87.1
Cairo-Durham Middle School	Cairo (T)	School	75.2	15.1	7.9	1.6	0.2	75.2	90.2	98.1
Cairo Senior Housing	Cairo (T)	User Defined	86	9.3	4	0.6	0.1	85.9	95.3	99.2
County Annex	Cairo (T)	User Defined	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
Cairo Town Hall	Cairo (T)	User Defined	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
Resurrection Lutheran Church	Cairo (T)	User Defined	35.8	26.1	25.3	10.1	2.7	35.7	61.8	87.1
Catskill United Methodist Church	Catskill	User Defined	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
Kiskatom Volunteer Fire Dept.	Catskill (T)	Fire/EMS	36.2	26	25.1	10	2.6	36.1	62.2	87.3
Leeds Hose Company #1	Catskill (T)	Fire/EMS	80.3	12.5	6	1.1	0.1	80.3	92.7	98.7

2,500-Year MRP Event										
Name	Town	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Palenville Fire Dept.	Catskill (T)	Fire/EMS	65.5	19.3	11.9	2.9	0.4	65.4	84.7	96.6
Catskill Elementary School	Catskill (T)	School	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
Grapeville Baptist School	Catskill (T)	School	35.3	26.1	25.5	10.3	2.8	35.2	61.3	86.8
Catskill Masonic Lodge 468	Catskill (T)	User Defined	80.3	12.5	6	1.1	0.1	80.3	92.7	98.7
Village of Catskill Police Department	Catskill (V)	Police	35.9	26.1	25.3	10.1	2.7	35.8	61.9	87.1
Greene County Sheriff Department Headqua	Catskill (V)	Police	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
Catskill East Side Station	Catskill (V)	Fire/EMS	35.9	26.1	25.3	10.1	2.7	35.8	61.9	87.1
Catskill Fire Company	Catskill (V)	Fire/EMS	35.9	26.1	25.3	10.1	2.7	35.8	61.9	87.1
Catskill Senior High School	Catskill (V)	School	35.9	26.1	25.3	10.1	2.7	35.8	61.9	87.1
Catskill Middle School	Catskill (V)	School	35.9	26.1	25.3	10.1	2.7	35.8	61.9	87.1
Catskill DPW	Catskill (V)	User Defined	35.9	26.1	25.3	10.1	2.7	35.8	61.9	87.1
Catskill Correctional Facility	Catskill (V)	User Defined	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
EMS/Shelter Facilities	Catskill (V)	User Defined	35.9	26.1	25.3	10.1	2.7	35.8	61.9	87.1
NYS Police Town of Coxsackie Satellite S	Coxsackie (T)	Police	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Earlton Fire Dept.	Coxsackie (T)	Fire/EMS	35.3	26.1	25.5	10.3	2.8	35.2	61.3	86.8
Coxsackie Correctional Facility	Coxsackie (T)	User Defined	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Greene Correctional Facility	Coxsackie (T)	User Defined	35.3	26.1	25.5	10.3	2.8	35.3	61.4	86.9
Village of Coxsackie Police Department	Coxsackie (V)	Police	35.1	26.1	25.6	10.4	2.8	35.1	61.2	86.7
D.M. Hamilton Steamer #2	Coxsackie (V)	Fire/EMS	35.1	26.1	25.6	10.4	2.8	35.1	61.2	86.7
Coxsackie Hose #3	Coxsackie (V)	Fire/EMS	35.1	26.1	25.6	10.4	2.8	35.1	61.2	86.7
Coxsackie-Athens Middle School	Coxsackie (V)	School	35.1	26.1	25.6	10.4	2.8	35.1	61.2	86.7
Coxsackie-Athens High School	Coxsackie (V)	School	63.5	20.1	12.7	3.2	0.5	63.4	83.5	96.2
Coxsackie Elementary School	Coxsackie (V)	School	35.1	26.1	25.6	10.4	2.8	35.1	61.2	86.7
COXSACKIE ATHENS CSD	Coxsackie (V)	User Defined	35.1	26.1	25.6	10.4	2.8	35.1	61.1	86.7
Coxsackie Campus	Coxsackie (V)	User Defined	35.1	26.1	25.6	10.4	2.8	35.1	61.1	86.7
Town of Durham Police Department	Durham (T)	Police	86	9.3	4	0.6	0.1	86	95.3	99.2
East Durham Volunteer Fire Co.	Durham (T)	Fire/EMS	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
Oak Hill-Durham Volunteer Fire Co.	Durham (T)	Fire/EMS	36.3	26	25.1	10	2.6	36.2	62.3	87.3
Durham Elementary School	Durham (T)	School	80.6	12.3	5.9	1.1	0.1	80.6	92.9	98.7
Durham Elementary School	Durham (T)	User Defined	80.6	12.3	5.9	1.1	0.1	80.6	92.9	98.7

