SECTION 3a- RISK ASSESSMENT: HAZARD PROFILES

Overview

Detailed profiles of hazards identified in the previous section as worthy of further evaluation in the overall risk assessment are provided in this section. Each hazard profile includes a description of the hazard and its causes and impacts, the location and extent of areas subject to the hazard, known historical occurrences, and the probability of future occurrences. The profiles also include specific information noted by members of the planning committee and other stakeholders, including unique observations or relevant anecdotal information regarding individual historical hazard occurrences and individual jurisdictions.

The following table summarizes each hazard, and whether or not it has been identified as a hazard worthy of further evaluation for each of the 22 municipal jurisdictions in the County. Following Table 3a.1, Figure 3a.1 presents a map of Rensselaer County for reference, including the most significant transport links and the location and boundaries of each participating jurisdiction.

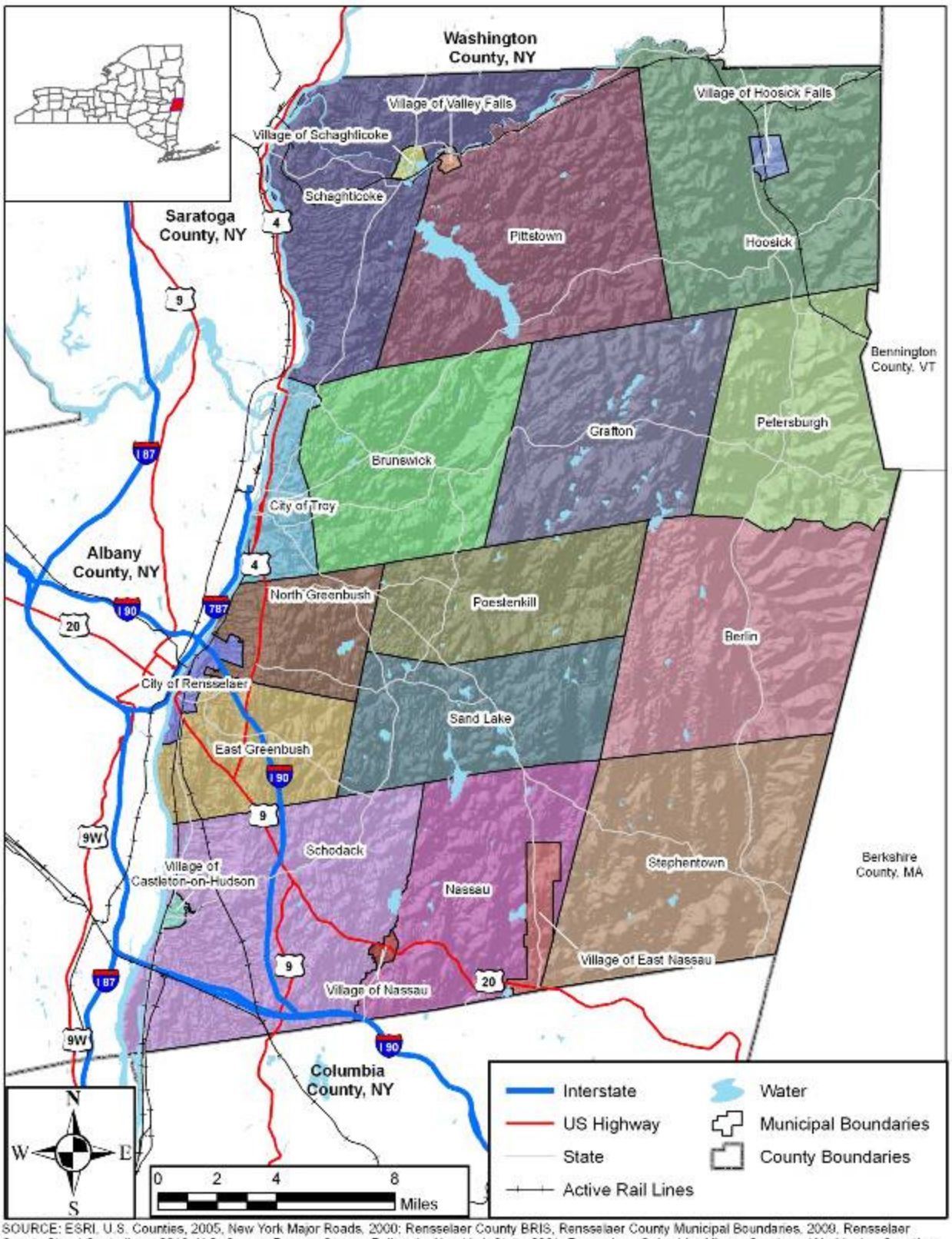
Table 3a.1
Summary of Profiled Hazards by Municipality

Jurisdiction	Extreme Temperatures	Extreme Wind	Hurricane and Tropical Storm	Tornado	Lightning	Winter Storm	Dam Failure[1]	Drought	Flood[2]	Ice Jam[3]	Earthquake	Landslide[4]	Wildfire[5]
Rensselaer, County of	■	■	■	■	■	■	■	■	■	■	■	■	■
Berlin, Town of	■	■	■	■	■	■		■	■		■	■	■
Brunswick, Town of	■	■	■	■	■	■	■	■	■		■	■	■
Castleton-on-Hudson, Village of	■	■	■	■	■	■		■	■	■	■	■	■
East Greenbush, Town of	■	■	■	■	■	■		■	■		■	■	■
East Nassau, Village of	■	■	■	■	■	■		■	■		■		■
Grafton, Town of	■	■	■	■	■	■	■	■	■		■		■
Hoosick, Town of	■	■	■	■	■	■		■	■	■	■	■	■
Hoosick Falls, Village of	■	■	■	■	■	■		■	■		■	■	■
Nassau, Town of	■	■	■	■	■	■		■	■	■	■		■
Nassau, Village of	■	■	■	■	■	■		■	■		■		■
North Greenbush, Town	■	■	■	■	■	■		■	■		■	■	■
Petersburgh, Town of	■	■	■	■	■	■		■	■	■	■	■	■
Pittstown, Town of	■	■	■	■	■	■	■	■	■		■	■	■
Poestenkill, Town of	■	■	■	■	■	■	■	■	■	■	■	■	■
Rensselaer, City of	■	■	■	■	■	■	■	■	■		■	■	■
Sand Lake, Town of	■	■	■	■	■	■		■	■		■		■
Schaghticoke, Town of	■	■	■	■	■	■	■	■	■		■	■	■
Schaghticoke, Village of	■	■	■	■	■	■	■	■	■		■		■
Schodack, Town of	■	■	■	■	■	■		■	■		■	■	■
Stephentown, Town of	■	■	■	■	■	■		■	■		■	■	■
Troy, City of	■	■	■	■	■	■	■	■	■	■	■	■	■
Valley Falls, Village of	■	■	■	■	■	■	■	■	■		■		■

Notes to accompany Table 3a.1:

1. Based on the identification of improved property in dam failure inundation areas on current EAP maps, or the presence of a high hazard dam (NYSDEC classification) either in the municipality or close upstream on a watercourse flowing through that municipality
2. Based on identification of improved property in mapped flood hazard zones (FEMA Q3 data)
3. Based on historical records, Flood Insurance Studies, and local information
4. Based on identification of improved property in mapped high incidence or high susceptibility landslide risk zones, plus those municipalities in which details of individual landslide events are available.
5. Based on identification of improved property in mapped wildfire hazard zones

Figure 3a.1: Rensselaer County Base Map



SOURCE: ESRI, U.S. Counties, 2005; New York Major Roads, 2000; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009, Rensselaer County Street Centerlines, 2010; U.S. Census Bureau, Census Railroads, New York State, 2001, Rensselaer, Columbia, Albany, Saratoga, Washington Counties, Area Hydrography, 2007; USGS, 1-Arc Second National Elevation Dataset, 2009

Extreme Temperatures

Extreme temperatures principally affect the health and safety of the human population, although they can also impact livestock, agricultural crops, and may also cause damage to infrastructure and property. This section provides detailed profiles of both extreme high and extreme low temperatures.

Description – Extreme Temperatures

Extreme Cold

According to National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS), the term "extreme cold" constitutes different conditions in different parts of the country, ranging from near freezing in the South to temperatures well below zero in the North.

In the South, temperatures near or just below freezing can cause pipes to burst in homes that are poorly insulated or without heat. In the North, where most buildings are insulated to a degree that can protect against most common winter temperatures for the area, long spells of below zero temperatures can result in increased numbers of people using space heaters and fireplaces to stay warm, thus increasing the risk of household fires and carbon monoxide poisoning. In addition, extreme cold can cause rivers to freeze, and ice jams to form, leading to flooding. Regardless of location, freezing temperatures can cause severe damage to crops and other vegetation; increased strain on community shelter facilities providing refuge from the cold to homeless populations and others in need; and an increased likelihood that automobiles/buses will fail to start. Local sources also report that fire departments are called to a noticeably higher number of chimney fires during periods of extreme cold.

Extreme cold can have severe negative impacts on human beings, including frostbite (an injury to the body that is caused by freezing) and hypothermia (the unintentional lowering of the body's core temperature to below 95 degrees Fahrenheit, which typically causes uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and apparent exhaustion). The NWS reports that extreme cold causes the death of roughly 26 people per year nationwide (based on a 10-year average). High winds during a period of extreme cold can exacerbate these affects, as the winds work to carry heat away from the body.

According to the New York State Climate Office, extreme cold events in New York State occur regularly, and are most common between October and March. They are most likely to occur in the northern and western portions of the state, and occur less often as one travels south toward New York City and Long Island. The record coldest temperature in New York State is -52° at Stillwater Reservoir (northern Herkimer County) on February 9, 1934 and also at Old Forge (also northern Herkimer County) on February 18, 1979. Some 30 communities have recorded temperatures of -40° or colder, most of them occurring in the northern one-half of the state and the remainder in the Western Plateau Division and in localities just south of the Mohawk Valley.

Extreme Heat

FEMA defines the term "extreme heat" as the condition whereby temperatures hover ten degrees or more above the average high temperature for a region, and last for several weeks. Extreme heat can also contribute to increased demand on energy supplies resulting from increased air conditioning usage, and an associated increased potential for power shortages or outages; an increased demand on medical offices, hospitals, etc. as individuals suffering from various heat related health effects seek medical attention or shelter in air conditioned facilities; and also crop losses under certain circumstances.

Some Core Planning Group members expressed concerns about the potential effects of power outages triggered by extreme temperature events, noting the vulnerability of critical facilities such as senior living centers, sewage treatment plants, and water treatment facilities (including public water supply well sites and pump stations).

The National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) has reported that heat waves occur during most summers in at least some part(s) of North America. East of the Rocky Mountains, high temperatures are often combined with high humidity. Highest temperatures of record and average relative humidity would be sufficient to cause heat-related health effects in all states. Health effects associated with extreme heat can begin with air temperatures as low as 80 degrees Fahrenheit and concurrent relative humidity of at least 40 percent.

Extreme heat can have severe negative impacts on human beings, including heat-related illnesses such as sunburn, fatigue, and heat cramps, heat exhaustion, and heat strokes. The NWS reports that heat waves cause the death of roughly 175 people per year nationwide. High humidity levels during a period of extreme heat can exacerbate these affects. Similarly, periods of extreme heat in urban areas can also result in magnified impacts on human health. This is primarily due to the combined affects of pollutant concentrations, high temperatures/humidity, and poor air circulation.

According to the New York State Climate Office, extreme heat events in New York State occur regularly, and are most common between May and mid-September. They are least likely to occur in the northern and western portions of the state, and occur more often as one travels south toward New York City and Long Island. The New York City area and most of the Hudson Valley record an average of from 18 to 25 days with such temperatures during the warm season, but in the Northern and Southern Plateaus the normal quota does not exceed 2 or 3 days. While temperatures of 100° are rare, many long-term weather stations, especially in the southern one-half of the State, have recorded maximums in the 100° to 105° range on one or more occasions. The highest temperature of record in New York State is 108° at Troy on July 22, 1926. Temperatures of 107° have been observed at Lewiston, Elmira, Poughkeepsie, and New York City.

Location and Extent – Extreme Temperatures

Rensselaer County is located in a region of the country that is susceptible to extreme heat and extreme cold. During periods of extreme temperature conditions the effects will be felt over a widespread geographic area, and it is generally assumed that Rensselaer County and all of its municipalities are uniformly exposed to extreme heat and extreme cold. The effects of extreme temperatures will be primarily limited to young children and the elderly, with occasionally minor, sporadic property damages (i.e., bursting pipes) and damages to crops and other vegetation. According to estimated 2006 US Census data reported in the New York State Hazard Mitigation Plan (NYSHMP), the percentage of the Rensselaer County population most susceptible to extreme temperatures (under 5yrs and over 65yrs) is 18.5%, slightly lower than the statewide average of 19.5%.

Historical Occurrence – Extreme Temperatures

The National Climatic Data Center (NCDC) at NOAA holds extreme temperature event data for Rensselaer County starting in February 1993. According to this database, Rensselaer County has been included in the area affected by 12 relevant extreme temperature events. No deaths or injuries were attributed to these events and the database includes a total of $50,000 in property damages for only one event. New York State has received no Federal Disaster or Emergency Declarations due solely to extreme temperatures. It should be noted that while the NCDC records seven specific extreme cold

events in the County, the NCDC records Rensselaer County as affected by a much larger number of winter storms involving snowfall and ice accumulation. These events are discussed in detail in subsequent sections. The Spatial Hazard Events and Losses Database for the United States (SHELDUS) records one extreme heat event in Rensselaer County in July of 1988, to which less than $2,000 in damages were attributed, but no further details or descriptions are available.

Extreme temperature events listed by NCDC as affecting Rensselaer County include the following:

Extreme Cold

February 1-2, 1993
An Arctic high pressure center descended from the Upper Great Lakes Region and moved into northern New York early on February 2nd. A strong pressure gradient which was set up across the area on February 1st produced northerly winds of 15 to 30 mph. The strong winds coupled with temperatures between 5 below zero and 10 above zero resulted in wind chill readings of 30 to 40 below zero in many areas. Temperatures fell so fast in the Mohawk Valley that transmission lines snapped leaving 10,000 customers without power. The winds diminished by the evening of the 1st and by the morning of February 2nd temperatures of 10 to 30 below zero were common across much of the area.

January 6, 1996
An arctic airmass settled over eastern New York on the 6th of January bringing extreme cold to the region. A record low was set in Albany with a reading of -19 degrees. This broke the old record low of -14 degrees set back in 1972.

January 15-16, 2004
An extremely cold airmass moved out of Siberia, then plunged southward through Canada and across the northeast by January 15. At the same time, a powerful storm developed off the Canadian Maritimes. The pressure gradient between the intense storm and the arctic high pressure, extending from central Canada southward through the Ohio Valley, produced gusty north to northwest winds in the 15 to 30 mph range, with higher gusts. This wind, combined with ambient temperatures ranging from zero to 15 below zero, resulted in dangerous wind chills across eastern New York during the night of January 15 through the morning of the 16th. Equivalent wind chill readings ranged from 25 to 30 below zero in the Mid Hudson Valley, to as low as 50 below zero across the Western Adirondacks. The brutal cold spell resulted in many closed schools and businesses on the 16th. The cold also resulted in a scattering of frozen and broken water pipes.

January 16, 2009
A bitterly cold air mass spread across much of east central New York and adjacent western New England during Friday January 16th. Widespread subzero temperatures were recorded across the region, with temperatures as low as -32 F recorded at Indian Lake in Hamilton County, and -30 F in Speculator. In addition, some wind added to the extreme cold across portions of the southern Adirondacks and eastern Catskills, with wind chills of -20 to -25 F.

Extreme Heat

Date Unspecified
The Core Planning Group noted that Rensselaer County had a case of extreme temperature fluctuation in the 1980's which caused a train derailment outside of North Petersburgh when the

steel of the rails responded to a temperature fluctuation of 50 degrees in one hour at the time of the passing train

June 7, 1999
On June 7, the season's second Bermuda High brought the first 90 degree temperature of 1999 to much of eastern New York. At the Albany International Airport it was the first official 90 degree temperature since August 16, 1997. The temperature did not stop there, but soared all the way to 95 degrees. This value tied the daily record for the date last set in 1925. The combination of heat and humidity produced a heat index between 100 and 105 degrees during the hottest portion of the day.

July 4-6, 1999
An intense Bermuda high became established over the mid Atlantic region during the Independence Day weekend. This high pumped heat along with very high humidity across eastern New York, especially on July 5 and 6. Temperatures soared to 90 or higher most everywhere while dewpoints climbed well into the 70s. At the Albany International airport, the temperature peaked at 94 on July 5 and 95 on July 6. However, after combining humidity values, the heat index reached as high as 105 on both days. On July 5, the dewpoint reached 79 to produce a heat index of 119 degrees. The heat index peaked around 110 degrees on July 6. The sultry air mass set the stage for a large severe thunderstorm outbreak during the afternoon of July 6 across eastern New York.

August 8-9, 2001
A strong Bermuda high developed early in August and brought the most extensive heat wave of the summer to eastern New York and adjacent New England between August 6 and 9. Officially, at the Albany International Airport, there were four consecutive days of 90 degrees or higher, the longest such stretch in over six years. The heat wave reached its peak on August 8 and 9. During those days, the high reached 100 and 102 at Poughkeepsie respectively. On those same days the Albany International Airport reached 93 and 96. The 96 was a new daily maximum record for August 9, eclipsing the old record of 94 set in 1949. Humidity levels were also high, which produced heat indices between 105 and 110 near Albany, and 110 to 115 closer to Poughkeepsie. The high heat indices did cause some heat related problems: 13 children from the Patersonville Camp in Schenectady County were treated for heat-related issues, nine of them in hospital. While there no other heat related problems reported to the National Weather Service, the heat led to record state electricity consumption, three days in a row. Governor Pataki closed down the State government at 2:00 PM on August 9 to conserve power. Hot weather also caused the railroad bridge to malfunction between the cities of Albany and Rensselaer, resulting in delays for four Amtrak passenger trains on August 9.