2,500-Year MRP Event										
Name	Town	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Oak Hill-Durham Volunteer Fire Company	Durham (T)	User Defined	36.3	26	25.1	10	2.6	36.2	62.3	87.3
Town of Durham Volunteer Ambulance Squad	Durham (T)	User Defined	80.4	12.4	5.9	1.1	0.1	80.4	92.8	98.7
NYS Police Town of Greenville Satellite	Greenville (T)	Police	80.3	12.5	6	1.1	0.1	80.2	92.7	98.7
Freehold Volunteer Fire Co.	Greenville (T)	Fire/EMS	63.7	20	12.6	3.2	0.5	63.7	83.7	96.3
Greenville Volunteer Fire District #1	Greenville (T)	Fire/EMS	80.3	12.5	6	1.1	0.1	80.2	92.7	98.7
Greenville Fire District - Norton Hill	Greenville (T)	Fire/EMS	86	9.3	4	0.6	0.1	86	95.3	99.2
Scott M. Ellis ES	Greenville (T)	School	63.7	20	12.6	3.2	0.5	63.7	83.7	96.3
Greenville Middle School	Greenville (T)	School	63.7	20	12.6	3.2	0.5	63.7	83.7	96.3
Greenville High School	Greenville (T)	School	63.7	20	12.6	3.2	0.5	63.7	83.7	96.3
Greenville Christian Life Center	Greenville (T)	User Defined	80.3	12.5	6	1.1	0.1	80.2	92.7	98.7
Town of Hunter Police Department	Hunter (T)	Police	80.8	12.2	5.8	1.1	0.1	80.7	92.9	98.8
NYS Police Town of Hunter Satellite Stat	Hunter (T)	Police	80.8	12.2	5.8	1.1	0.1	80.7	92.9	98.8
H.D. Lane Volunteer Fire Co.	Hunter (T)	Fire/EMS	81.3	12	5.6	1	0.1	81.2	93.2	98.8
Haines Falls Volunteer Fire Co.	Hunter (T)	Fire/EMS	80.8	12.2	5.8	1.1	0.1	80.7	92.9	98.8
Hunter-Tannersville Middle and High School	Hunter (T)	School	80.8	12.2	5.8	1.1	0.1	80.7	92.9	98.8
Hunter Fire Co. #1	Hunter (V)	Fire/EMS	37.3	26	24.6	9.6	2.5	37.2	63.2	87.8
Hunter Elementary School	Hunter (V)	School	37.3	26	24.6	9.6	2.5	37.2	63.2	87.8
East Jewett Fire Dept.	Jewett (T)	Fire/EMS	80.8	12.2	5.8	1.1	0.1	80.7	92.9	98.8
Jewett Fire Dept.	Jewett (T)	Fire/EMS	81.1	12.1	5.7	1	0.1	81	93.1	98.8
Salt Shed	Jewett (T)	User Defined	80.8	12.2	5.8	1.1	0.1	80.7	93	98.8
Town Building	Jewett (T)	User Defined	80.8	12.2	5.8	1.1	0.1	80.7	93	98.8
Highway Building	Jewett (T)	User Defined	81	12.1	5.7	1	0.1	80.9	93	98.8
Town of Lexington Fire co.	Lexington (T)	Fire/EMS	38.9	25.9	23.9	9.1	2.3	38.8	64.7	88.6
Town of Lexington Fire Station #2	Lexington (T)	Fire/EMS	81.6	11.8	5.5	1	0.1	81.5	93.3	98.8
Town Hall	Lexington (T)	User Defined	38.9	25.9	23.9	9.1	2.3	38.8	64.7	88.6
Town Highway	Lexington (T)	User Defined	65.3	19.4	11.9	2.9	0.4	65.2	84.6	96.5
Cornell H&L Fire Co.	New Baltimore (T)	Fire/EMS	85.8	9.4	4	0.7	0.1	85.7	95.2	99.2
Medville-Grapeville Vol. Fire Co.	New Baltimore (T)	Fire/EMS	80.2	12.5	6	1.1	0.1	80.2	92.7	98.7
Cornell H&L Fire Co. Station #2	New Baltimore (T)	Fire/EMS	85.8	9.4	4	0.7	0.1	85.7	95.2	99.2
Circle of Friends	New Baltimore (T)	School	80.2	12.6	6	1.1	0.1	80.1	92.7	98.7

2,500-Year MRP Event										
Name	Town	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Highway Garage	New Baltimore (T)	User Defined	80.2	12.6	6	1.1	0.1	80.1	92.7	98.7
Town Hall	New Baltimore (T)	User Defined	85.8	9.4	4	0.7	0.1	85.7	95.2	99.2
Greene County Sheriff Prattsville SubSta	Prattsville (T)	Police	67.7	18.4	10.9	2.6	0.4	67.7	86.1	97
Prattsville Hose Co.	Prattsville (T)	Fire/EMS	67.7	18.4	10.9	2.6	0.4	67.7	86.1	97
Greene County Head Start	Prattsville (T)	School	38.3	25.9	24.2	9.3	2.4	38.2	64.2	88.3
New York State Aqueduct Shaft	Prattsville (T)	User Defined	82.5	11.3	5.2	0.9	0.1	82.5	93.7	98.9
Tannersville Fire Dept.	Tannersville (V)	Fire/EMS	80.8	12.2	5.8	1.1	0.1	80.7	92.9	98.8
Village Hall/Court	Tannersville (V)	User Defined	80.8	12.2	5.8	1.1	0.1	80.7	92.9	98.8
Village Garage	Tannersville (V)	User Defined	66	19.1	11.6	2.8	0.4	66	85.1	96.7
Tannersville Fire and Rescue	Tannersville (V)	User Defined	80.8	12.2	5.8	1.1	0.1	80.7	92.9	98.8
Town of Windham Police Department	Windham (T)	Police	80.8	12.2	5.8	1.1	0.1	80.7	93	98.8
Hensonville Hose Co.	Windham (T)	Fire/EMS	80.8	12.2	5.8	1.1	0.1	80.7	93	98.8
Windham Hose Co. #1	Windham (T)	Fire/EMS	66.8	18.8	11.3	2.7	0.4	66.8	85.6	96.8
Windham Ambulance	Windham (T)	Fire/EMS	80.8	12.2	5.8	1.1	0.1	80.7	93	98.8
Windham-Ashland Central School	Windham (T)	School	66.8	18.8	11.3	2.7	0.4	66.8	85.6	96.8
School Bus Garage	Windham (T)	User Defined	66.1	19.1	11.6	2.8	0.4	66	85.1	96.7
Town Hall	Windham (T)	User Defined	80.8	12.2	5.8	1.1	0.1	80.7	93	98.8
Main Car Fuel Storage Center	Windham (T)	User Defined	80.8	12.2	5.8	1.1	0.1	80.7	93	98.8

Source: HAZUS-MH MR3
Notes:
T = Town.
User Defined = The Planning Committee identified additional facilities as critical including municipal buildings and Department of Public Works facilities.
V = Village.

Impact on Economy

Earthquakes also have impacts on the economy, including: loss of business function, damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings. A Level 1 HAZUS-MH analysis estimates the total economic loss associated with each earthquake scenario, which includes building- and lifeline-related losses (transportation and utility losses) based on the available inventory [facility (or GIS point) data only]. Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the "Impact on General Building Stock" section discussed earlier. Lifeline-related losses include the direct repair cost to transportation and utility systems and are reported in terms of the probability of reaching or exceeding a specified level of damage when subjected to a given level of ground motion. These losses are discussed below.

For the 100-year MRP event, in terms of utilities, HAZUS-MH MR3 estimates each potable water facility, wastewater facility, electric transfer/substation and communication facility will be fully functional day one of the event. Damage results are not considered to be significant as a result of a 100-year event; therefore, utility loss estimates are not discussed further in this assessment for this HMP.

Tables 5.4.5-16 and 5.4.5-17 summarize the HAZUS-MH MR3 estimated probability of damage that each utility may sustain (as defined by the column heading) and estimated loss of use in days a result of a 500-year and 2,500-year MRP earthquake event, respectively. Damage categories are related to the damage ratio (defined as ratio of repair to replacement cost) for evaluation of direct economic loss. Refer to the HAZUS-MH MR3 Earthquake Technical Manual for a description of the damage categories for each utility feature.

A Level 1 HAZUS-MH analysis does not compute damage estimates for roadway segments and railroad tracks. However, it is assumed these features will experience damage due to ground failure and regional transportation and distribution of these materials will be interrupted as a result of an earthquake event. Losses to the community that result from damages to lifelines can be much greater than the cost of repair (HAZUS-MH MR3 Earthquake User Manual, 2007).

For the 100-year MRP event, HAZUS-MH MR3 estimates all highway and railway bridges in Greene County will be fully functional day one of the event. For the 500-year and 2,500- year MRP events, HAZUS-MH MR3 estimates highway and railway bridges will nearly 100% functional day one of the event. Tables 5.4.5-18 and 5.4.5-19 summarize the estimated damages and functionality of transportation features in Greene County for 500- and 2,500-year MRP events.