June 9-10, 2008
Unseasonably hot and humid conditions persisted from Monday June 9th, until Tuesday afternoon on June 10th. Temperatures reached the mid to upper 90s across much of the mid Hudson Valley and Capital Region during each afternoon. The combination of high temperatures and humidity levels produced heat indices of 100 to 104 degrees. Many schools across the region either cancelled classes, or had early dismissals due to the extreme heat.

Dates Unspecified
The Core Planning Group noted that extreme heat events in the past have caused pavement buckling, mainly on the interstates but also on other roadways, causing damage to passing vehicles.

Probability of Occurrence – Extreme Temperatures

Extreme heat events and extreme cold events not involving other manifestations of severe winter weather will remain an infrequent occurrence in Rensselaer County, and the probability of future occurrences in Rensselaer County is fairly certain, depending on the type of occurrence.

Based on historical records over the last 17 years, in New York State, extreme temperature events of all types can be expected to occur approximately 6.3 times per year. Of these, 4.1 are likely to be extreme cold events, and 2.2 are likely to be extreme heat events, making extreme cold events are likely to occur in any given year with approximately double the frequency of extreme heat. Based on NCDC records for Rensselaer County, this trend is different in the planning area, where, based on NCDC records of the last 17 years, extreme cold events are marginally more likely in any given year than extreme heat events, but unseasonal warmth events are more likely than unseasonal cold events. Overall, the available information suggests that Rensselaer County can expect to experience a serious extreme cold event once every two to three years, and an extreme heat event once every three to four years.

Extreme Wind

Description – Extreme Wind

Wind, as defined by the American Meteorological Society, is air that is in constant motion relative to the surface of the earth. Since vertical components of atmospheric motion are relatively small, especially near the surface of the earth, meteorologists use the term "wind" to denote almost exclusively the horizontal component. Extreme winds are most commonly the result of tornadoes, hurricanes, tropical cyclones, extratropical cyclones (northeasters), destructive wind, and thunderstorms, but can also occur in their absence as mere "windstorms".

Extreme wind events might occur over large, widespread areas or in a very limited, localized area. They can occur suddenly without warning. They can occur at any time of the day or night, at any location within Rensselaer County. Extreme winds pose a significant threat to lives, property, and vital utilities due to flying debris, such as rocks, lumber, fuel drums, sheet metal and loose gear of any type that can be picked up by the wind and hurled with great force. Extreme winds also down trees and power lines, often resulting in power outages across an affected area."

(1) Tornadoes: Tornadoes are the most commonly known type of windstorm causing the most damage to property and life and all is due to severe winds. As researched by FEMA, there are, on average, 10 severe windstorms, classified as tornadoes, in the United States defined as F4 or F5 on the Fujita scale. (The Fujita scale reflects how much wind damage results from a tornado expressed in wind speeds. For example, wind speeds can vary between 50 and 250 mph in a typical F5 tornado.)

(2) Hurricanes: A hurricane is a tropical storm with winds that have reached a constant speed of 74 mph or more. Hurricane winds blow in a large spiral around a relative calm center known as the "eye." The "eye" is generally 20 to 30 miles wide.

(3) Coastal Storms: Coastal storms include both tropical cyclones and extratropical cyclones. The National Weather Service defines these terms as follows:

- Cyclone: An area of low pressure around which winds blow counterclockwise in the Northern Hemisphere. Also, the term used for a hurricane in the Indian Ocean and in the Western Pacific Ocean.

- Tropical Cyclone: A cyclone that forms over tropical or sub-tropical waters around centers of low barometric pressure. Tropical cyclones derive their energy from the ocean. Tropical cyclones can be further broken down according to maximum sustained winds, as follows:

Tropical Depression:	Winds < 39mph
Tropical Storm:	39 mph ≤ Winds < 74 mph
Hurricane: *	Winds ≥ 74 mph

** Note that "hurricanes" are tropical cyclones that develop over the Atlantic Ocean, northeast Pacific Ocean, or south Pacific Ocean. Similar storms that develop over the western North Pacific Basin are referred to as "typhoons" (or, if maximum sustained winds are at least 150 mph, "super typhoons").*

- Extratropical Cyclone: A non-tropical cyclone that forms around a center of low barometric pressure and derives its energy from the atmosphere. Extratropical cyclones are more commonly referred to as "winter storms." Extratropical storms can be experienced on both the East and West Coasts of the United States. On the East Coast, extratropical cyclones are often called "Nor'easters" due to the direction of the storm winds.

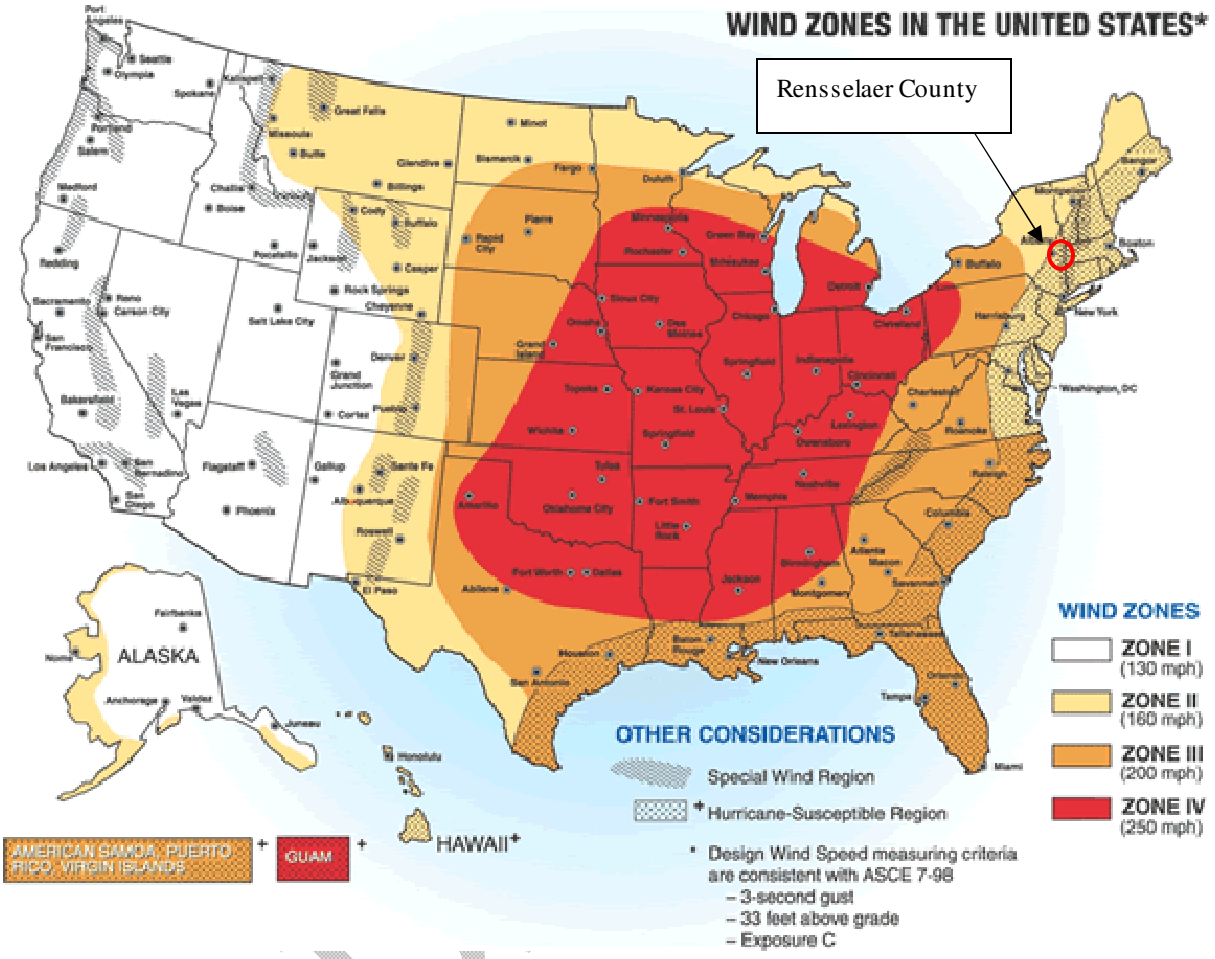
(4) Destructive Wind: Destructive wind is a windstorm that poses a significant threat to life and property and destroying everything in its path. Destructive wind can also cause damage by flying debris, such as rocks, lumber, fuel drums, sheet metal and loose gear of any type which can be picked up by the wind and hurled with great force.

(5) Thunderstorms: A thunderstorm is a combination of moisture, rapidly rising warm air and forceful winds capable of lifting air that's either warm or cold. They also contain lightning and thunder.

Location – Extreme Winds

Extreme wind events are experienced in every region of the United States. A useful tool for determining the location of the extreme wind hazard area in a jurisdiction is depicted in Figure 3a.2 - Wind Zones in the United States. This map of design wind speeds was developed by the American Society of Civil Engineers. It divides the United States into four wind zones, geographically representing frequency and magnitude of potential extreme wind events. The figure shows that Rensselaer County and its jurisdictions are within a single wind zone; Zone II, with a design wind speed for shelters of 160 miles per hour, and that the region in which the County is located is also considered to be susceptible to hurricanes, which are the subject of a detailed profile later in this section.

Figure 3a.2 - Wind Zones in the United States



Extent – Extreme Winds

The severity of a severe wind event depends upon the maximum sustained winds experienced in any given area. Extreme winds pose a significant threat to lives, property and infrastructure due to direct wind forces but also flying debris, such as rocks, lumber, fuel drums, sheet metal and loose gear of any type that can be picked up by the wind and hurled with great force. Extreme winds also down trees and power lines that often result in power outages across an affected area. Table 3a.2 illustrates the severity and typical effects of various wind speeds, as obtained from the NOAA NCDC web site.

Table 3a.2
Severity and Typical Effects of Various Speed Winds

Maximum Wind Speeds	Equivalent Saffir-Simpson Scale* (Hurricanes)	Equivalent Fujita Scale (Tornadoes)	Severity	Typical Effects
40-72 mph *(35-62 kt)*	Tropical Storm = 39-73 mph	F0	Minimal	Some damage to chimneys; breaks twigs and branches off tress; pushes over shallow-rooted trees; damages signboards; some windows broken; hurricane wind speed begins at 73 mph.
73-112 mph *(63-97 kt)*	Cat 1 = 74-95mph Cat 2 = 96-110 mph Cat 3 = 111-130 mph	F1	Moderate	Peels surfaces off roofs; mobile homes pushed off foundations or overturned; outbuildings demolished; moving autos pushed off the roads; trees snapped or broken.
113-157 mph *(98-136 kt)*	Cat 3 = 111-130 mph Cat 4 = 131-155 mph Cat 5 > 155 mph	F2	Considerable	Roofs torn off frame houses; mobile homes demolished; frame houses with weak foundations lifted and moved; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
158-206 mph *(137-179 kt)*	Cat 5 > 155 mph	F3	Severe	Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forests uprooted; heavy cars lifted off the ground and thrown; weak pavement blown off roads.
207-260 mph *(180-226 kt)*	? Cat 5 > 155 mph	F4	Devastating	Well constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and disintegrated; large missiles generated; trees in forest uprooted and carried some distance away. The maximum wind speeds of hurricanes are not likely to reach this level.
261-318 mph *(227-276 kt)*	N/A	F5	Incredible	Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 300 ft (100 m); trees debarked; incredible phenomena will occur. The maximum wind speeds of hurricanes are not expected to reach this level.
Greater than 319 mph *(277 kt)*	N/A	F6	N/A	The maximum wind speeds of tornadoes are not expected to reach this level. The maximum wind speeds of hurricanes are not expected to reach this level.

** The Saffir-Simpson Scale is a five-category wind speed / storm surge classification scale used to classify Atlantic hurricane intensities. The Saffir-Simpson values range from Category 1 to Category 5. The strongest SUSTAINED hurricane wind speeds correspond to a strong F3 (Severe Tornado) or possibly a weak F4 (Devastating Tornado) value. Whereas the highest wind gusts in Category 5 hurricanes correspond to moderate F4 tornado values, F5 tornado wind speeds are not reached in hurricanes.*

Previous Occurrences – Extreme Winds

Rensselaer County has experienced numerous damaging extreme wind events in the past including hurricanes and tropical storms, severe thunderstorms and tornadoes.

NOAA's NCDC database records 172 high wind and thunderstorm wind events affecting Rensselaer County between August 1962 and May 2010 (data includes wind events greater than 50 knots/57.5mph, with the exception of tornado events which are addressed separately within this section). It should be noted that detailed recording for this event category appears to have started in the mid 1980s (only 23 of these events are recorded before 1986), and descriptions are only available for wind events from the early 1990s onwards. Although these incidents resulted in a reported total of one death and 12 injuries across the region which they affected, only two injuries could be confirmed as having occurred in Rensselaer County. Some significant high wind events recorded by NCDC for which the event descriptions specifically refer to impacts in Rensselaer County include the events presented in Table 3a.3 below.

Table 3a.3
Selected Damaging Wind Events in Rensselaer County
(Source: NOAA NCDC)

Date	Affected Areas	Description	Recorded Property Damage*
9/10/1993	Town of Nassau	Thunderstorm winds downed trees and power lines in the southeast corner of the Town of Nassau.	$5,000
11/2/1994	City of Troy	High winds resulted in damage across parts of eastern New York as trees and power lines were downed, in Rensselaer County Troy was the hardest hit.	$5,000
12/24/1994	Rensselaer County	Trees, tree limbs and power lines were downed by high winds in Rensselaer County	$500,000
2/4/1995	Town of Stephentown	high winds downed trees and power lines with wind gusts in excess of 50 knots reported in Stephentown.	$50,000
4/23/1996	Town of Hoosick	A severe thunderstorm downed many trees, took the roof off a double wide trailer home and moved an old barn off its foundation.	$45,000
12/1/1996	Rensselaer County	Damaging winds downed trees and power lines over parts of eastern New York. Damage was most widespread in Saratoga, Warren and Rensselaer Counties.	$115,000
7/3/1997	Town of Stephentown	Thunderstorm winds lifted a barn and dropped it on East Road. Many trees and power lines were also downed by the wind.	$30,000
7/6/1999	City of Rensselaer, Town of Pittstown	Powerful thunderstorms brought down trees and power lines in many localities. A microburst was recorded in Rensselaer, bringing a large number of trees down. In addition, roofs were peeled off homes. An even more destructive microburst with estimated winds of 100 mph brought thousands of trees down between Raymertown and Pittstown, and tore roofs off storage buildings.	$500,000
9/16/1999	Rensselaer County	Rensselaer County was included in the area covered by the disaster declaration following Tropical Storm Floyd.	$3,700,000
5/24/2000	Town of East Greenbush	Trees and power lines were blown down in East Greenbush.	$9,000
6/2/2000	City of Troy, Town of Hoosick	Trees were downed in and around Troy. Downed power lines resulted in a fire which damaged a home in North Hoosick. More trees were knocked down in Buskirk. At the height of the storm, as many as 30,000 customers in and around the Capital District had no electric or gas power. An additional 20,000 customers had no power across the Mid Hudson Valley and Catskill region.	$29,000
6/25/2000	Town of Berlin, Town of Brunswick, Town of Grafton, Town of Pittstown	Thunderstorm winds blew down trees in Brunswick, Berlin, Tomhannock and Grafton Lake. In Tomhannock, trees were uprooted near the reservoir with two falling on houses. Wind gusts were estimated to be in the 60 to 100 mph range at Grafton State Park, which not only resulted uprooted many trees but damaged camps and year-round houses. Power lines were also downed.	$22,000
8/3/2000	City of Troy, Town of Nassau, Town of East Greenbush, Village of Castletonn	Numerous trees were reported down in Nassau and East Greenbush. Trees and wires were also downed at Castleton-on-Hudson. Also, wind damaged St. Joseph's Church in South Troy.	$17,000

Table 3a.3
Selected Damaging Wind Events in Rensselaer County
(Source: NOAA NCDC)

Date	Affected Areas	Description	Recorded Property Damage*
7/4/2001	Town of Schaghticoke, Town of Brunswick	Large tree limbs and power lines were brought down in Speigletown, Schaghticoke and Eagle Mills.	$10,000
7/10/2001	Town of East Greenbush	Trees and wires were blown down in the town of East Greenbush	$27,000
8/9/2001	Town of Schaghticoke	Trees and wires were blown down at Melrose.	$8,000
5/3/2002	Rensselaer County	Trees, large limbs and power lines were blown down in Rensselaer County	$30,000
5/31/2002	Rensselaer County	Downed trees and power lines in Rensselaer County.	$15,000
8/1/2002	Village of Castleton-on-Hudson	A large section of a roof was blown off a boat club facility in Castleton-on-Hudson.	$25,000
8/15/2002	City of Troy	Many wires and trees were blown down in the city of Troy.	$25,000
8/16/2002	Town of Pittstown, Town of Brunswick	Wind damage knocked down trees and power lines in Troy, Johnsonville, Pittstown and Brunswick.	$10,000
9/11/2002	Southeastern Rensselaer County	A large concentration of wind damage was recorded in southeastern Rensselaer County where Route 20 near Nassau was closed by many trees toppling onto power lines.	$118,000
8/22/2003	City of Troy	Wind gusts brought down power lines in Troy, which resulted in sporadic power losses.	$5,000
11/13/2003	Town of Schaghticoke	A portion of the roof of a convenience store was blown off in Melrose.	$275,000
4/19/2004	Town of Schodack, Town of North Greenbush	Strong wind gusts blew down wires in towns of Schodack and North Greenbush.	Not recorded
12/23/2004	Town of Schodack	Power lines were blown down in Schodack Center.	Not recorded
9/15/2005	Town of Pittstown	Severe thunderstorms knocked down trees and power lines.	Not recorded
10/16/2005	City of Troy	Trees and power lines were blown down in Troy.	Not recorded
1/18/2006	Town of Grafton	High winds brought down trees and power lines in Grafton	Not recorded
1/21/2006	Town of Schaghticoke	High winds blew down power lines and damaged at least one house in Schaghticoke.	$1,000
2/17/2006	Rensselaer County	Trees were blown down across a wide area causing major power outages. National Grid described the storm as the most damaging event in terms of the number of customers without service in more than five years. Niagara Mohawk Power Corporation reported that close to 120,000 people across eastern New York were without power from this wind storm.	Not recorded
6/19/2006	City of Troy	Trees and power lines were blown down in Troy.	Not recorded
12/1/2006	Town of Hoosick, Eastern Rensselaer County	Strong winds downed power lines in Hoosick. Numerous power outages were reported in eastern Rensselaer County from the strong winds.	Not recorded
5/31/2007	Town of North Greenbush	A police officer and firefighter were both injured in North Greenbush while rescuing two people from an auto accident during a thunderstorm, as a large tree limb fell on them due to strong winds	Not recorded
6/5/2007	Towns of Schaghticoke and Hoosick	Wires were reported downed by strong thunderstorm winds in Schaghticoke and Hoosick.	Not recorded