Table 5.4.5-16. Estimated Utility Impacts in Greene County from the 500-year MRP Earthquake Event

500-year MRP Event									
			Percent Probability of Sustaining Damage					Percent Functionality	
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Athens Generating CO LP	Athens (T)	Electric	99.4	0.5	0.1	0	0	99.6	99.9
Catksill Village Potable Supply Pump	Athens (V)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9
Sleepy Hollow Lake (Private Pump)	Athens (V)	Potable Water	89.4	7.3	3.2	0.1	0	94.7	99.8
Athens Village Potable Water Supply	Athens (V)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9
Catskill Village Potable Water Supply	Athens (V)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9
Sleepy Hollow Lake (Private Supply)	Athens (V)	Potable Water	89.4	7.3	3.2	0.1	0	94.7	99.8
Athens Village Potable Supply Pump Stati	Athens (V)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9
Sleepy Hollow Pump Station (Private)	Athens (V)	Wastewater	89.4	7.3	3.2	0.1	0	92.1	99.8
ATHENS (V) STP - MAIN PLANT	Athens (V)	Wastewater	98.6	1.2	0.2	0	0	98.9	99.9
Sleepy Hollow Lake WWTP (Private Plant)	Athens (V)	Wastewater	89.4	7.3	3.2	0.1	0	92	99.5
Athens Village Pump	Athens (V)	Wastewater	89.4	7.3	3.2	0.1	0	92.1	99.8
Athens Village Pump	Athens (V)	Wastewater	89.4	7.3	3.2	0.1	0	92.1	99.8
Cairo Sewer District	Cairo (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Catskill (T) SD#4	Catskill (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Central Hudson General Electric 3	Catskill (V)	Electric	89.7	7.2	3	0.1	0	93.5	99.8
Central Hudson General Electric 2	Catskill (V)	Electric	89.7	7.2	3	0.1	0	93.5	99.8
Central Hudson General Electric 1	Catskill (V)	Electric	99.4	0.5	0.1	0	0	99.6	99.9
Sewer Pump Station 6	Catskill (V)	Wastewater	89.7	7.2	3	0.1	0	92.3	99.8
Water Pressure Reducing Valve Vault 2	Catskill (V)	Wastewater	89.7	7.2	3	0.1	0	92.3	99.5
Water Pressure Reducing Valve Vault 1	Catskill (V)	Wastewater	89.7	7.2	3	0.1	0	92.3	99.5
Catskill Wastewater Treatment Plant	Catskill (V)	Wastewater	98.6	1.1	0.2	0	0	99	99.9
Sewer Pump Station 1	Catskill (V)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Sewer Pump Station 2	Catskill (V)	Wastewater	89.7	7.2	3	0.1	0	92.3	99.8
Sewer Pump Station 3	Catskill (V)	Wastewater	89.7	7.2	3	0.1	0	92.3	99.8
Sewer Pump Station 5	Catskill (V)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Sewer Pump Station 7	Catskill (V)	Wastewater	89.7	7.2	3	0.1	0	92.3	99.8
Sewer Pump Station 8	Catskill (V)	Wastewater	89.7	7.2	3	0.1	0	92.3	99.8
Sewer Pump Station 4	Catskill (V)	Wastewater	89.7	7.2	3	0.1	0	92.3	99.8
Coxsackie (V) STP	Coxsackie (V)	Wastewater	98.6	1.2	0.2	0	0	98.9	99.9

500-year MRP Event									
			Percent Probability of Sustaining Damage					Percent Functionality	
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Waste Water Pump Station 3	Hunter (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Mochne Tashba WWTP	Hunter (T)	Wastewater	89.9	7	3	0.1	0	92.4	99.5
Waste Water Pump Station 5	Hunter (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Waste Water Pump Station 4	Hunter (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Waste Water Pump Station 2	Hunter (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Waste Water Pump Station 1	Hunter (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Elka Park WWTP	Hunter (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Well 2	Hunter (V)	Potable Water	90.1	6.9	2.9	0.1	0	95.1	99.8
Well 1	Hunter (V)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9
Well 3	Hunter (V)	Potable Water	90.1	6.9	2.9	0.1	0	95.1	99.8
Water Treatment Plant	Hunter (V)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Waste Water Pump Station 1	Hunter (V)	Wastewater	90.1	6.9	2.9	0.1	0	92.6	99.8
Waste Water Pump Station 2	Hunter (V)	Wastewater	90.1	6.9	2.9	0.1	0	92.6	99.8
Waste Water Treatment Plant	Jewett (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Central Hudson Substation	Lexington (T)	Electric	99.4	0.5	0.1	0	0	99.6	99.9
Waste Water Treatment Plant/Pump Station	New Balitmore (T)	Wastewater	99.4	0.6	0.1	0	0	99.5	99.9
New Baltimore (T) SD STP	New Balitmore (T)	Wastewater	99.4	0.6	0.1	0	0	99.5	99.9
Emergency Radio Broadcast Tower	New Baltimore (T)	Communication	99.4	0.6	0.1	0	0	99.9	99.9
Electric Power Plant/Substation	New Baltimore (T)	Electric	98.5	1.2	0.2	0	0	99.1	99.9
Prattsville Water District Tower	Prattsville (T)	Potable Water	97.4	2.1	0.5	0	0	98.8	99.9
Village Water Tower/Sunview Tower	Tannersville (V)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9
Village Well	Tannersville (V)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9
Tannersville STP	Tannersville (V)	Wastewater	97.3	2.2	0.5	0	0	98	99.9
Village Water Treatment Plant	Tannersville (V)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
WRIP CH 250	Windham (T)	Communication	99.7	0.3	0	0	0	99.9	99.9
GC Transfer Station	Windham (T)	Electric	99.4	0.5	0.1	0	0	99.6	99.9
New York State Electric Substation	Windham (T)	Electric	99.4	0.5	0.1	0	0	99.6	99.9
Storage Tank	Windham (T)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9
Hensonville West Winds Well	Windham (T)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9
Hensonville 2 Water Wells	Windham (T)	Potable Water	99.4	0.5	0.1	0	0	99.7	99.9

500-year MRP Event									
			Percent Probability of Sustaining Damage					Percent Functionality	
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Waste Water Pump House 3	Windham (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Waste Water Pump Station 1	Windham (T)	Wastewater	99.4	0.5	0.1	0	0	99.5	99.9
Waste Water Pump House 1	Windham (T)	Wastewater	97.3	2.2	0.5	0	0	98	99.9
Pump House	Windham (T)	Wastewater	97.3	2.2	0.5	0	0	98	99.9
Town Water Pump House	Windham (T)	Wastewater	97.3	2.2	0.5	0	0	98	99.9
Waste Water Pump House 2	Windham (T)	Wastewater	97.2	2.3	0.5	0	0	97.9	99.9

Source: HAZUS-MH MR3, 2007
Note(s):
T = Town
V = Village

Table 5.4.5-17. Estimated Utility Impacts in Greene County from the 2,500-year MRP Earthquake Event

2,500-year MRP Event											
			Percent Probability of Sustaining Damage					Percent Functionality		
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Athens Generating CO LP	Athens (T)	Electric	93.6	4.7	1.6	0	0	96.1	99.9	99.9
Catksill Village Potable Supply Pump	Athens (V)	Potable Water	93.6	4.7	1.6	0	0	96.9	99.9	99.9
Sleepy Hollow Lake (Private Pump)	Athens (V)	Potable Water	49.6	20	24.9	4.4	1	68.6	95.8	96.7
Athens Village Potable Water Supply	Athens (V)	Potable Water	93.6	4.7	1.6	0	0	96.9	99.9	99.9
Catskill Village Potable Water Supply	Athens (V)	Potable Water	93.6	4.7	1.6	0	0	96.9	99.9	99.9
Sleepy Hollow Lake (Private Supply)	Athens (V)	Potable Water	49.6	20	24.9	4.4	1	68.6	95.8	96.7
Athens Village Potable Supply Pump Stati	Athens (V)	Potable Water	93.6	4.7	1.6	0	0	96.9	99.9	99.9
Sleepy Hollow Pump Station (Private)	Athens (V)	Wastewater	49.6	20	24.9	4.4	1	58.7	95.7	98
Athens (V) STP – Main Plant	Athens (V)	Wastewater	81.9	11.2	6.4	0.4	0.1	86.3	99.5	99.5
Sleepy Hollow Lake WWTP (Private Plant)	Athens (V)	Wastewater	49.6	20	24.9	4.4	1	59.5	94.7	95.2
Athens Village Pump	Athens (V)	Wastewater	49.6	20	24.9	4.4	1	58.7	95.7	98
Athens Village Pump	Athens (V)	Wastewater	49.6	20	24.9	4.4	1	58.7	95.7	98
Cairo Sewer District	Cairo (T)	Wastewater	93.6	4.7	1.6	0	0	95.3	99.9	99.9
Catskill (T) SD#4	Catskill (T)	Wastewater	93.4	4.8	1.7	0	0	95.1	99.9	99.9
Central Hudson General Electric 3	Catskill (V)	Electric	50.5	19.9	24.3	4.2	1	62.9	99	99.4
Central Hudson General Electric 2	Catskill (V)	Electric	50.5	19.9	24.3	4.2	1	62.9	99	99.4
Central Hudson General Electric 1	Catskill (V)	Electric	93.4	4.8	1.7	0	0	95.9	99.9	99.9
Sewer Pump Station 6	Catskill (V)	Wastewater	50.5	19.9	24.3	4.2	1	59.6	95.9	98.1
Water Pressure Reducing Valve Vault 2	Catskill (V)	Wastewater	50.5	19.9	24.3	4.2	1	60.3	95	95.4
Water Pressure Reducing Valve Vault 1	Catskill (V)	Wastewater	50.5	19.9	24.3	4.2	1	60.3	95	95.4
Catskill Wastewater Treatment Plant	Catskill (V)	Wastewater	82.5	11	6.2	0.3	0.1	86.7	99.5	99.6
Sewer Pump Station 1	Catskill (V)	Wastewater	93.4	4.8	1.7	0	0	95.1	99.9	99.9
Sewer Pump Station 2	Catskill (V)	Wastewater	50.5	19.9	24.3	4.2	1	59.6	95.9	98.1
Sewer Pump Station 3	Catskill (V)	Wastewater	50.5	19.9	24.3	4.2	1	59.6	95.9	98.1
Sewer Pump Station 5	Catskill (V)	Wastewater	93.4	4.8	1.7	0	0	95.1	99.9	99.9
Sewer Pump Station 7	Catskill (V)	Wastewater	50.5	19.9	24.3	4.2	1	59.6	95.9	98.1
Sewer Pump Station 8	Catskill (V)	Wastewater	50.5	19.9	24.3	4.2	1	59.6	95.9	98.1
Sewer Pump Station 4	Catskill (V)	Wastewater	50.5	19.9	24.3	4.2	1	59.6	95.9	98.1
Coxsackie (V) STP	Coxsackie (V)	Wastewater	81.9	11.2	6.4	0.4	0.1	86.3	99.5	99.5