Table 3a.3
Selected Damaging Wind Events in Rensselaer County
(Source: NOAA NCDC)

Date	Affected Areas	Description	Recorded Property Damage*
7/9/2007	Town of Poestenkill, Central Rensselaer County	Numerous trees and wires were reported down across central Rensselaer county due to strong thunderstorm winds, particularly near Poestenkill.	Not recorded
7/9/2007	Town of Schodack	Multiple trees and wires were reported downed by strong thunderstorm winds in and near Schodack Center.	Not recorded
8/3/2007	City of Troy	Thunderstorm winds downed numerous trees and wires in several parts of Troy. Also, a roof was partially blown off of a building.	Not recorded
8/17/2007	Town of East Greenbush	Trees and wires were reported down in East Greenbush due to strong thunderstorm winds.	Not recorded
8/25/2007	Town of East Greenbush	Trees and wires were reported down in East Greenbush due to strong thunderstorm winds. One tree fell onto a house in East Greenbush, causing minor damage.	$5,000
8/25/2007	Town of Berlin	Trees and wires were reported downed in Berlin by strong thunderstorm winds.	Not recorded
8/30/2007	Town of Brunswick	Multiple trees and wires were reported downed in Brunswick by strong thunderstorm winds	Not recorded
12/23/2007	Town of Nassau, Town of Stephentown	Numerous power outages were reported in Nassau and Stephentown as a result of downed tree limbs and wires due to high winds.	Not recorded
5/31/2008	Town of Hoosick	Trees and wires were reported downed in Buskirk by strong thunderstorm winds and a barn was reportedly blown 120 feet from its location near Eagle Bridge.	Not recorded
6/22/2008	Town of Schaghticoke	Wires were reported downed in Reynolds by strong thunderstorm winds.	Not recorded
6/23/2008	Town of Nassau, Town of Schodack	Strong thunderstorm winds snapped power poles and downed wires in Nassau and Schodack.	Not recorded
7/18/2008	Town of East Greenbush	Trees and wires were reported down in East Greenbush due to strong thunderstorm winds.	Not recorded
7/19/2008	Town of Schodack	Trees and wires were reported down in East Schodack due to strong thunderstorm winds.	Not recorded
5/14/2009	Town of Schaghticoke, Town of Brunswick	Trees and wires were reported down and blocking State Route 40 Schaghticoke, as a result of strong winds. In addition, power lines were reported down near Brunswick Center, on Route 7..	$5,000
6/15/2009	Town of East Greenbush	Wires were reported downed in East Greenbush due to strong thunderstorm winds.	Not recorded
6/30/2009	Town of Petersburgh	Trees and wires were reported down in Petersburg due to strong thunderstorm winds.	Not recorded
12/9/2009	Town of Sand Lake	A radio tower was ripped from its foundation and a half mile swathe of trees was downed in Averill Park.	Not recorded
5/4/2010	City of Troy, Town of Poestenkill, Town of Schodack	Trees and wires were reported down in Snyders Corner due to strong thunderstorm winds. Several buildings were damaged in Troy, and wires were reported downed in Troy and Schodack Center.	$55,000

*May include damage incurred outside Rensselaer County

The SHELDUS database lists more than 250 storm events featuring high winds affecting Rensselaer County since February 1960 (including more than 170 events recorded before 1986) to which approximately $40 million in property damages was attributed. Since the SHELDUS database does not provide descriptions or locations of the impacts of individual events, the NCDC descriptions in Table 3a.3 will suffice to illustrate the effects of the high wind hazard in Rensselaer County, and the SHELDUS data has been primarily used in the estimation of potential damages arising due to extreme winds in Section 3c.

The Village of Castleton noted that historic extreme wind events impacting the Village have caused mostly damage to trees (as opposed to buildings and other types of improved property).

Probability of Occurrence – Extreme Winds

Extreme wind events will remain a very frequent occurrence in Rensselaer County, and the probability of future occurrences in Rensselaer County is certain. The entire planning area is susceptible to a range of recurring events that cause extreme wind conditions including severe thunderstorms (most frequent), hurricanes, and tornadoes. Table 3a.3 illustrates a summary of wind-related events in both New York and Rensselaer County based on historic occurrences reported in NOAA's NCDC Storm Events Database during the period from 1960 to 2010, and provides an associated average annual number of storms. It shows an average annual number of events which featured wind in excess of 50 knots (57.5mph), in Rensselaer County of at least 3.4 based solely on historical occurrences recorded by NCDC. Table 3a.4 does not include tornadoes, which are addressed later in this section.

Table 3a.4
Average Annual Number of High Wind Events (Statewide vs. Rensselaer County)
(Source: NOAA's NCDC Storm Events Database for the period January 1960 – August 2010)

Event Type	Total Number of Events in New York State	Total Number of Events in Rensselaer County	Average Annual Number of Events in New York State	Average Annual Number of Events in Rensselaer County
Thunderstorm and High Wind Events	9,413	168	188	3.4

Extreme winds can occur in Rensselaer County during tornadoes, hurricanes, and thunderstorms, but can also occur in their absence as mere "windstorms." Damage-causing extreme winds have a history of occurrence throughout Rensselaer County, and are highly likely to occur in the future on more than an annual basis.

Hurricanes and Tropical Storms

Hazards Associated with Hurricane and Tropical Storm Events

Hurricanes and tropical storms are particular types of *events*. The *hazards* associated with a hurricane or tropical storm event are: high winds, flooding (including storm surge), coastal erosion, and wave action. Each of the unique hazards associated with hurricane and tropical storm events are summarized briefly below, and addressed specifically elsewhere in the plan. Hurricane and tropical storm events are discussed in the remainder of this section.

- Winds. After making landfall, hurricane winds can remain at or above hurricane force well inland (sometimes more than 100 miles). In addition, hurricanes can also spawn tornadoes. Typically, the more intense a hurricane is, the greater the tornado threats. High winds are addressed separately in this document.
- Flooding. Upon making landfall, a hurricane rainfall can be as high as 20 inches or more in a 24-hour period, with amounts in the 10 to 15 inch range being most common. If the storm is large and moving slowly, the rainfall amounts can be much higher. Heaviest rainfall tends to be along the coastline, but sometimes there is a secondary maximum further inland. Following a hurricane, inland streams and rivers can flood and trigger landslides. Flooding can also be caused when drainage system capacities are exceeded. Flooding is addressed separately in this document.
- Storm Surge. Even more dangerous than the high winds of a hurricane is the storm surge, a dome of ocean water that is basically pushed ashore by the hurricane winds. Hurricane storm surge can be as much as 20 feet at its peak and 50 to 100 miles wide, depending on hurricane strength and depth of offshore waters. Generally, the stronger the hurricane and the shallower the offshore water depths, the higher the storm surge. Most hurricane fatalities and coastal damages are attributable to storm surge, as opposed to hurricane winds. Storm surge can cause the most damage when it occurs during high tides. Storm surge can come ashore as much as five hours in advance of the time that a hurricane makes landfall.
- Coastal Erosion. The currents created by the tide and storm surge, combined with wave action, can severely erode coastlines. Many buildings withstand hurricane force winds until their foundations, undermined by erosion, are weakened and fail.
- Wave Action**.** Hurricanes and tropical storms are also associated with significant wave action, which can damage not only buildings but infrastructure and protective features along ocean shorelines.

Description – Hurricanes and Tropical Storms

A **hurricane** is a severe tropical cyclone with winds that have reached a constant speed of 74 miles per hour or more. Hurricane winds blow in a large spiral around a relative calm center known as the "eye." The "eye" is generally 20 to 30 miles wide, and the system can extend outward from the eye by up to 400 miles. In the Northern Hemisphere, circulation is in a counterclockwise motion around the eye. These storms are usually short in duration but are extremely powerful and cause the greater amount of damage due to significant storm surges and high winds. If these systems have wind speeds of between 39 and 73 miles per hour, they are classified as **tropical storms**.

In the Atlantic basin, hurricanes and tropical storms are most likely to occur between June 1st and November 30th, with the peak number of events typically occurring between mid-August and late October.

Location – Hurricanes and Tropical Storms

No one jurisdiction within Rensselaer County is any more likely to have the path of such a system traverse within its borders than any other location, although due to the distance of Rensselaer County from the coastline, most hurricanes that reach the New York State area are likely to become downgraded to tropical storms if they move any distance inland. Because of the size of hurricane and tropical storm systems, areas within Rensselaer County can still be affected even when the eye makes landfall outside of Rensselaer County. The hazards associated with hurricane and tropical storm events have distinct hazard area locations, discussed in other sections of this report. For Rensselaer County, these include wind and flood hazards.

Extent – Hurricanes and Tropical Storms

The magnitude or severity of hurricanes is categorized by the Saffir-Simpson scale. The Saffir-Simpson Scale is a five-category wind speed / storm surge classification scale used to classify Atlantic hurricane intensities. The scale is used to give an estimate of the potential property damage and flooding that can be expected. The Saffir-Simpson values range from Category 1 to Category 5, as shown in Table 3a.5. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf in the landfall region.

Note that, for tropical storms (not represented on the scale), winds are between 39 and 73 miles per hour and typical effects include breakage of twigs and branches off tress, toppling of shallow-rooted trees, and some damage to signboards and windows. The magnitude or severity of hurricane and tropical storm events will increase under the following conditions:

- as the storm category increases;
- as the diameter of the storm system increases;
- as the system's forward speed decreases;
- as rainfall amounts increase;
- as the quantity of people, structures and infrastructure in the affected areas increases.

Table 3a.5
The Saffir-Simpson Hurricane Scale

Category	Wind Speed (miles per hour)	Storm Surge (feet above normal sea level)	Expected Damage	Photo Example
1	74-96 mph	4-5 ft	Minimal: Damage is done primarily to shrubbery and trees, unanchored mobile homes are damaged, some signs are damaged, no real damage is done to structures	
2	96-110 mph	6-8 ft	Moderate: Some trees are toppled, some roof coverings are damaged, and major damage is done to mobile homes.	
3	111-130 mph	9-12 ft	Extensive: Large trees are toppled, some structural damage is done to roofs, mobile homes are destroyed, and structural damage is done to small homes and utility buildings.	

Table 3a.5
The Saffir-Simpson Hurricane Scale

Category	Wind Speed (miles per hour)	Storm Surge (feet above normal sea level)	Expected Damage	Photo Example
4	131-155 mph	13-18 ft	Extreme: Extensive damage is done to roofs, windows, and doors; roof systems on small buildings completely fail; some curtain walls fail.	
5	Greater than 155 mph	Greater than 18 ft	Catastrophic: Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, and entire buildings could fail.	

** Source: FEMA's How-To #2, page 2-23*

For the sake of clarity, it should also be noted that, for communities with mapped erosion, surge, or wave action zones, the magnitude or severity will also increase with increasing degree of erosion, surge and/or wave action. However, there are no mapped erosion or significant wave action hazard areas in Rensselaer County.

Previous Occurrences – Hurricane and Tropical Storm Events

Hurricanes and tropical storms have impacted Rensselaer County and its participating jurisdictions in the past, and will continue to do so in the future. Orange County has an active history of hurricanes and tropical storms. According to NOAA historical records, the tracks of three hurricanes, nine tropical storms and six tropical depressions have passed within 65 miles of the Rensselaer County seat at Troy since 1861. These include two Category 1 hurricanes and 15 tropical storms. The most proximate tropical storm events to Rensselaer County during the last 100 years were an unnamed tropical storm which passed directly over the county in 1949, and the famously destructive New England Hurricane of 1938, which was still considered a Category 2 hurricane when it passed approximately 10-12 miles to the east of Rensselaer County.

Rensselaer County has also been significantly impacted by hurricanes and tropical storm events which passed the County at a greater distance: for example the remnants of Hurricane Floyd in September 1999 and Hurricane Belle in August 1976, both of which resulted in Federally-declared disasters for areas including Rensselaer County. The SHELDUS database also records that damages were experienced in Rensselaer County due to three additional hurricane/tropical storm events; Hurricane Brenda in 1961, Hurricane Doria in 1971, and Hurricane David in 1979. SHELDUS records no descriptions in each case but does list damages of $8,000, $26,000, and $31,000 respectively. The NCDC database does not specifically list any such events for Rensselaer County under the Hurricane and Tropical Storm category, the database does include some description of the effects of Hurricane/Tropical Storm Floyd under the High Winds category. In the absence of readily available descriptions of other relevant hurricane events, the following description may be assumed to be representative of the typical impact of strong tropical storms on the Rensselaer County area.

September 16-17, 1999

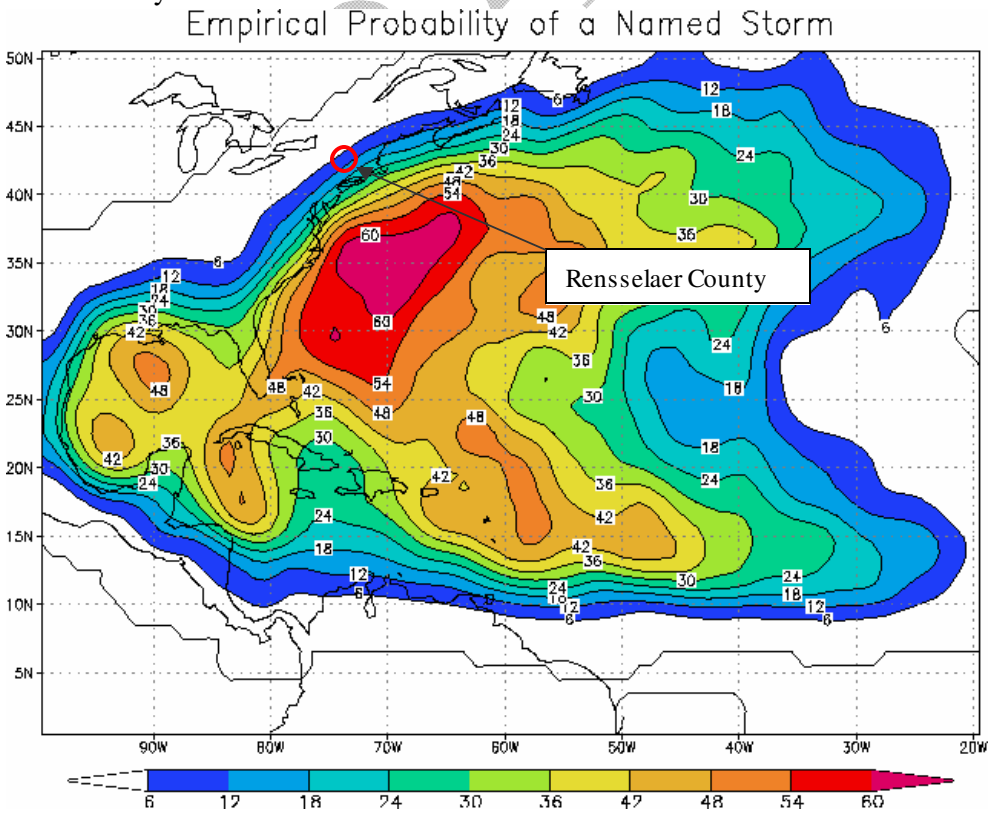
The remnants of Hurricane Floyd moved up the eastern seaboard on September 16 and during the early hours on September 17. The storm brought both high winds and exceptionally heavy rainfall to eastern New York, which included a large swath of 3 to 6 inch amounts. Locally higher amounts of rainfall, exceeding a foot, fell in some areas. Specific rainfall amounts included 6.12

inches at Albany International Airport, the highest ever officially recorded from any given storm. Even higher amounts of rainfall included 8.15 inches in Delmar and 9 inches at Knox, both located in Albany County. 12.21 inches of rainfall was recorded in Cairo, Greene County, the most associated with the storm. The rain produced widespread flooding across the region, which proved very destructive and in one case, deadly. The rains, combined with left-over rain from Tropical Storm Dennis, a week earlier, alleviated the fourteen month drought across most of the region. Winds from the passage of Floyd gusted to 49 mph at Albany International Airport during the evening of September 16. Higher gusts estimated over 60 mph were common across the hill towns. The combination of the wind and very saturated ground produced widespread downing of trees and power lines across much of eastern New York. The rain and wind produced massive power outages across the region. As many as 80,000 people lost power in the Mid Hudson Valley region, 54,000 in the Greater Capital District and another 25,000 in the Lake George Saratoga region. Some individuals had to wait over a week for power to be restored. The storm resulted in lost wages, closed schools throughout the region, and cancelled flights at Albany International Airport. Floyd resulted in the counties of Albany, Dutchess, Greene and Rensselaer being declared "major disaster areas" by Governor Pataki.

Probability of Occurrence – Hurricane and Tropical Storm Events

Internet resources on NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) web site were researched to gain an understanding of the relative likelihood of Rensselaer County being impacted by a coastal storm as compared to other locations in the Atlantic Basin (see Figure 3a.3). The data indicates that Rensselaer County and its jurisdictions have roughly a 6-12 percent chance of being impacted by a named storm in any given year.

Figure 3a.3 - Probability of a Named Storm in the Atlantic Basin



Tornado

Description – Tornado Events

The American Meteorological Society "Glossary of Meteorology" defines a tornado as violently rotating column of air that has contact with the ground and extends downward from a cumulonimbus cloud. Tornado wind speeds can range from as low as 40 mph to as high as 318 mph. Tornadoes often accompany thunderstorms and hurricanes. Tornadoes can occur at any time of the year but are more prevalent during the spring and summer months. The hazard associated with a tornado event is high winds. The non-tornado high wind hazard is addressed specifically elsewhere in the plan. Tornado events are discussed in the remainder of this section.

Location – Tornado Events

Tornadoes can occur anywhere in the US. They have struck in all 50 states, with the highest concentration on the central plains and in the southeastern states, such as Oklahoma, Texas, and Florida. Over 350 tornados have struck New York State since 1952. No one jurisdiction within Rensselaer County is any more likely to have a tornado touch down within its borders than any other location. The hazard associated with tornado events (high winds) have distinct hazard area locations, discussed in other sections of this report.

Extent – Tornado Events

The magnitude or severity of a tornado is dependent upon wind speed and is categorized by the Fujita Scale, presented in Table 3a.6. Tornadoes are typically considered to be "significant" for F2 or F3 on the Fujita Scale and "violent" for F4 and F5.

Table 3a.6
The Fujita Scale: Tornado Magnitude
(Source: NOAA)

Scale	Wind Estimate (mph)	Damage Type	Damage Description
F0	< 73	Light	Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73 - 112	Moderate	Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113 - 157	Considerable	Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158 - 206	Severe	Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207 - 260	Devastating	Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261 - 318	Incredible	Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Previous Occurrences – Tornado Events

NOAA's NCDC records tornado event data for Rensselaer County from August 1973 to May 2010, and records nine tornados in the county in this period. The database lists one of these events as being rated F0, five rated F1, and three rated F2. The damage caused by these events resulted in more than $10.6 million in property damage and one injury, and the locations and tracks recorded for these events are shown in Figure 3a.4.

The SHELDUS database lists two additional tornado events in Rensselaer County occurring in 1961 and 1980, but attributes less than $13,000 damages in total to these events, and includes no supplemental information regarding magnitude, location, or impacts. A summary of all tornados recorded by the two primary data sources described above is presented in Table 3a.7.

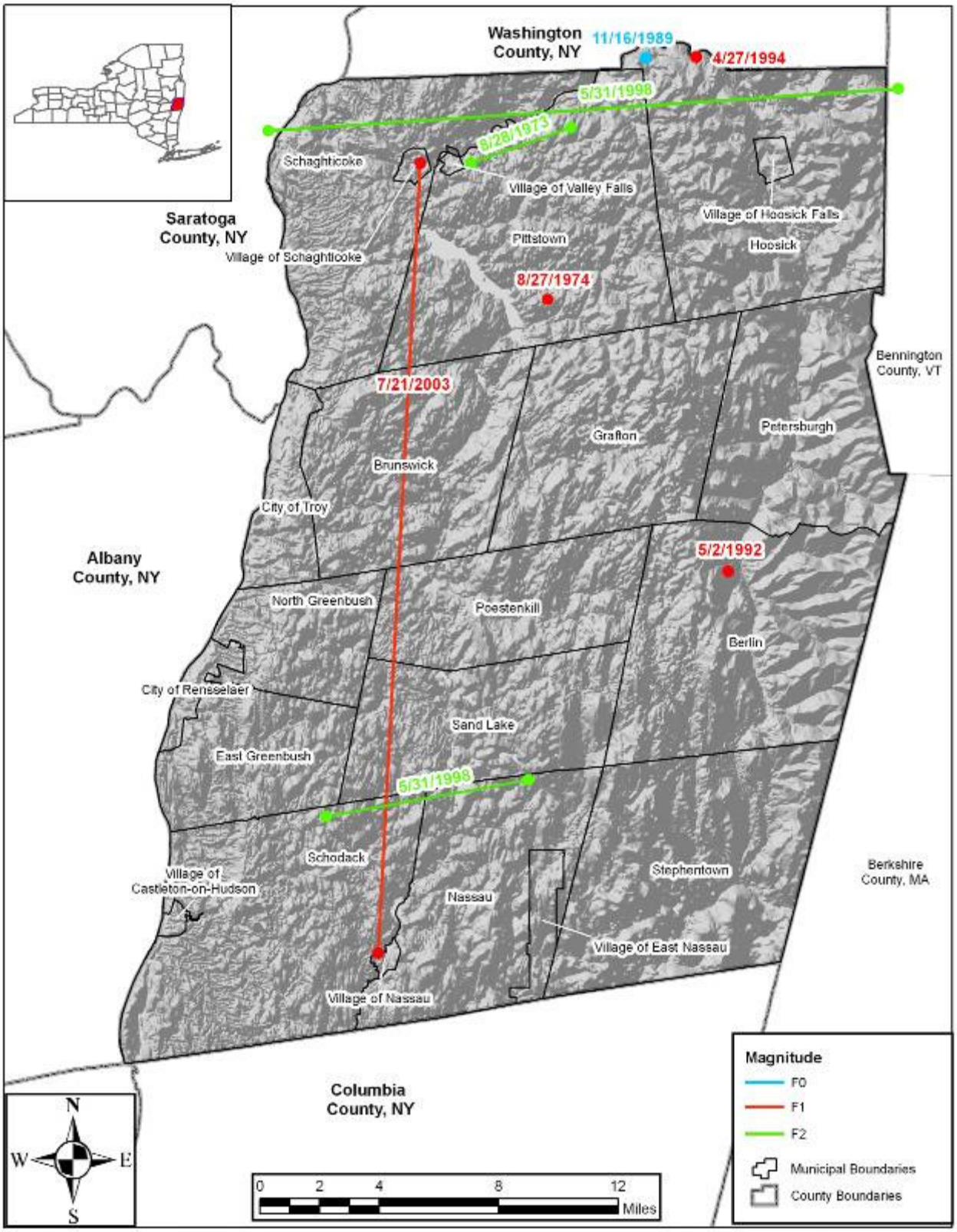
Table 3a.7
Recorded Tornado Events in Rensselaer County
(Source: NOAA NCDC, SHELDUS)

Date	Affected Areas	Magnitude	Recorded Property Damage*
8/25/1961	Not recorded	Not recorded	$114
8/28/1973	Town of Pittstown	F2	$25,000
8/27/1974	Town of Pittstown	F1	$25,000
7/11/1980	Not recorded	Not recorded	$12,500
11/16/1989	Town of Hoosick	F0	$25,000
5/2/1992+	Town of Berlin	F1	$25,000
5/2/1992+	Town of Berlin	F1	$250,000
4/27/1994	Town of Hoosick	F1	$50,000
5/31/1998	Town of Schaghticoke, Town of Pittstown, Town of Hoosick	F2	$10,000,000
5/31/1998	Town of Schodack, Town of Nassau	F2	$175,000
7/21/2003	Village of Nassau, Town of Schodack, Town/Village of Schaghticoke	F1	$50,000

*May include damage incurred outside Rensselaer County
+Listed as two separate events at the same location by NCDC: As well as different damage totals, NCDC also lists different path lengths and widths for each tornado. SHELDUS lists a single tornado occurring in the town of Berlin on this date with damages of $50,000 attributed.

The available descriptions of the impacts of the tornado events recorded by the NCDC database are presented following Figure 3a.4.

Figure 3a.4: Locations and Tracks of Tornados Recorded in Rensselaer County



SOURCE: Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; National Climate Data Center, Event Record Details - Tornadoes; USGS, 1-Arc Second National Elevation Dataset, 2009

May 31, 1998

During the morning hours of May 31, a strong low pressure system over the upper Great Lakes pushed a warm front across eastern New York and western New England, and several lines of severe thunderstorms formed ahead of an approaching cold front. This resulted in two tornados that caused damage in Rensselaer County. The first tornado touched down west of Mechanicville in Saratoga County and intensified to F3 before crossing the Hudson River into the Town of Schaghticoke in Rensselaer County and decreasing to an F2. The tornado tracked across the Town of Schaghticoke and just brushed the Village of Schaghticoke to the north. Czub Grain Farm on Verbeck Avenue was heavily damaged. It then followed the Hoosic River as it crossed the Village of Valley Falls and into the northern portion of the Town of Pittstown to Millertown. At this point the track became discontinuous and the intensity decreased to an F1. In the Town of Hoosick the path became continuous again and increased to an F2. Several farms suffered extensive damage including Lakeland Dairy Farm where a 60 ton silo and barn were leveled. The tornado then tracked from extreme northeast Rensselaer County to Bennington County in southern Vermont where it quickly decreased to an F1 after crossing the border. Governor Pataki declared a State of Emergency in Saratoga and Rensselaer Counties. In Rensselaer County approximately 50 to 60 homes and businesses were damaged or destroyed, and substantial damages to treed/forested areas were incurred. Power was not restored to parts of this region for three to four days. Approximately 70 injuries occurred with this tornado but no one was killed.

May 31, 1998

The second tornado generated by the weather system mentioned above tracked across southern Rensselaer County. This tornado first touched down on Palmer Road about two miles east of Interstate 90 in the Town of Schodack. The tornado moved due east and passed just south of North Schodack then tracked east northeast to Millers Corners on the south shore of Burden Lake. The damage path continued in this direction to Pike Pond before it dissipated at Alps Mountain. This tornado destroyed three barns, damaged several homes and produced extensive tree damage along its path. This event resulted in the declaration of disaster DR-1222, under which Rensselaer and neighboring counties were eligible for funding under the FEMA Public Assistance Grant Program.

July 21, 2003

A large upper air trough dug across the western Great Lakes on Monday, July 21. At the surface, a deep low pressure area moved across the eastern Great Lakes, driving a warm front across eastern New York and adjacent New England. The air became very unstable in the warm air mass behind the front. The combination of the unstable air and strong wind shear aloft, produced the most significant severe outbreak of the season across the region, and the largest tornado outbreak since May 31, 1998. This storm spawned a long-lived significant tornado which initially touched down in southeastern Greene County, and produced a discontinuous path of 17 miles in Greene County, 12.2 miles in northwestern Columbia County and 4.8 miles in southern Rensselaer County. The tornado left a swathe of destruction including hundreds, if not thousands of trees uprooted and snapped away, along with lots of power and telephone wires. Many roads in each of these counties were impassable due to debris. The first confirmed touchdown as an F1 in the town of Palenville, Greene County and remained at that magnitude when it touched down near the Village of Nassau in Rensselaer County, near Route 20. The average width of the twister was between 75 and 100 yards and a discontinuous path length of more than four miles. More homes and a garage were severely damaged but no injuries were reported. The roof on the Agway was blown off and a gazebo landed across the state highway in a pile of splintered wood. The NWS Survey team noted that the twister had multiple vortices in this area and additional straight line

damage was also noted in the same town. The last touchdowns were in the town of Schaghticoke with an F1 rating.

Core Planning Group members also report a tornado of unknown magnitude which affected the Park Avenue/McClellan Drive area of the Village of Nassau.

Probability of Occurrence – Tornado Events

The historic record suggests that a tornado occurrence in Rensselaer County is of moderately low probability, since 11 tornado events have been definitively recorded by NOAA and SHELDUS in Rensselaer County in the last 50 years, which gives an historic occurrence rate of 0.22 per year. The National Severe Storms Laboratory has published data which suggests that the annual probability of tornado occurrence in the Rensselaer County area is between 0.2 and 0.4 per year, as shown in Figure 3a.5, below. This is supported by the New York State plan, which includes a figure sourced from the U.S. Geological Survey mapping tornado risk across the continental United States. This figure (reproduced below as Figure 3a.6) indicates that Rensselaer County lies outside the areas of "High Risk" within the continental USA.

Based on the available data, it can be stated that while tornados of magnitude F0 or F1 may occur within Rensselaer County within the foreseeable future, the probability of occurrence is significantly less than one per year, and most likely to be in the order of one every 15 years or so.

Figure 3a.5: National Severe Storms Laboratory Tornado Probability

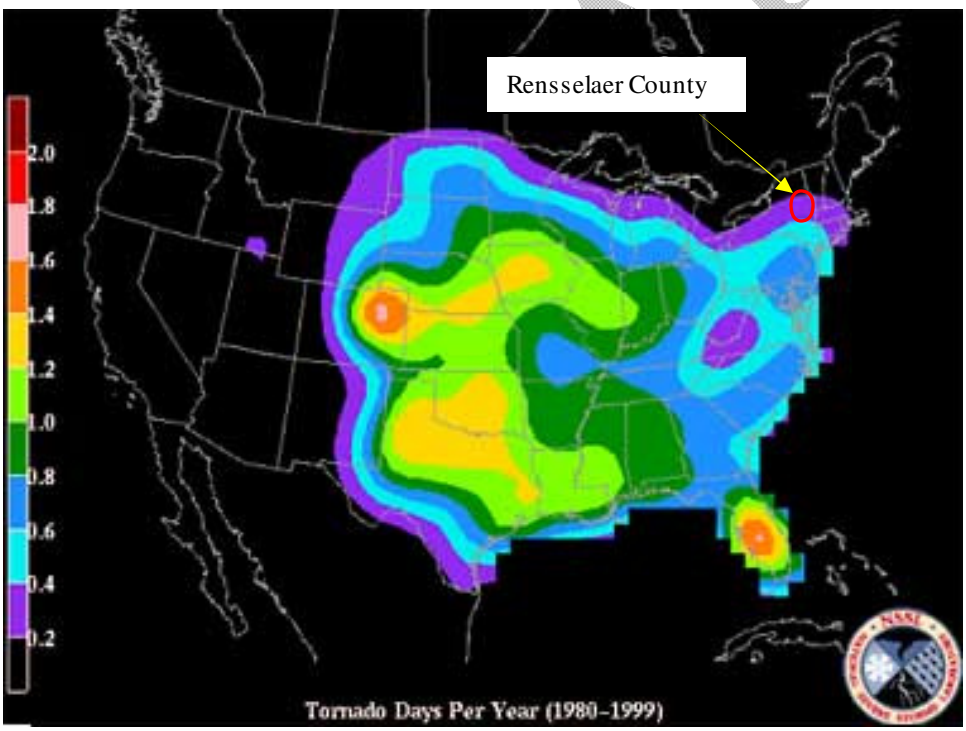
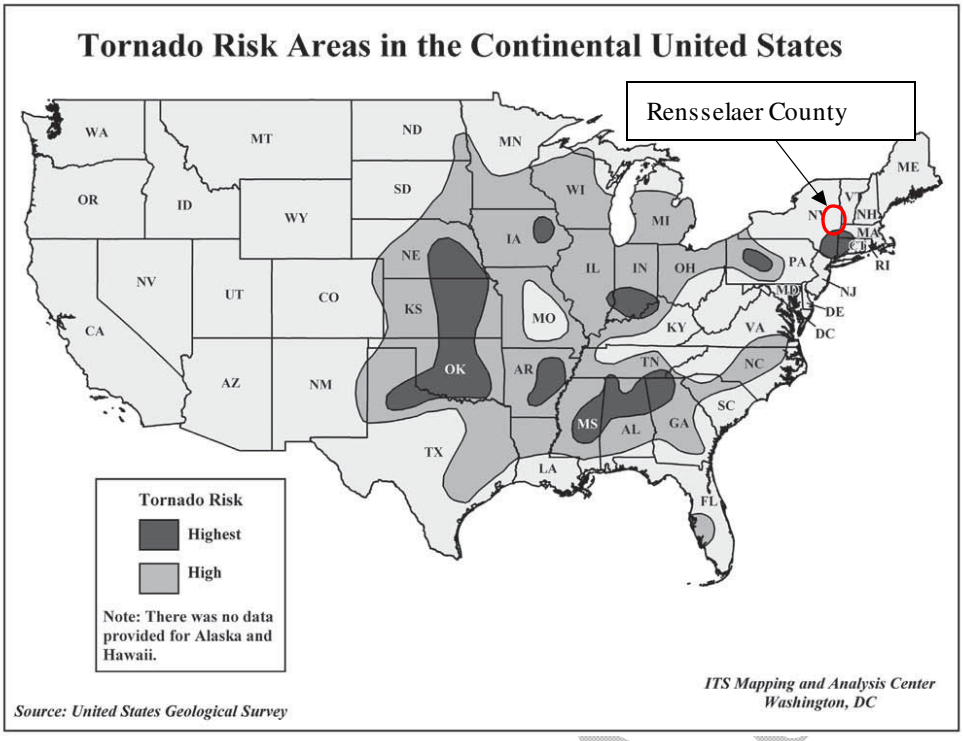


Figure 3a.6: Tornado Risk Areas in the Continental USA



Lightning

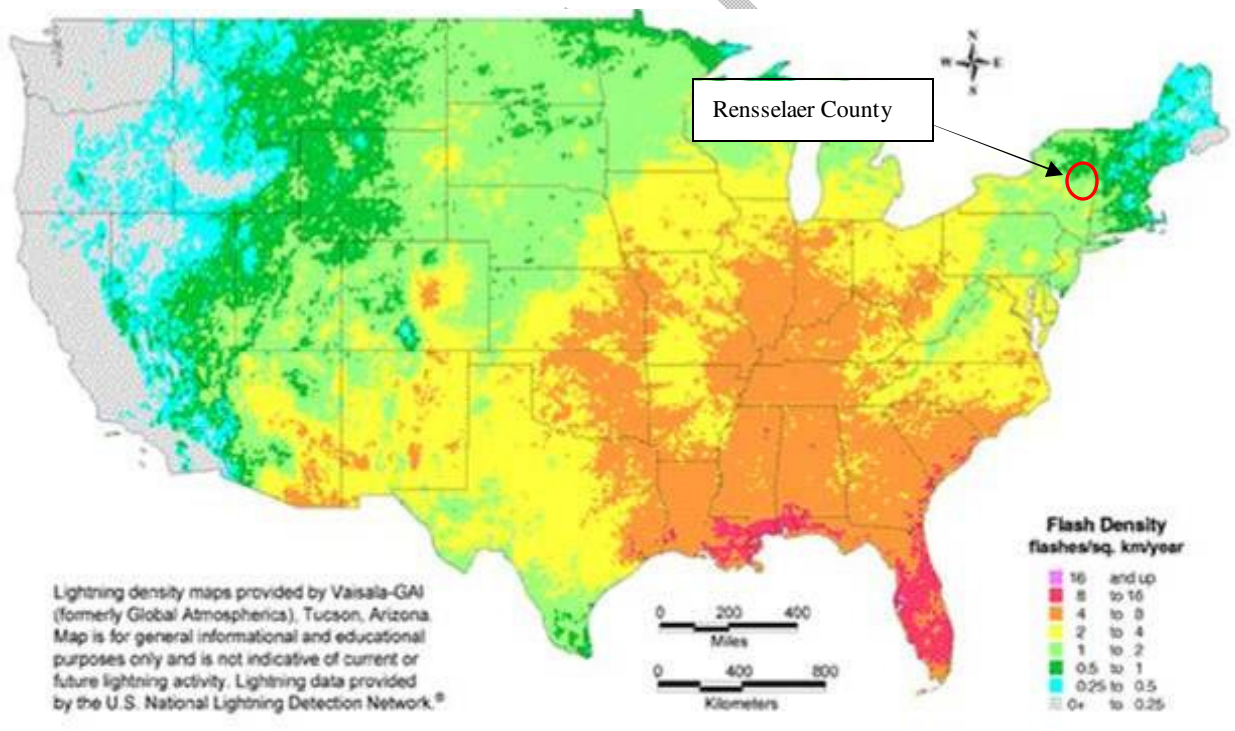
Description – Lightning

Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a "bolt" when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes, but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder. On average, 73 people are killed each year by lightning strikes in the United States.