2,500-year MRP Event											
			Percent Probability of Sustaining Damage					Percent Functionality		
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Waste Water Pump Station 3	Hunter (T)	Wastewater	93.5	4.8	1.6	0	0	95.2	99.9	99.9
Mochne Tashba WWTP	Hunter (T)	Wastewater	51.1	19.9	24	4.1	0.9	60.8	95.1	95.6
Waste Water Pump Station 5	Hunter (T)	Wastewater	93.5	4.8	1.6	0	0	95.2	99.9	99.9
Waste Water Pump Station 4	Hunter (T)	Wastewater	93.5	4.8	1.6	0	0	95.2	99.9	99.9
Waste Water Pump Station 2	Hunter (T)	Wastewater	93.5	4.8	1.6	0	0	95.2	99.9	99.9
Waste Water Pump Station 1	Hunter (T)	Wastewater	93.5	4.8	1.6	0	0	95.2	99.9	99.9
Elka Park WWTP	Hunter (T)	Wastewater	93.6	4.7	1.6	0	0	95.2	99.9	99.9
Well 2	Hunter (V)	Potable Water	51.5	19.8	23.8	4	0.9	70	96.2	97.1
Well 1	Hunter (V)	Potable Water	93.6	4.7	1.6	0	0	96.9	99.9	99.9
Well 3	Hunter (V)	Potable Water	51.5	19.8	23.8	4	0.9	70	96.2	97.1
Water Treatment Plant	Hunter (V)	Wastewater	93.6	4.7	1.6	0	0	95.2	99.9	99.9
Waste Water Pump Station 1	Hunter (V)	Wastewater	51.5	19.8	23.8	4	0.9	60.4	96.1	98.2
Waste Water Pump Station 2	Hunter (V)	Wastewater	51.5	19.8	23.8	4	0.9	60.4	96.1	98.2
Waste Water Treatment Plant	Jewett (T)	Wastewater	93.4	4.8	1.7	0	0	95.1	99.9	99.9
Central Hudson Substation	Lexington (T)	Electric	94.2	4.3	1.4	0	0	96.4	99.9	99.9
Waste Water Treatment Plant/Pump Station	New Balitmore (T)	Wastewater	93.4	4.9	1.7	0	0	95.1	99.9	99.9
New Baltimore (T) SD STP	New Balitmore (T)	Wastewater	93.4	4.9	1.7	0	0	95.1	99.9	99.9
Emergency Radio Broadcast Tower	New Baltimore (T)	Communication	93.4	4.9	1.7	0	0	99	99.9	99.9
Electric Power Plant/Substation	New Baltimore (T)	Electric	81.6	11.4	6.6	0.4	0.1	87.8	99.9	99.9
Prattsville Water District Tower	Prattsville (T)	Potable Water	70.8	15.7	12.2	1.1	0.2	83.6	98.9	99.2
Village Water Tower/Sunview Tower	Tannersville (V)	Potable Water	93.5	4.8	1.6	0	0	96.9	99.9	99.9
Village Well	Tannersville (V)	Potable Water	93.5	4.8	1.6	0	0	96.9	99.9	99.9
Tannersville STP	Tannersville (V)	Wastewater	70.7	15.7	12.3	1.1	0.2	77.3	98.6	98.8
Village Water Treatment Plant	Tannersville (V)	Wastewater	93.6	4.7	1.6	0	0	95.2	99.9	99.9
WRIP CH 250	Windham (T)	Communication	96	3.1	0.9	0	0	99.5	99.9	99.9
GC Transfer Station	Windham (T)	Electric	93.4	4.8	1.7	0	0	96	99.9	99.9
New York State Electric Substation	Windham (T)	Electric	93.4	4.8	1.7	0	0	96	99.9	99.9
Storage Tank	Windham (T)	Potable Water	93.4	4.8	1.7	0	0	96.8	99.9	99.9
Hensonville West Winds Well	Windham (T)	Potable Water	93.4	4.8	1.7	0	0	96.8	99.9	99.9
Hensonville 2 Water Wells	Windham (T)	Potable Water	93.4	4.8	1.7	0	0	96.8	99.9	99.9