Location - Lightning

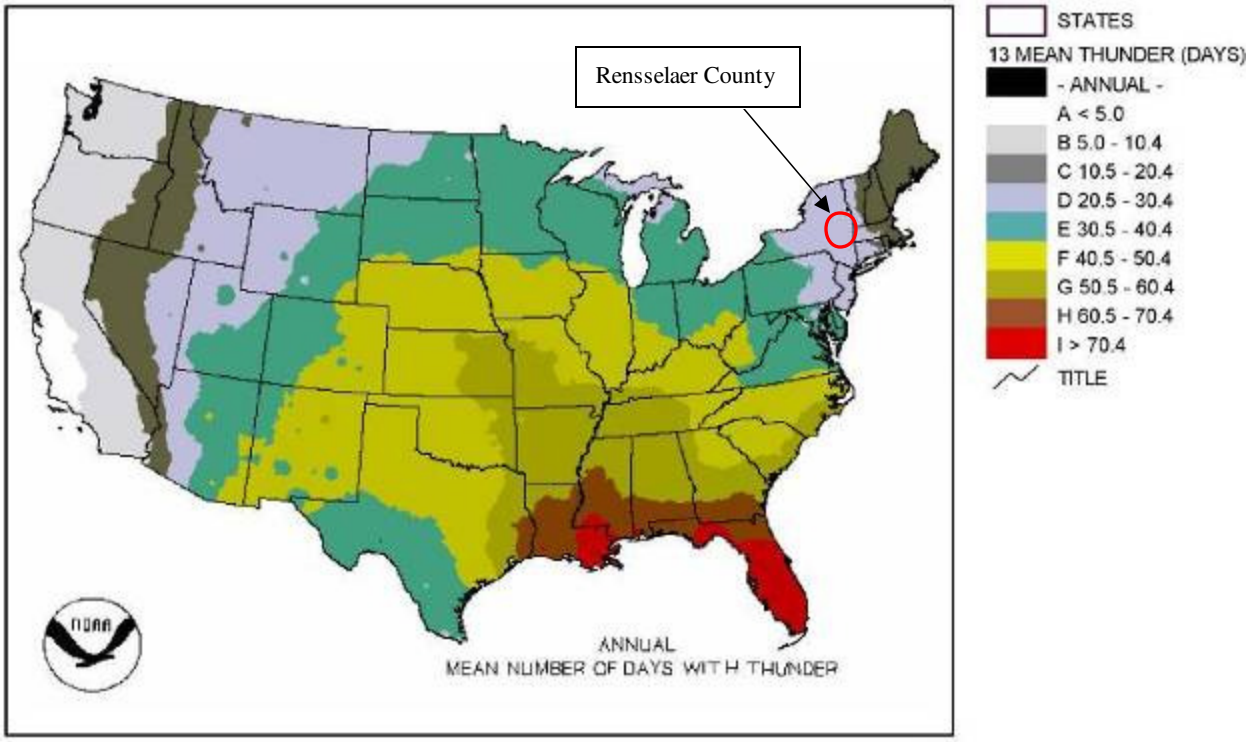
Rensselaer County is located in a region of the country that is susceptible to lightning strikes, though not as susceptible as southeastern states. Figure 3a.7 shows a lightning flash density map for the years 1996-2000 based upon data provided by Vaisala's U.S. National Lightning Detection Network (NLDN®). The map indicates that the planning area can expect approximately 1-2 lightning flashes per square kilometer per year (approximately 3-5 lightning flashes per square mile).

Figure 3a.7: Lightning Flash Density – Contiguous United States



NOAA mapping presented in Figure 3a.8 also shows that Rensselaer County is located in a region that experiences approximately 20 to 30 thunderstorm days per year. By comparison, approximately one third of the contiguous United States experience fewer thunder days, while some areas of the southeastern United States experience more than 70 thunder days per year.

Figure 3a.8: Mean Annual Thunder Days – Contiguous United States



Extent - Lightning

Essentially all areas of Rensselaer County are considered equally susceptible to lightning strike. While lightning occurs randomly anywhere and anytime, the most common location for lightning fatalities and injuries to people is in open areas such as parks, beaches, golf courses and other recreational areas.

Previous Occurrences – Lightning

NOAA records that New York State has experienced the fifth most deaths from lightning in the United States from 1959 to 1994. The NCDC database records 11 lightning events in Rensselaer County since July 1994, causing $286,000 in property damages and 11 injuries. The details and descriptions of damages given for these events are as follows:

August 16, 1996
Lightning burned a single story barn to the ground in Pittstown. Tools and recreational vehicles were lost in the fire. Damages were estimated at $25,000.

July 6, 1999
Lightning struck several buildings in the City of Rensselaer, causing damage estimated at $10,000 in total.

July 6, 1999
Lightning struck a home in Hoosick, which resulted in much of the house being gutted by fire. Damages were estimated at $70,000.

July 4, 2001
Lightning struck a house in Schaghticoke producing minor damage (estimated at $25,000) and at least one injury.

June 5, 2002
Lightning struck a barn in Brunswick, causing significant damage (estimated at $50,000) to that structure.

July 1, 2004
Lightning struck a place of business in Brunswick. Two minor injuries occurred; one due to smoke inhalation, and another due to a firefighter falling off a ladder. Damages were estimated at $1,000.

July 8, 2004
Seven people sent to hospital with injuries when lightning struck a softball field in Wynantskill in the Town of North Greenbush**.**

July 8, 2004
A house was struck by lightning in the town of Schaghticoke. Damages were estimated at $5,000.

July 2010
A direct strike to the Rensselaer County Bureau of Public Safety building damaged in July 2010 damaged equipment and required temporary operations out of the BPS trailer for several days.

The SHELDUS database records an additional 59 lightning events in the county between April 1961 and July 2004, causing almost $2.86 million in damages. Since the SHELDUS database does not provide descriptions or locations of the impacts of individual events, the NCDC descriptions above will suffice to illustrate the effects of the high wind hazard in Rensselaer County, and the SHELDUS data has been primarily used in the estimation of potential damages arising due to extreme winds in Section 3c.

Core planning group members also report that the Town Hall telephone system in the Town of Grafton was recently destroyed by a lightning strike.

Probability of Future Occurrences – Lightning

The probability of occurrence for future lightning events in the planning is certain. According to NOAA, Rensselaer County is located in an area of the country that experiences an average of one to two lightning flashes per square kilometer (three to five lightning flashes per square mile per year - in the order of 2,000 to 3,300 strikes per year over the 22 jurisdictions in the planning area). Given this frequency of occurrence, it can be expected that future lightning events will continue to threaten life and cause damage to property and communications equipment throughout the County.

Winter Storm / Ice Storm

Hazards Associated with Winter Storm / Ice Storm

Severe winter storms are particular types of events. They are characterized by the hazards of high winds, extreme cold, heavy precipitation (in the form of snow and/or ice), and sometimes wave action, coastal erosion and flooding. Winter storm and ice storm events are discussed in general terms in this section of the document; while specific hazards such as flooding and erosion are discussed elsewhere in the plan.

Description – Winter Storms / Ice Storms

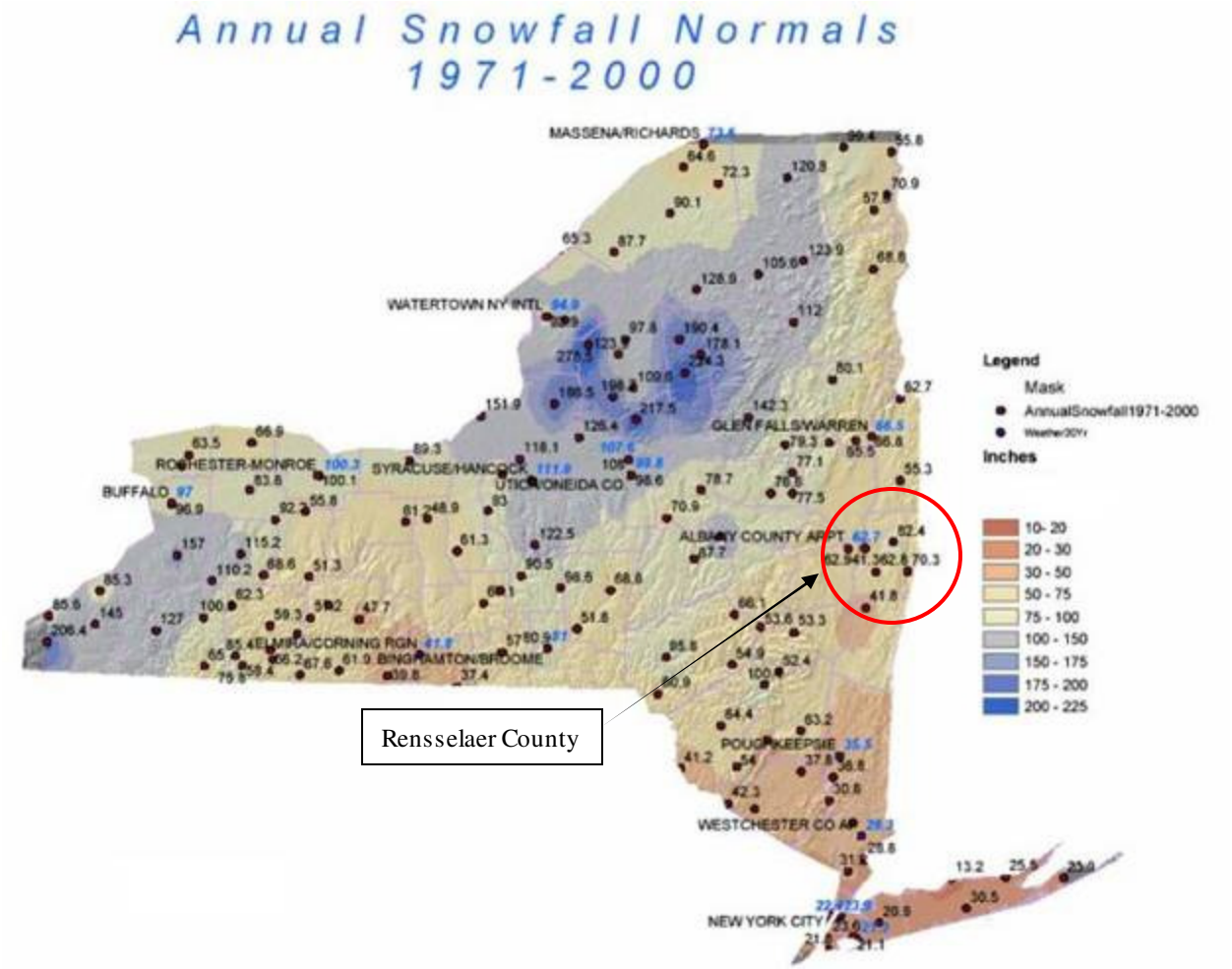
Winter storms consist of cold temperatures and heavy snow or ice. Because winter storms are regular, annual occurrences in Rensselaer County, they are considered hazards only when they result in damage to specific structures and/or overwhelm local capabilities to handle disruptions to traffic, communications, and electric power.

Winter storms and ice storms typically occur in New York from late October until mid-April. Peak months for these events for Rensselaer County and its jurisdictions are December through March.

Statewide, according to NOAA data average annual snowfall ranges from a low of approximately 10 – 20 inches in the New York City / Long Island area, to over 200 inches in the north of the State, in the Adirondack Mountains. For Rensselaer County, Figure 3a.9 indicates that average annual snowfall ranges from 40 to 80 inches per year, while the NYSHMP reports that the average annual snowfall for the County overall is 64.5 inches, the 37th highest in the state. This can vary greatly from one year to the next, particularly if several major extended-period storms impact the area (during which snowfall totals can approach or exceed annual averages).

Freezing rain is another common manifestation of winter storms: This occurs when precipitation that begins as snow at high altitude melts as it falls through zones with an air temperature above freezing, before encountering a colder layer prior to ground impact, causing it to freeze on contact with any object it encounters at ground level. Freezing rain frequently causes travel problems on roadways, breaks off tree limbs and brings down power and telephone cables. Rensselaer County lies within an area which experiences an average of 18 to 21 hours of freezing rain per year, which is higher than most other areas of New York State (See Figure 3a.10). Freezing rain is comparatively uncommon in the USA outside the northeastern states.

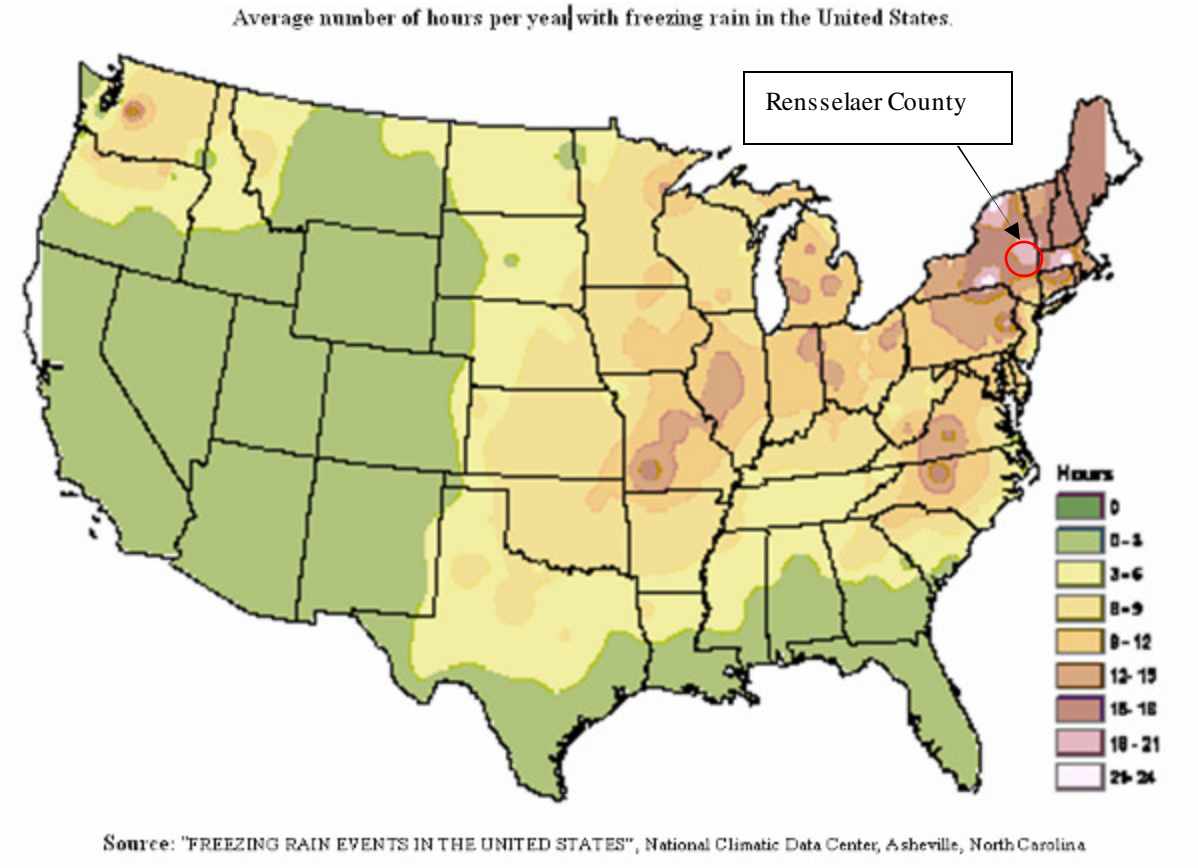
Figure 3a.9: New York State Snowfalls



Location – Winter Storms / Ice Storms

All of Rensselaer County is exposed to winter storms and ice storms and generally no single jurisdiction in the County is more likely to experience components of winter storms such as heavy snow and freezing rain than any other; however, the effects of these phenomena on individual communities may vary with location; the more rural jurisdictions in the County could be expected to be impacted more by heavy snow and freezing rain due to access transportation issues and distances from major population centers and additional emergency response resources.

Figure 3a.10: Freezing Rain Zones Nationwide



Extent – Winter Storms / Ice Storms

A severe winter storm can adversely affect roadways, utilities, business activities and can cause loss of life, frostbite, or freezing. The most common effect of winter storms and ice storms is traffic accidents, interruptions in power supply and communications; and the failure of inadequately designed and/or maintained roofing systems. Power outages and temperatures below freezing for extended periods of time can cause pipes to freeze and burst. Heavily populated areas tend to be significantly impacted by losses of power and communications systems due to downed lines. Distribution lines can be downed by the weight of snow or ice, or heavy winds. When limbs and lines fall on roadways, transportation routes can be adversely affected and buildings and automobiles can be damaged. Heavy snow loads can cause roof collapse for residential, commercial, and industrial structures in cases of inadequate design and/or maintenance. Severe winter storms can also cause extensive coastal flooding, coastal erosion, and wave damage. If significant snowfall amounts melt quickly, inland flooding can occur as bankfull conditions are exceeded or in areas of poor roadway drainage.

The severity of the effects of winter storms and ice storms increases as the amount and rate of precipitation increase. In addition, storms with a low forward velocity are in an area for a longer duration and become more severe in their affects. Storms that are in full force during the morning or evening rush hours tend to have their affects magnified because more people are out on the roadways and directly exposed.

The magnitude of a severe winter storm or ice storm can be qualified into five main categories by event type, as shown below:

- Heavy Snowstorm: Accumulations of four inches or more of snow in a six-hour period, or six inches or more of snow in a twelve-hour period.
- Sleet Storm: Significant accumulations of solid pellets which form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces posing hazards to pedestrians and motorists.
- Ice Storm: Significant accumulations of rain or drizzle freezing on objects (tress, power lines, roadways, etc.) as it strikes them, causing slippery surfaces and damage from the sheer weight of ice accumulation.
- Blizzard: Wind velocity of 35 miles per hour or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period of time.
- Severe Blizzard: Wind velocity of 45 miles per hour, temperatures of 10 degrees Fahrenheit or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period of time.

Previous Occurrences – Winter Storms / Ice Storms

In Rensselaer County, severe winter snow and ice storms are considered normal and expected. A review of the New York State Hazard Mitigation Plan in conjunction with data from NOAA and FEMA shows that Rensselaer County has been specifically included in three snow- or ice-related declared disasters and one snow- or ice- related emergency declaration, as detailed in Table 3a.8.

Table 3a8
Winter Storm Disaster/Emergency Declarations Affecting Rensselaer County
(Source: NYSEMO / FEMA)

Disaster/ Emergency #	Description:	Declared Date (and Incident Period)	Eligible Assistance for Rensselaer County
DR-1827*	Severe Winter Storm	3/4/2009 (12/11-2008 – 12/31/2008)	Public Assistance
DR-1083	Blizzard	1/12/1996 (1/7/1996 – 1/9/1996)	Public Assistance
DR-801	Severe Winter Storm	11/10/1987 (10/4/1987)	Public Assistance
EM-3173	Snowstorm	2/26/2003 (12/25/2002 – 1/3/2003)	Public Assistance

*Initially declared an emergency (EM-3299) on 12/18/2008.

In addition to this information, the NCDC database holds detailed snow and ice events for Rensselaer County from January 1993 (when detailed NCDC records begin) to May 2010, and a review of the NCDC database yielded 106 significant snow and ice events reported as having affected Rensselaer County during this period. These events are reported as being responsible for property damage totaling more than $20 million, although this includes damage reported in counties besides Rensselaer County that were affected by the same events. Details and descriptions for some of the events are as follows:

October 4, 1987
What was at the time the earliest winter storm on record for Albany, this unusual snowstorm covered the Capital Region with 6-12 inches of very heavy, wet snow. Though not unusual in terms of its snowdepth, this storm caused tremendous damage as the weight of its heavy, wet

snow fell on trees in full leaf, downing limbs and power lines and leaving many areas without power for several days. The storm resulted in the declaration of disaster DR-801.

March 12-13, 1993
What has sometimes been termed the "Storm of the Century" or the "Great Blizzard of 1993" was a massive storm which, at its peak, stretched from Canada to Central America. Its impacts were felt up and down the US east coast, where hurricane force winds and upwards of a foot of snow combined with storm surge and scattered tornados. Total US damages from this storm were estimated at $6.6 billion. In nearby Albany, 27 inches of snow were reported. Impacts in Rensselaer County noted by Core Planning Group members included heavy snow accumulations, high winds, tree damage, power outages, limited road passage, and various parking restraints. The storm resulted in Federal emergency declaration EM-3107.

December 31, 1994
A mixture of snow and freezing rain occurred across much of eastern New York creating treacherous traveling conditions on New Years Eve. In the Capital District area alone hundreds of accidents occurred as roadways became ice covered. The icy conditions forced the closure of several major highways and several of the accidents had fatalities.

January 12, 1996
Heavy snow fell across much of eastern New York except for the central Mohawk Valley Region. Specific snowfall totals included 12 inches in Troy in Rensselaer County. The storm resulted in the declaration of disaster DR-1083 under which Rensselaer County became eligible for funding under the FEMA Public Assistance Grant Program.

December 6, 1996
Heavy snow fell over eastern New York. The wet snow downed trees and power lines which resulted in power outages for several thousand customers. Specific snowfall totals included 8 inches at Averill Park in Rensselaer County.

March 31, 1997
Heavy snow fell over eastern New York from the Mohawk Valley southward. Snowfall amounts were highly elevation dependent. Snowfall exceeded 2 feet in many mountain locations. Specific snowfall totals included 15 inches at the Albany Airport and 11 inches at Poestenkill in Rensselaer County. The wet snow brought down many trees and power lines causing widespread power outages and many road closures and many areas remained without power for several days. In the Capital District, 50,000 customers lost power.

January 13, 2000
A band of moderate to heavy snow fell across Schoharie, the northern portion of Schenectady, much of Albany and western Rensselaer counties. Snowfall in this area ranged from seven to 11 inches of snow fell in the aforementioned area, with nine inches at Brunswick in Rensselaer County. There were closures of numerous schools as well as some businesses.

February 5-6, 2001
A swath of heavy snowfall, accumulating seven inches or more fell across much of eastern New York. A stripe of very heavy snow fell across portions of the Mid Hudson Valley and Taconic Hills. In these areas, snowfall rates exceeded four inches per hour during the height of the storm, which took place during the later afternoon hours. Stephentown in Rensselaer County was buried with 20.3 inches. The storm closed many schools and some businesses.

December 6-8, 2003
Snow began in the mid Hudson Valley very early Saturday morning, and covered the whole region by late in the day. A band of heavy snow, with rates up to 3 inches per hour, settled over the Taconics for awhile on Saturday afternoon into the evening hours. The storm lasted about 30 hours. By the time the low pressure had moved to the east, a general swath of one to two feet of snow had fallen across the region. Unusually high amounts fell east of Albany in Rensselaer County with 32 inches noted at Averill Park and up to 39 inches at West Sand Lake. The storm caused numerous flight cancellations at Albany International Airport. Many localities declared snow emergencies. There were quite a few vehicular accidents but most were minor.

December 25-26, 2003 and January 3-4, 2004
Back-to-back severe snowstorms blanketed much of New York State. This resulted in a FEMA emergency declaration EM-3173. The declaration allowed state and local governments, and certain private non-profit organizations in the counties to apply for federal assistance to fund 75 percent of the total eligible costs of equipment, contracts, and personnel overtime related to emergency services in dealing with the snow. The State of New York was responsible for 12.5 percent of the eligible costs and applicants funded the remaining 12.5 percent. Federal assistance provided to Rensselaer County and its municipalities as a result of this declaration totaled nearly $800,000. Core Planning Group members recalled heavy snow accumulations, high winds, tree damage, power outages, limited road passage, and various parking restraints as a result of these events.

December 11-12, 2008
A significant wintry mix of snow, sleet and freezing rain fell, beginning Thursday afternoon, and ending midday Friday. Snow and sleet accumulations of 3 to 6 inches fell. In addition, freezing rain, with estimated accretions in excess of one half of an inch, led to numerous downed tree limbs, trees and power lines. Total ice accretion from freezing rain ranged from around one half of an inch, up to one inch across portions of the Capital District and the Berkshires. The ice storm resulted in widespread damage to trees and resultant power outages across eastern New York, where an estimated 220,000 utility customers lost power. Many schools and businesses were shut down for several days due to the loss of power, and impassable roads from extensive fallen debris, resulting in significant economic and societal impacts. States of emergency were declared across large portions of eastern New York. The hardest hit areas were within the immediate Capital District, across Albany and extreme southern Saratoga Counties, as well as across the central and southern Taconics, from central Rensselaer County into Columbia County and northern Dutchess County. Bitterly cold temperatures followed in the wake of the storm Saturday and Sunday, compounding the power outages across the region. Numerous warming shelters were setup to assist those who were without power and heat. The storm resulted in the declaration of disaster DR-1827, under which Rensselaer County received more than $600,000 in funding from the FEMA Public Assistance Grant Program.

January 1-3, 2010
A powerful storm formed in the Gulf of Maine on Saturday, January 2nd and moved gradually westward toward the northern New England coast Saturday night into Sunday, January 3rd, bringing a widespread snowfall to east central New York along with blustery conditions, resulting in blowing and drifting of the snow. Snowfall totals were generally 6 to 16 inches, with up to 2 feet across portions of Washington and eastern Rensselaer counties.

In addition to the events listed by NCDC, the SHELDUS database lists a further 107 winter storm events affecting Rensselaer County since January 1960 (of which all but four were recorded before 1993) to which slightly under $30 million in property damages was attributed. Since the SHELDUS database does not provide descriptions or locations of the impacts of individual events, the NCDC descriptions above will suffice to illustrate the effects of snow and ice in Rensselaer County, and the SHELDUS data has been primarily used in the estimation of potential damages arising due to winter storms in Section 3c.

Probability of Occurrence – Winter Storms / Ice Storms

This plan aims to assess the probability of future occurrences of severe snowfalls and ice storms in terms of frequency based on historical events. Using the historical data presented above, and the primary generic descriptions of the events recorded by the NCDC as having affected Rensselaer County, Table 3a.9 summarizes the occurrence of winter storm events and their annual occurrence: Rensselaer County and its municipal jurisdictions have experienced 106 recorded significant winter storms / ice storms between 1993 and 2010, – an average of 5.7 events per year.

Winter storm events will remain a very frequent occurrence in Rensselaer County, and the probability of future occurrences in the County is certain, but the impacts of snow and ice storms are more likely to be major disruptions to transportation, commerce and electrical power as well as significant overtime work for government employees, rather than large scale property damages and/or threats to human life and safety.

Table 3a.9
Occurrence of Winter Storms/Ice Storms, Rensselaer County (1993 – 2010)
(Source: NOAA's NCDC Storm Events Database)

Type *	Total Number of Events	Average Annual Number of Events
Freezing Rain	3	0.2
Heavy Snow	35	2.1
Ice Storm	3	0.2
Winter Storm	59	3.5
Snow/freezing rain	7	0.4
Total	106	6.3

**** Event Type Definitions***

Freezing Rain: *Rain or drizzle which falls in liquid form and freezes on impact with cold surfaces to form a glaze on the ground and exposed objects.*
Heavy Snow: *Snowfall of 6 inches or more in 12 hours or less, or 8 inches or more in 24 hours or less.*
Ice Storm: *Accumulations of 1/4 inch or more of freezing rain.*
Winter Storm: *Combination of two or more of the following winter weather events; heavy snow, freezing rain, sleet and strong winds.*

Dam Failure

Description – Dam Failure

Dam failure is the breakdown, collapse or other failure of a dam structure characterized by the uncontrolled release of impounded water that results in downstream flooding. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and severe property damage if development exists downstream. There are varying degrees of failure, and an unexpected or unplanned dam breach is considered one type of failure. A breach is an opening through a dam which drains the water impounded behind it. A controlled breach is a planned, constructed opening and not considered a dam failure event, while an uncontrolled breach is the unintentional discharge from the impounded water body and considered a failure.

Dam failure can result from natural events, human-induced events or a combination of the two. Natural occurrences that may cause dam failure include hurricanes, floods, earthquakes and landslides; human-induced actions may include the deterioration of the foundation or the materials used in dam construction. In recent years, dams have also received considerably more attention in the emergency management community as potential targets for terrorist acts.

Dam failure presents a significant potential for disaster, in that significant loss of life and property would be expected in addition to the possible loss of power and water resources. The most common cause of dam failure is prolonged rainfall that produces flooding. Failures due to other natural events such as hurricanes, earthquakes or landslides are significant because there is generally little or no advance warning. The best way to mitigate dam failure is through the proper construction, inspection, maintenance and operation of dams, as well as maintaining and updating Emergency Action Plans for use in the event of a dam failure.

The New York State Department of Environmental Conservation (NYSDEC), the body responsible for dam safety and regulation in the State of New York, classifies the hazard potential of dams using four categories, shown in Table 3a.10.

Table 3a.10
Dam Hazard Potential Classifications

NYSDEC Classification	Description
Class "C" or "High Hazard"	A dam failure may result in widespread or serious damage to home(s); damage to main highways, industrial or commercial buildings, railroads, and/or important utilities, including water supply, sewage treatment, fuel, power, cable or telephone infrastructure; or substantial environmental damage; such that the loss of human life or widespread substantial economic loss is likely.
Class "B" or "Moderate Hazard"	A dam failure may result in damage to isolated homes, main highways, and minor railroads; may result in the interruption of important utilities, including water supply, sewage treatment, fuel, power, cable or telephone infrastructure; and/or is otherwise likely to pose the threat of personal injury and/or substantial economic loss or substantial environmental damage. Loss of human life is not expected.
Class "A" or "Low Hazard"	A dam failure is unlikely to result in damage to anything more than isolated or unoccupied buildings, undeveloped lands, minor roads such as town or county roads; is unlikely to result in the interruption of important utilities, including water supply, sewage treatment, fuel, power, cable or telephone infrastructure; and/or is otherwise unlikely to pose the threat of personal injury, substantial economic loss or substantial environmental damage.
Class "D" or "Negligible or No Hazard"	"A dam that has been breached or removed, or has failed or otherwise no longer materially impounds waters, or a dam that was planned but never constructed. Class "D" dams are considered to be defunct dams posing negligible or no hazard. The department may retain pertinent records regarding such dams.

Location and Extent – Rensselaer County Dams

For the purpose of this analysis, the NYSDEC database was evaluated for any dams listed in Rensselaer County (96 in total). As well as those dams listed by NYSDEC as located within Rensselaer County, the database also records four locks on the Hudson River in neighboring Saratoga County (Lock C-1 Dam at Waterford, Lock C-2 Dam at Mechanicville, Lock C-3 Dam at Mechanicville, and Lock C-4 Dam at Stillwater). Although these structures are recorded by NYSDEC as located in Saratoga County, since they span the river between Rensselaer and Saratoga Counties it has been assumed that breach or failure of the structures would have impacts on both sides of the river and hence all have been evaluated in the risk assessment. Of these 100 dams, 10 are classified as High Hazard Potential (C), 17 are classified as Moderate Hazard Potential (B), 48 are classified as Low Hazard Potential, and 21 are Negligible, or No Hazard Potential (Class D - dams classified as 'No Hazard' indicate dams that are not built or no longer function as dams). The NYSDEC also includes an additional dam in the County for which no hazard code is assigned, but due to the small size and rural location of this structure, Class A/Low Hazard has been assumed. Table 3a.11 presents details for all dams affecting Rensselaer County classified as of high

or moderate hazard by the NYSDEC, and the location of all relevant high and moderate hazard dams recorded in the NYSDEC inventory of dams is presented in Figure 3a.11.

A Word about the Hudson River Locks

In the study area there are four locks on the Hudson River which are classified as dams by the NYSDEC. They are Lock 3 in Mechanicville (C- high hazard); Lock 2 in Mechanicville (A-low hazard); Lock 1 in Waterford (B-moderate hazard); and the Federal Lock in Troy (B-moderate hazard). Additionally, Lock 4 (A- low hazard) lies just upstream of the County's northern boundary in Stillwater. Locks 1 through 4 are owned and operated by the NYS Canal Corporation, and the Federal Lock is owned and operated by the US Army Corps of Engineers. Dam inundation mapping was requested for moderate and high hazard dams (Lock 3, Lock 1, and the Federal Lock). Dam inundation mapping for Lock 3 was provided by NYSDEC and is illustrated graphically in Figure 3a-14. Mapping for Lock 1 was requested but not available at the time of the plan preparation. The NYSDEC has indicated that no inundation mapping has been prepared for the Federal Lock in Troy. The NYSDEC provided an excerpt from the Emergency Action Plan that on file for this lock, prepared by Albany Engineering Corporation (May 2010), which states *"…discharge due to a major failure of the project structures would be restricted to levels that would not exceed average flow for the river section. Failure under either "fair weather" or flood conditions will not significantly alter water levels that occur under normal seasonal flow and flood conditions. This situation does not warrant the preparation of inundation maps and none are provided [in the EAP] at this time*."