2,500-year MRP Event											
			Percent Probability of Sustaining Damage					Percent Functionality		
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Waste Water Pump House 3	Windham (T)	Wastewater	93.4	4.8	1.7	0	0	95.2	99.9	99.9
Waste Water Pump Station 1	Windham (T)	Wastewater	93.4	4.8	1.7	0	0	95.2	99.9	99.9
Waste Water Pump House 1	Windham (T)	Wastewater	70.4	15.8	12.4	1.2	0.2	76.8	98.9	99.5
Pump House	Windham (T)	Wastewater	70.4	15.8	12.4	1.2	0.2	76.8	98.9	99.5
Town Water Pump House	Windham (T)	Wastewater	70.4	15.8	12.4	1.2	0.2	76.8	98.9	99.5
Waste Water Pump House 2	Windham (T)	Wastewater	70	15.9	12.7	1.2	0.2	76.5	98.8	99.4

Source: HAZUS-MH MR3, 2007
Note(s):
T = Town
V = Village

Table 5.4.5-18. Estimated Impacts to Transportation Features in Greene County from the 500-year MRP Earthquake Event

500-year MRP Event									
			Percent Probability of Sustaining Damage					Percent Functionality	
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Sandy Plains	Athens (T)	Airport	89.4	7.3	3.1	0.1	0	97.8	99.8
Helipad	Athens (V)	Airport	99.4	0.5	0.1	0	0	99.9	99.9
Peckham Dock.	Athens (V)	Port	98.6	1.2	0.2	0	0	99.8	99.9
Phelps Terminal State Highway 385	Athens (V)	Port	89.4	7.3	3.2	0.1	0	97.8	99.8
Amos Post Athens Terminal Dock.	Athens (V)	Port	89.4	7.3	3.2	0.1	0	97.8	99.8
Catskill Valley Airpark	Cairo (T)	Airport	89.5	7.3	3.1	0.1	0	97.8	99.8
Independent Cement Plant Dock.	Catskill (T)	Port	98.6	1.1	0.2	0	0	99.8	99.9
Lehigh Portland Cement Co., Alsen Dock.	Catskill (T)	Port	98.6	1.1	0.2	0	0	99.8	99.9
Lehigh Portland Cement Co., Cementon Doc	Catskill (T)	Port	98.6	1.1	0.2	0	0	99.8	99.9
Laidlaw Transit Inc	Catskill (V)	Bus	99.4	0.5	0.1	0	0	99.9	99.9
Amos Post Catskill Terminal Dock.	Catskill (V)	Port	98.6	1.1	0.2	0	0	99.8	99.9
Deer Run	Coxsackie (T)	Airport	99.4	0.5	0.1	0	0	99.9	99.9
Freehold	Greenville (T)	Airport	89.3	7.4	3.2	0.1	0	97.8	99.8
Greenville - Rainbow	Greenville (T)	Airport	99.4	0.6	0.1	0	0	99.9	99.9
Hunter Mountain	Jewett (T)	Airport	99.4	0.5	0.1	0	0	99.9	99.9
Wayne Delp	New Baltimore (T)	Airport	99.4	0.6	0.1	0	0	99.9	99.9
Adirondack Trailways	Tannersville (V)	Bus	99.4	0.5	0.1	0	0	99.9	99.9
Laidlaw Transit Inc	West Coxsackie	Bus	98.5	1.2	0.2	0	0	99.8	99.9

Source: HAZUS-MH MR3, 2007
Notes:
T = Town
V = Village

Table 5.4.5-19. Estimated Impacts to Transportation Features in Greene County from the 2,500-year MRP Earthquake Event