Table 3a.11
Moderate and High Hazard Potential Dams – Rensselaer County
(Source: NYSDEC)

Dam Name	Municipality	River/Stream	Owner	Maximum Storage (Acre-Feet)	Dam Height (Feet)	NYSDEC Hazard Potential	EAP on File
Wright Lake Dam	City of Troy	Piscawan Kill	City of Troy	129	46	C	Y
Bradley Lake Dam	City of Troy	Piscawan Kill	City of Troy	215	50	C*	Y
Martin Dunham Reservoir Dam	Town of Grafton	Quacken Kill	NYS Parks & Recreation	4,500	59	C*	
Mill Pond Dam	Town of Grafton	TR-Quacken Kill	NYS Parks & Recreation	173	12	C	
Second Pond Dam	Town of Grafton	TR-Quacken Kill	NYS Parks & Recreation	415	9	C	
Long Pond Dam	Town of Grafton	TR-Quacken Kill	NYS Parks & Recreation	1,702	9	C	
Tomhannock Reservoir Dam	Town of Pittstown / Town of Schaghticoke	Tomhannock Creek	City of Troy	56,600	68	C*	Y
Johnsonville Dam	Town of Pittstown / Town of Schaghticoke	Hoosic River	Brookfield Renewable Power	6,430	39	C*	Y
Quackenderry Creek Dam	City of Rensselaer	Quackenderry Creek	City of Rensselaer	47	17	C	Y
Lock C-3	Town of Schaghticoke	Hudson River	NYS Canal Corp	8,785	37	C	Y
Black River Pond Dam	Town of Berlin	Black River	NYS Parks & Recreation	1,710	42	B	
Camp Fire Girls Dam	Town of Poestenkill	Potter Creek	Beverly Dennis	4	9	B	
Dyken Pond Dam	Town of Berlin	Poesten Kill	Rensselaer County	3,273	20	B	
Burden Lake Dam	Town of Berlin	TR-Wynanatskill	City of Troy	7,600	24	B	
Glass Lake Dam	Town of Sand Lake	Wynantskill	Glass Lake Preservation Corporation	3,630	17	B	
Van Derheyden Reservoir Dam	Town of Brunswick	Piscawan Kill	Town of Brunswick	79	11	B	
Faith Mills Lower Dam	Town of Sand Lake	Wynantskill	Clifford Clark, Harold Hackel	26	18	B	
Nassau Lake Dam	Town of Nassau / Town of Schodack	Valatie Kill	Nassau Lake Park Improvement Association Inc	550	10	B	
Kane Dam	Town of Sand Lake	Wynantskill	Phillip V Caruso	50	25	B	
Hastings Power Dam	Town of Sand Lake	Wynantskill	Richard W Hastings	22	22	B	
Rail Joint Mill Dam	Town of Sand Lake	Wynantskill	City of Troy	10	25	B	
Lock C-1	Pleasantdale	Hudson River	NYS Canal Corp	11,600	24	B	N
Troy Lock & Dam #1 (Federal)	City of Troy	Hudson River	Green Island Power Authority	8,200	20	B	Y
Hoosac School Dam	Town of Hoosick	Pine Valley Brook	Hoosac School	103	25	B	

Table 3a.11
Moderate and High Hazard Potential Dams – Rensselaer County
(Source: NYSDEC)

Dam Name	Municipality	River/Stream	Owner	Maximum Storage (Acre-Feet)	Dam Height (Feet)	NYSDEC Hazard Potential	EAP on File
Deep Kill Dam	Town of Schaghticoke	Deep Kill	Steve J Elsey	62	30	B	
Schaghticoke Dam	Village of Schaghticoke	Hoosic River	Brookfield Renewable Power	1,150	28	B	Y
James Thompson Dam	Village of Valley Falls	Hoosic River	Valley Falls LP	320	20	B	
Babcock Lake Dam	Town of Grafton	TR-Sunkauissia Creek	Babcock Lake Estates Inc	200	9	B	

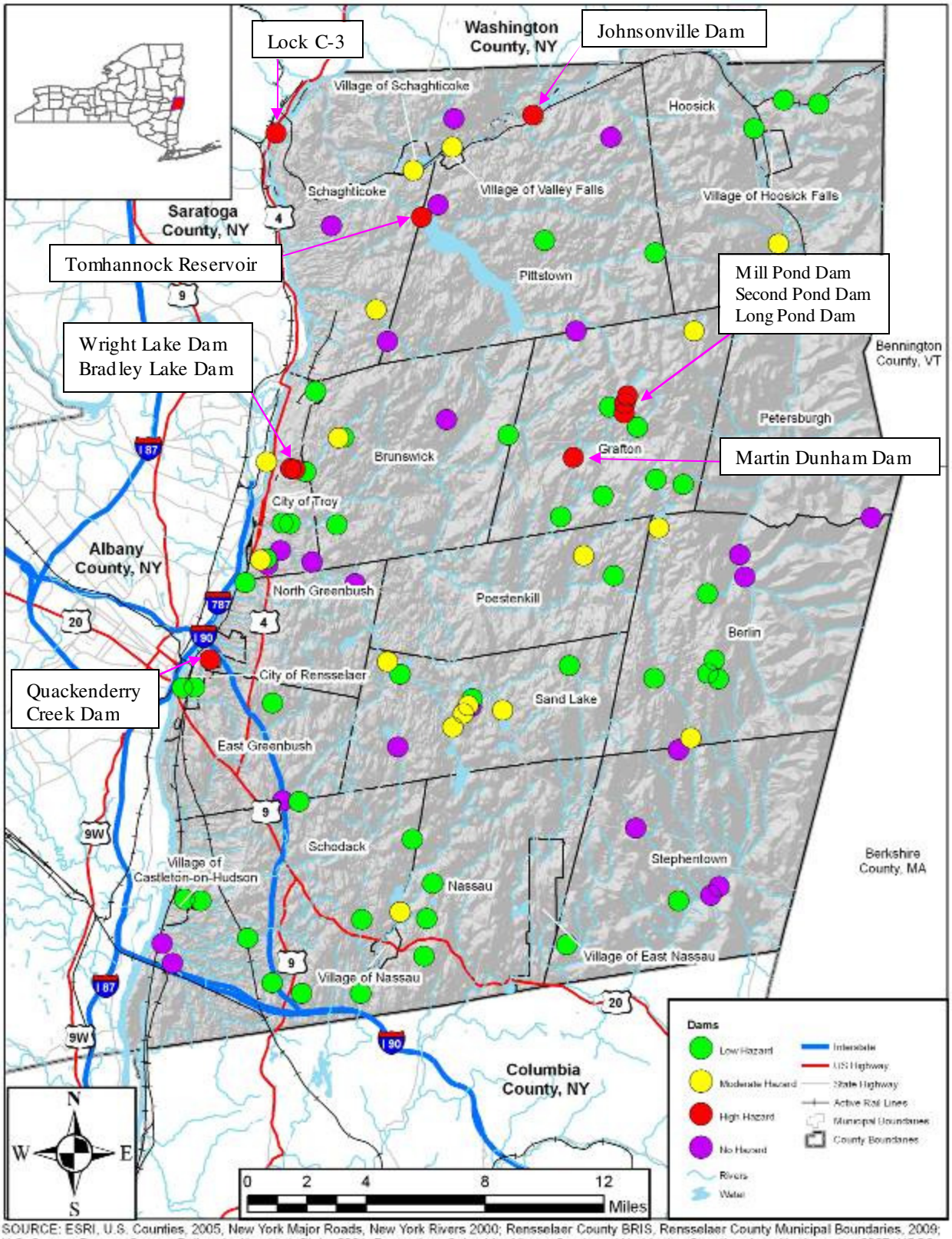
TR = Tributary of, * = USGS 'Major' dam

Of the 28 high and moderate hazard potential dams in Table 3a.9, four have been classified by USGS as "major" dams, which represents the most significant hazard risk based on the potential consequences of a dam failure. According to USGS, major dams are described as 50 feet or more in height, or with a normal storage capacity of 5,000 acre-feet or more, or with a maximum storage capacity of 25,000 acre-feet or more. The largest dam in the County measured by storage is the Tomhannock Reservoir Dam, which is the only dam in the County to meet all three of the "major" dam criteria. This dam is classified by NYSDEC as of High Hazard Potential.

A method of estimating exposure to and potential losses from dam failure hazard which is acceptable for mitigation planning purposes uses data produced through detailed dam failure inundation studies. These studies are often prepared by the owners of dam facilities as part of their own Emergency Action Plans (EAPs) and are kept on file by NYSDEC. Dam failure inundation studies have been previously completed for all the high hazard dams in Table 3a.9 except for the Tomhannock Reservoir. The inundation area for the Quackenderry Creek Dam was not readily available electronically for incorporation into the GIS parcel analyses. However in general, the inundation area extends from the dam downstream to Broadway. From the dam to the John Street Bridge, downstream features are characterized by a broad floodplain with steep valley sidewalls (approximately 500 feet wide and 200 feet deep). Detailed inundation mapping as presented in the EAP extends through an area of the City called "The Hollow", from the John Street Bridge downstream to Broadway in an area extending outward from the creek banks for a distance of roughly 315 feet, and within which six road crossings and over 20 residences are reported. These dam failure inundation maps are presented in Figures 3a-12 through 3a-19. Subsequent figures and tables also include the moderate hazard Schaghticoke Dam, since inundation mapping was readily available for this dam.

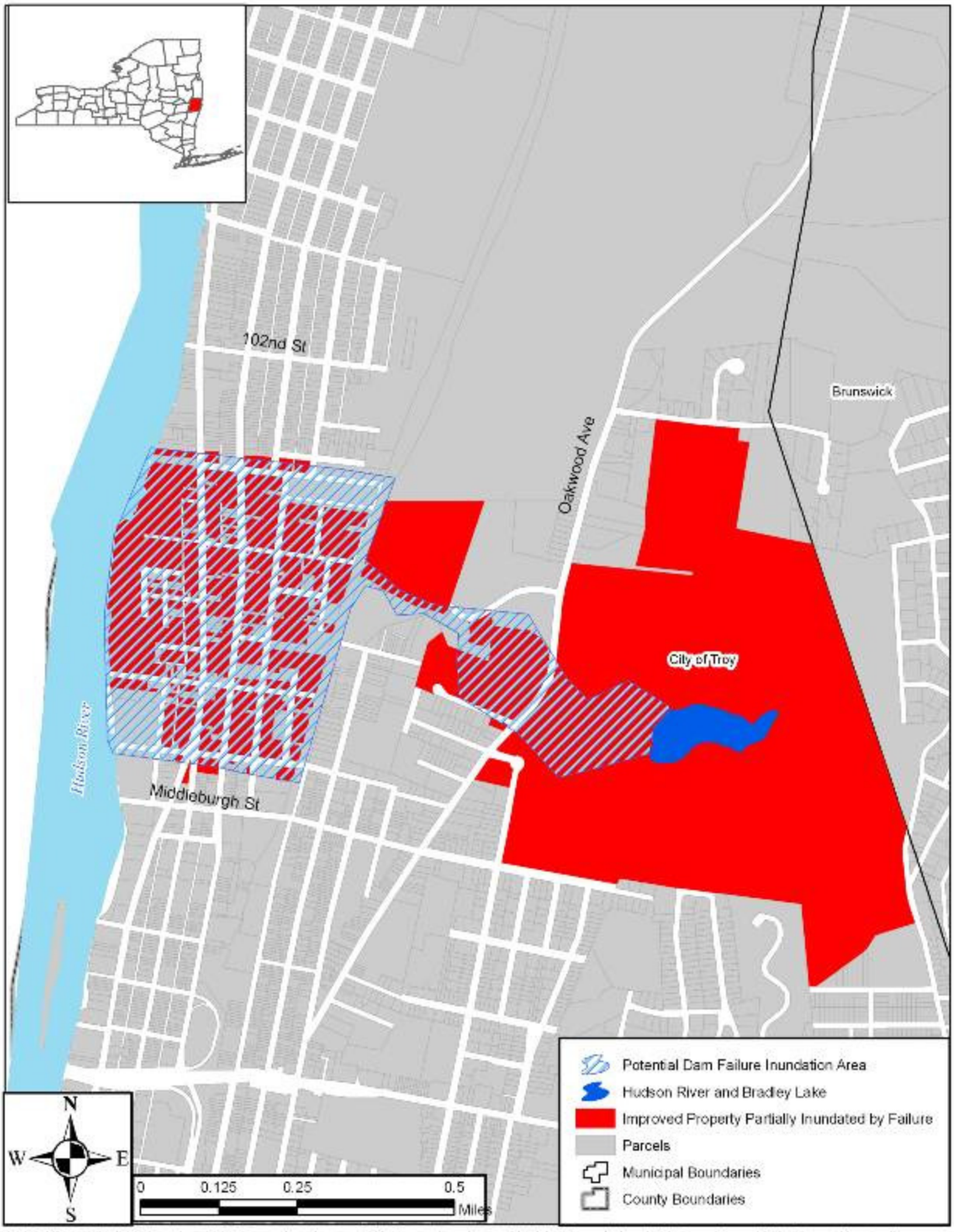
It is recommended that Rensselaer County and any municipality potentially exposed to flooding caused by dam failure investigate the development of inundation mapping and response plans for dams where none are available or where the existing mapping is outdated or lacking in detail as part of their future hazard mitigation strategies.

Figure 3a.11: Rensselaer County Dams



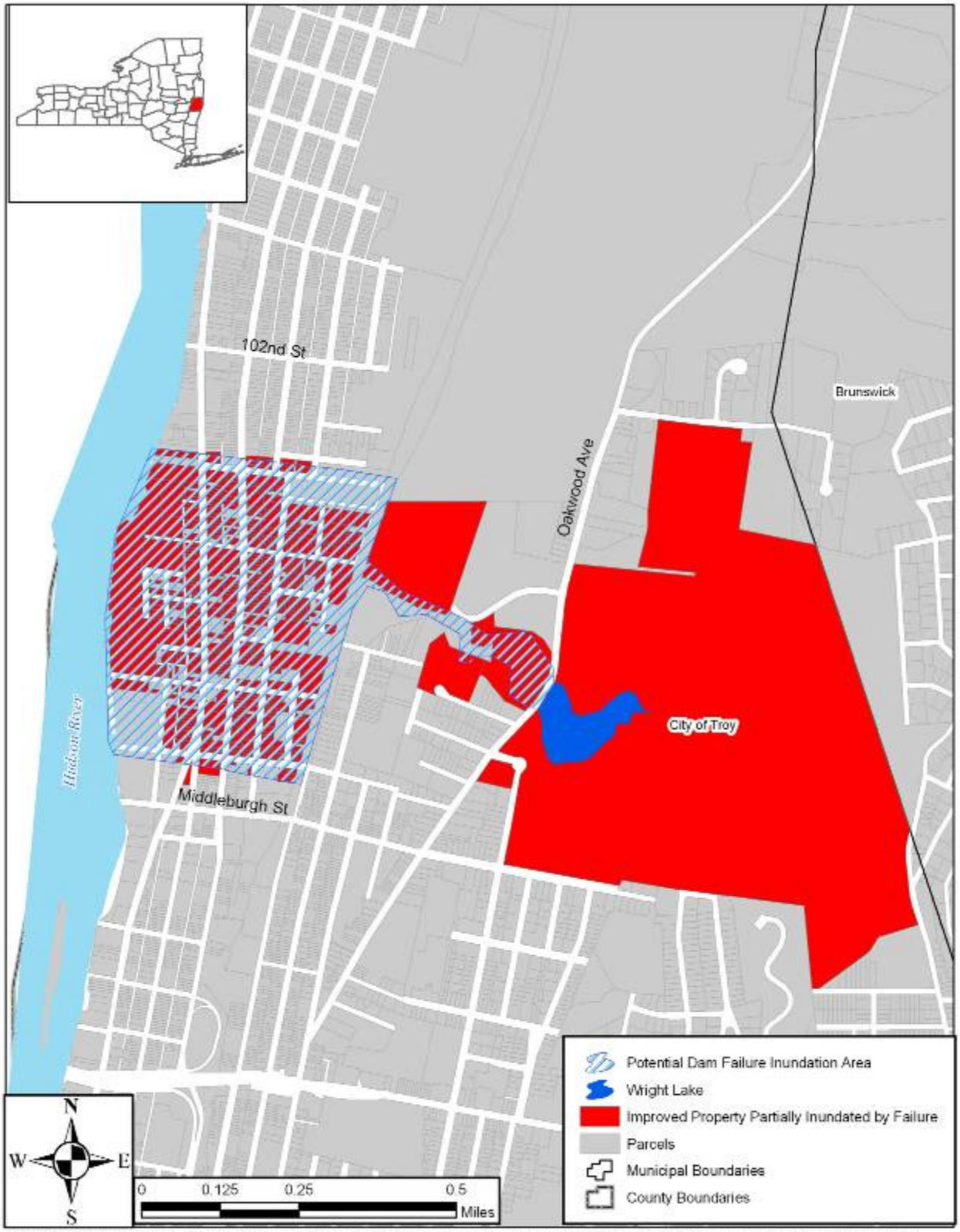
SOURCE: ESRI, U.S. Counties, 2005, New York Major Roads, New York Rivers 2000; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; U.S. Census Bureau, Census Railroads, New York State, 2001, Rensselaer, Columbia, Albany, Saratoga, Washington Counties, Area Hyrdography, 2007; USGS, 1-Arc Second National Elevation Dataset, 2009; NYSDEC, Inventory of Dams, 2010

Figure 3a.12: Potential Area Affected by Failure of the Bradley Lake Dam



SOURCES: ESRI, U.S. Counties, 2005; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; Parcel data, 2010; Rivers; Waterbodies; C.T. Male Associates, P.C., Inundation Map Wright and Bradley Lake Dams, 1989

Figure 3a.13: Potential Area Affected by Failure of the Wright Lake Dam



SOURCES: ESRI, U.S. Counties, 2005; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; Parcel data, 2010; Rivers; Waterbodies; C.T. Male Associates, P.C., Inundation Map Wright and Bradley Lake Dams, 1989