2,500-year MRP Event										
			Percent Probability of Sustaining Damage					Percent Functionality		
Name	Town	Type	None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Sandy Plains	Athens (T)	Airport	49.8	20	24.8	4.4	1	79.7	95.7	96.2
Helipad	Athens (V)	Airport	93.6	4.7	1.6	0	0	98.9	99.9	99.9
Peckham Dock.	Athens (V)	Port	81.9	11.2	6.4	0.4	0.1	95.5	99.6	99.6
Phelps Terminal State Highway 385	Athens (V)	Port	49.6	20	24.9	4.4	1	79.6	95.6	96.2
Amos Post Athens Terminal Dock.	Athens (V)	Port	49.6	20	24.9	4.4	1	79.6	95.6	96.2
Catskill Valley Airpark	Cairo (T)	Airport	50	20	24.7	4.3	1	79.8	95.7	96.2
Independent Cement Plant Dock.	Catskill (T)	Port	82.5	11	6.2	0.3	0.1	95.7	99.6	99.6
Lehigh Portland Cement Co., Alsen Dock.	Catskill (T)	Port	82.5	11	6.2	0.3	0.1	95.7	99.6	99.6
Lehigh Portland Cement Co., Cementon Doc	Catskill (T)	Port	82.5	11	6.2	0.3	0.1	95.7	99.6	99.6
Laidlaw Transit Inc	Catskill (V)	Bus	93.4	4.8	1.7	0	0	98.8	99.9	99.9
Amos Post Catskill Terminal Dock.	Catskill (V)	Port	82.5	11	6.2	0.3	0.1	95.7	99.6	99.6
Deer Run	Coxsackie (T)	Airport	93.6	4.7	1.6	0	0	98.9	99.9	99.9
Freehold	Greenville (T)	Airport	49.6	20	24.9	4.4	1	79.6	95.6	96.1
Greenville - Rainbow	Greenville (T)	Airport	93.4	4.8	1.7	0	0	98.8	99.9	99.9
Hunter Mountain	Jewett (T)	Airport	93.6	4.7	1.6	0	0	98.9	99.9	99.9
Wayne Delp	New Baltimore (T)	Airport	93.4	4.9	1.7	0	0	98.8	99.9	99.9
Adirondack Trailways	Tannersville (V)	Bus	93.5	4.8	1.6	0	0	98.9	99.9	99.9
Laidlaw Transit Inc	West Coxsackie	Bus	81.6	11.4	6.6	0.4	0.1	95.4	99.6	99.6

Source: HAZUS-MH MR3, 2007

HAZUS-MH MR3 also estimates the volume of debris that may be generated as a result of an earthquake event to enable the study region to prepare and rapidly and efficiently manage debris removal and disposal. Debris estimates are divided into two categories: (1) reinforced concrete and steel that require special equipment to break it up before it can be transported, and (2) brick, wood and other debris that can be loaded directly onto trucks with bulldozers (HAZUS-MH Earthquake User's Manual). For the 100-year MRP event, HAZUS-MH MR3 estimates approximately no debris will be generated. For the 500-year MRP event, HAZUS-MH MR3 estimates approximately 4.3 tons of debris will be generated (approximately 3.1 tons of brick/wood debris and 1.2 tons of reinforced concrete/steel debris). For the 2,500-year MRP event, HAZUS-MH MR3 estimates more than 31.6 tons of debris will be generated (approximately 18.8 tons of brick/wood debris and 12.8 tons reinforced concrete/steel debris). Table 5.4.5-20 below displays the amounts of debris generated by 500- and 2,500-year MRP events.

Table 5.4.5-20. Estimated Debris Generated by the 500- and 2,500-year MRP Earthquake Events

Town	500-Year		2,500-Year	
	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Ashland (T), Prattsville (T) and Windham (T)	0.2	0.1	1.4	0.6
Athens (T) and Athens (V)	0.2	0.0	1.1	0.5
Cairo (T)	0.3	0.1	1.6	0.7
Catskill (T)	0.3	0.1	2.1	1.0
Catskill (V)	0.3	0.1	1.6	0.8
Coxsackie (T)	0.2	0.1	1.3	1.5
Coxsackie (V)	0.9	0.5	5.5	6.0
Durham (T) and Greenville (T)	0.3	0.1	1.7	0.8
Halcott (T), Lexington (T), Jewett (T), Hunter (T), Hunter (V), Tannersville (V)	0.2	0.1	1.6	0.6
New Baltimore (T)	0.1	0.0	0.8	0.4
Greene County (Total)	**3.1**	**1.2**	**18.8**	**12.8**

Source: HAZUS-MH MR3, 2007
Notes: T = Town. V = Village.

Future Growth and Development

As discussed in Section 4 and in each community's annex (Volume II, Section 9), areas targeted for future growth and development have been identified across the County. It is anticipated that the human exposure and vulnerability to earthquake impacts in newly developed areas will be similar to those that currently exist within the County. Current building codes require seismic provisions that should render new construction less vulnerable to seismic impacts than older, exisiting construction that may have been built to lower construction standards.

Additional Data and Next Steps

A Level 1 HAZUS-MH earthquake analysis was conducted for Greene County using the default model data, with the exception of the updated critical facility inventory which included user-defined data. For future plan updates, a Level 2 HAZUS analysis can be conducted. A Level 2 analysis provides more accurate loss estimates by replacing the national default inventories with more accurate local inventories. Additional data needed to conduct a Level 2 HAZUS-MH analysis would include: (1) updated demographic and building stock data to refine/update the default data for all jurisdictions; and (2) soil

liquefaction data. In terms of general building stock data, updated building age, construction type and current replacement value would further support the refined analysis.

Overall Vulnerability Assessment

Earthquakes are occasional events in the study area causing impacts and losses mainly to the County's structures and facilities. Existing and future mitigation efforts should continue to be developed and employed that will enable the study area to be prepared for these events when they occur. The overall hazard ranking determined by the Planning Committee for this hazard is 'Low' (see Table 5.3-6).