Figure 3a.14: Potential Area Affected by Failure of Lock C-3 at Mechanicville

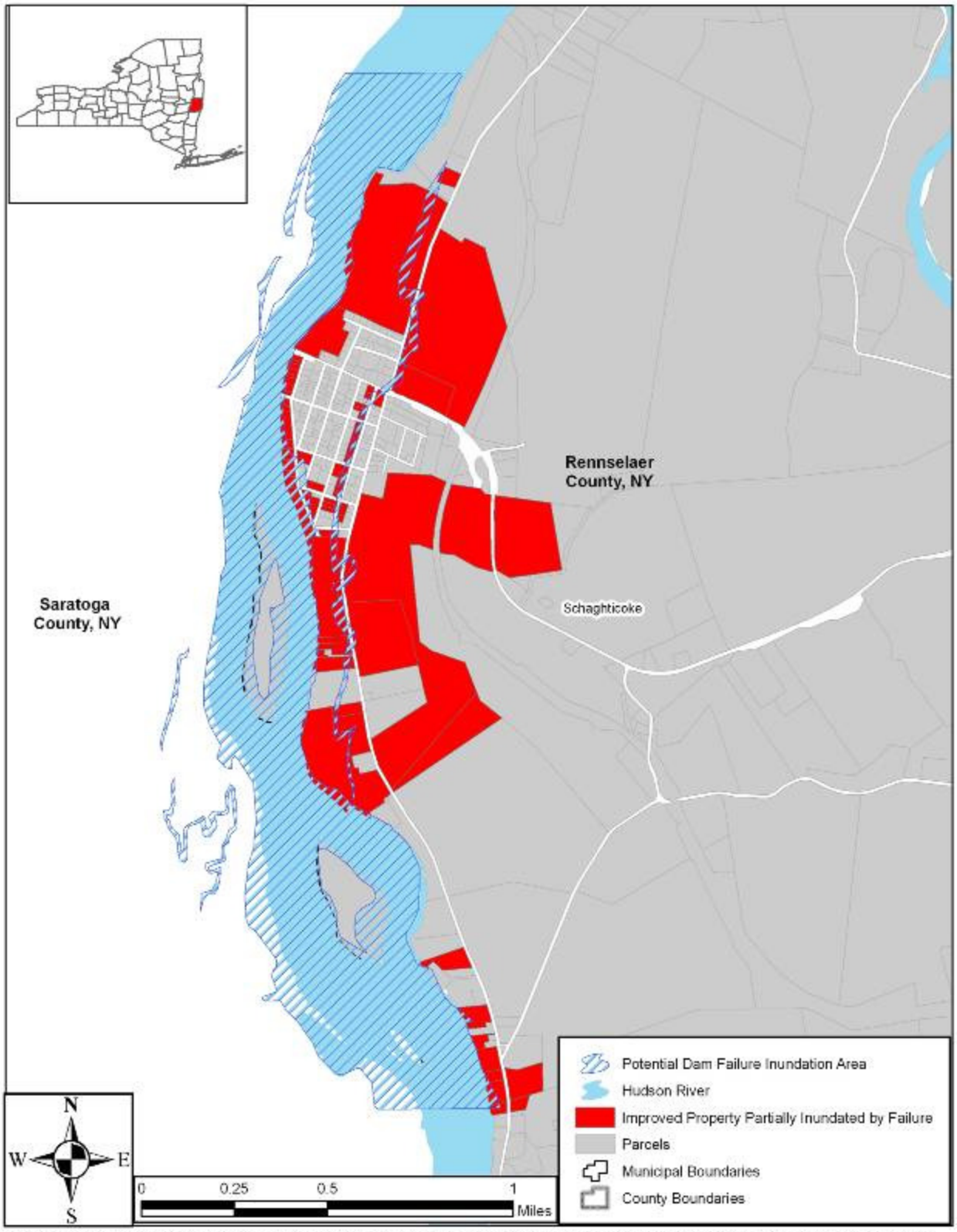
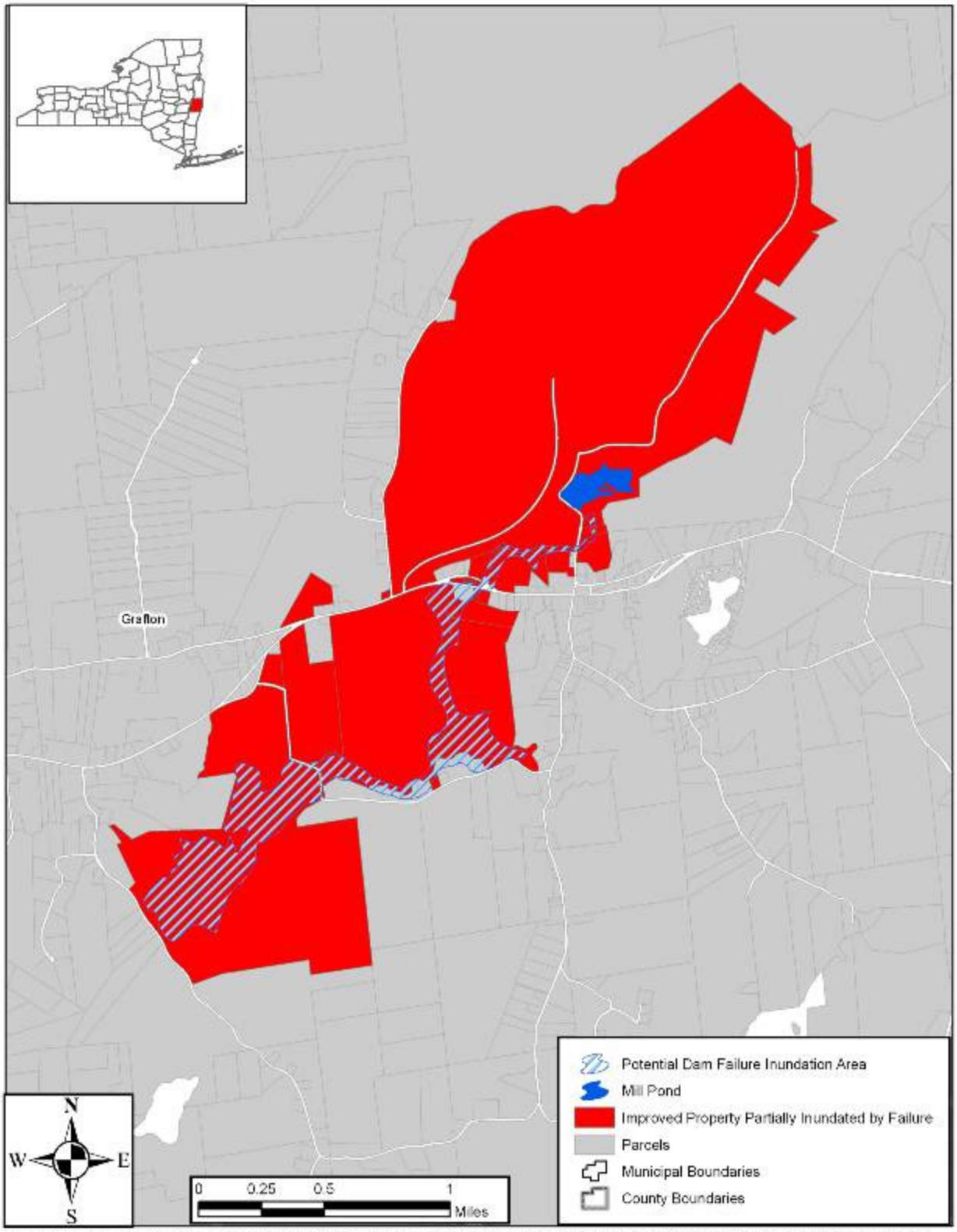
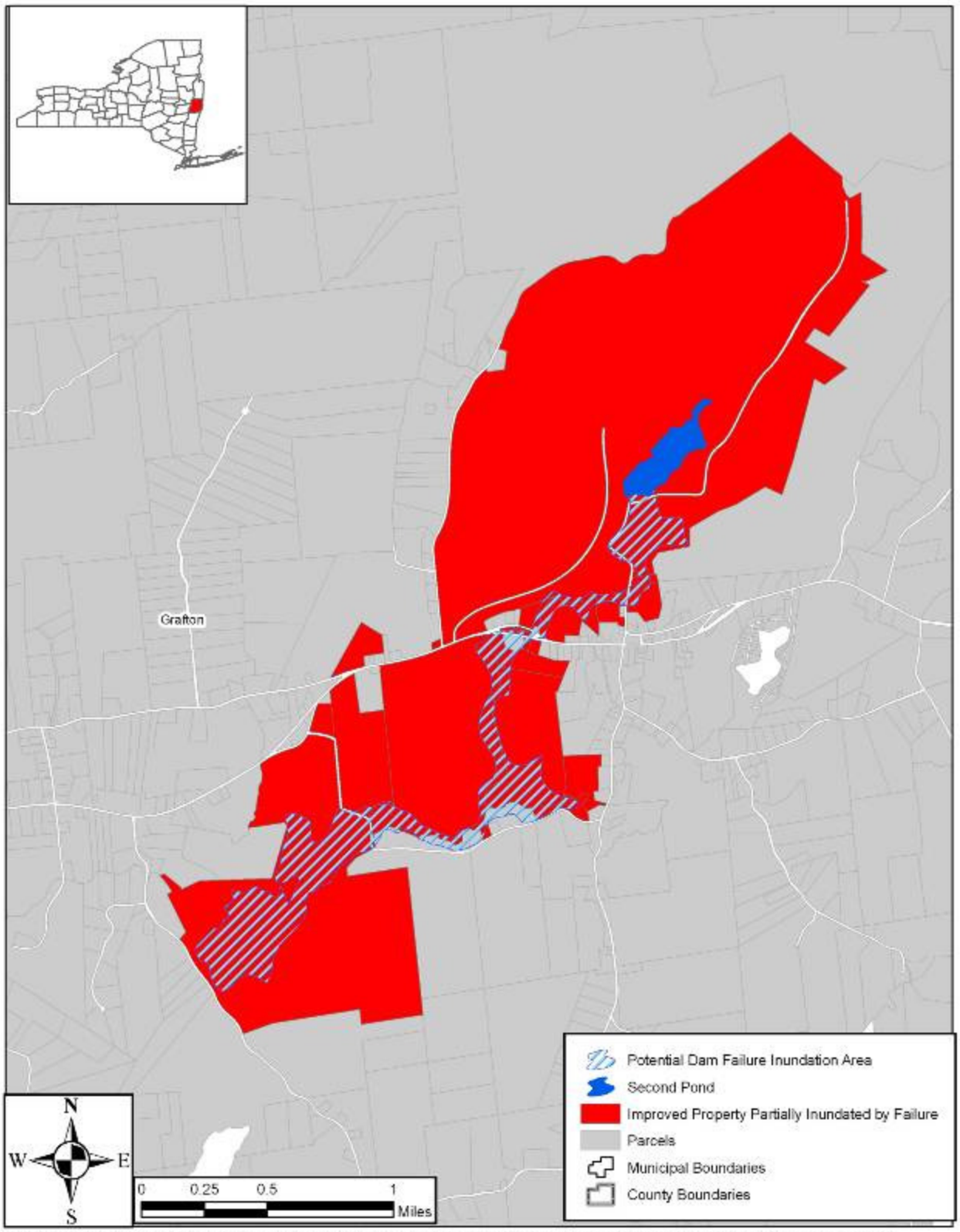


Figure 3a.15: Potential Area Affected by Failure of Mill Pond Dam



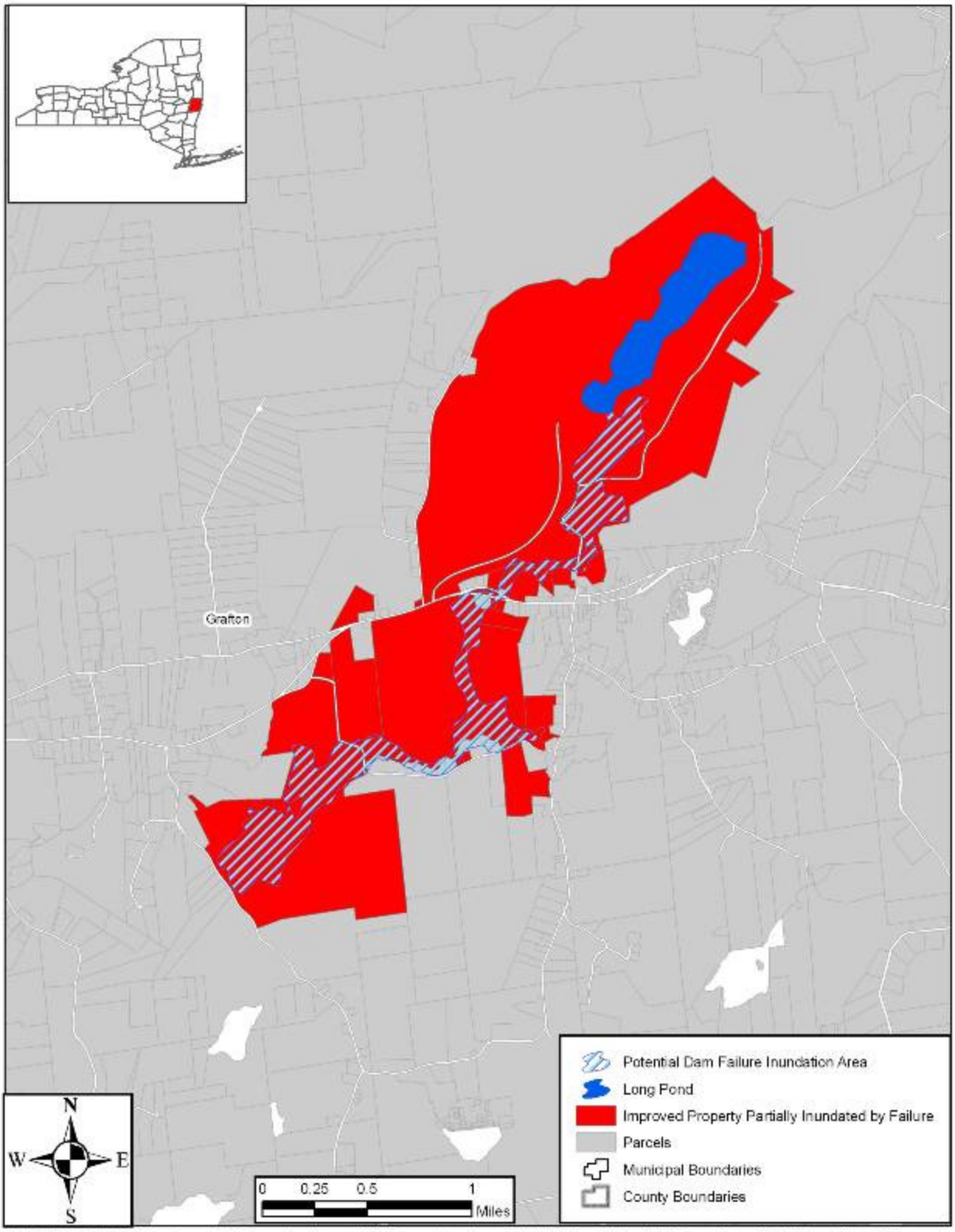
SOURCES: ESRI, U.S. Counties, 2006; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; Parcel data, 2010; Rivers; Civil Dynamics, Inundation Limits for Mill Pond Dam, 2006

Figure 3a.16: Potential Area Affected by Failure of Second Pond Dam



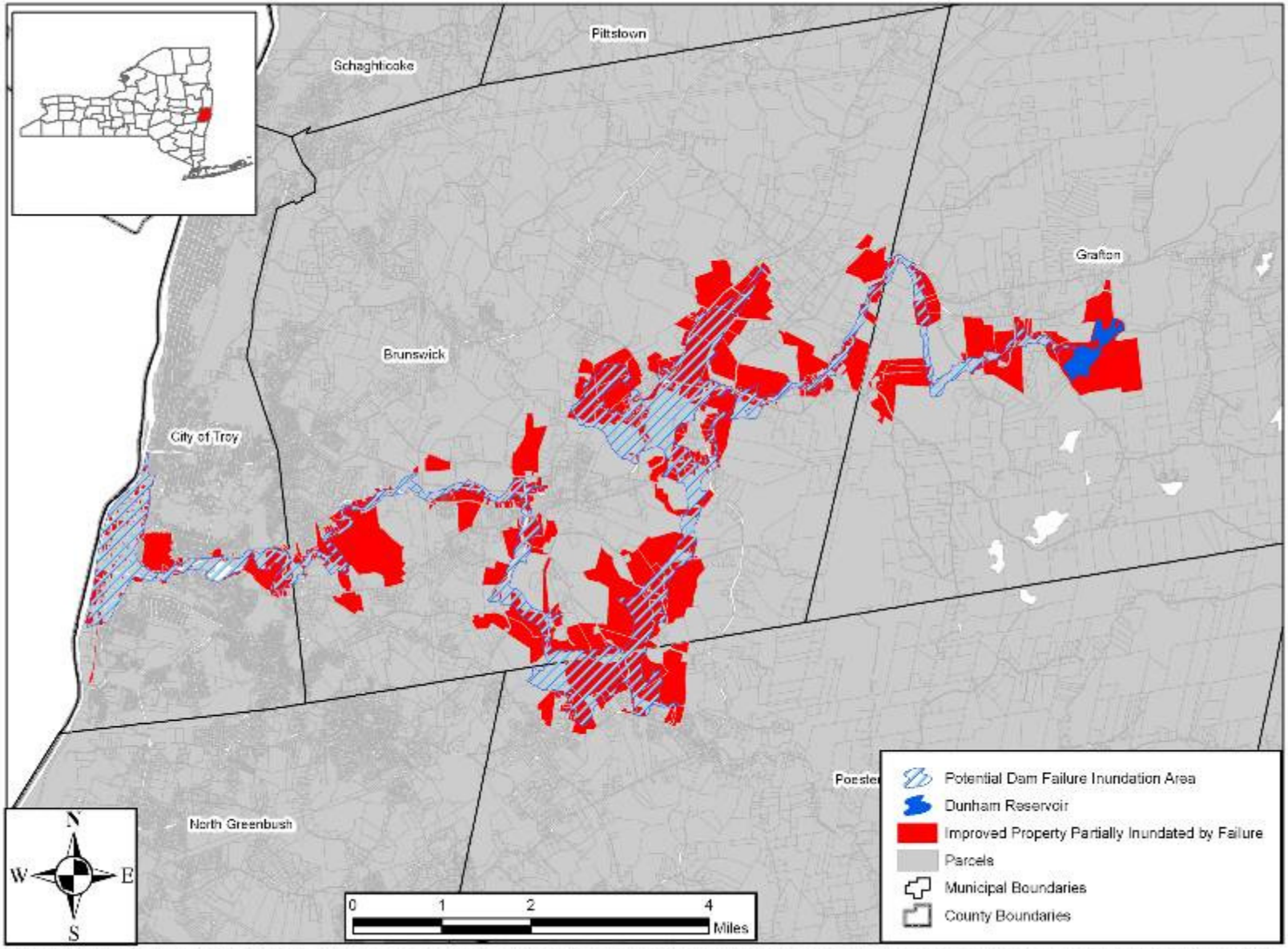
SOURCES: ESRI, U.S. Counties, 2005; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; Parcel data, 2010; Waterbodies; Civil Dynamics, Inundation Limits for Second Pond Dam, 2008

Figure 3a.17: Potential Area Affected by Failure of Long Pond Dam



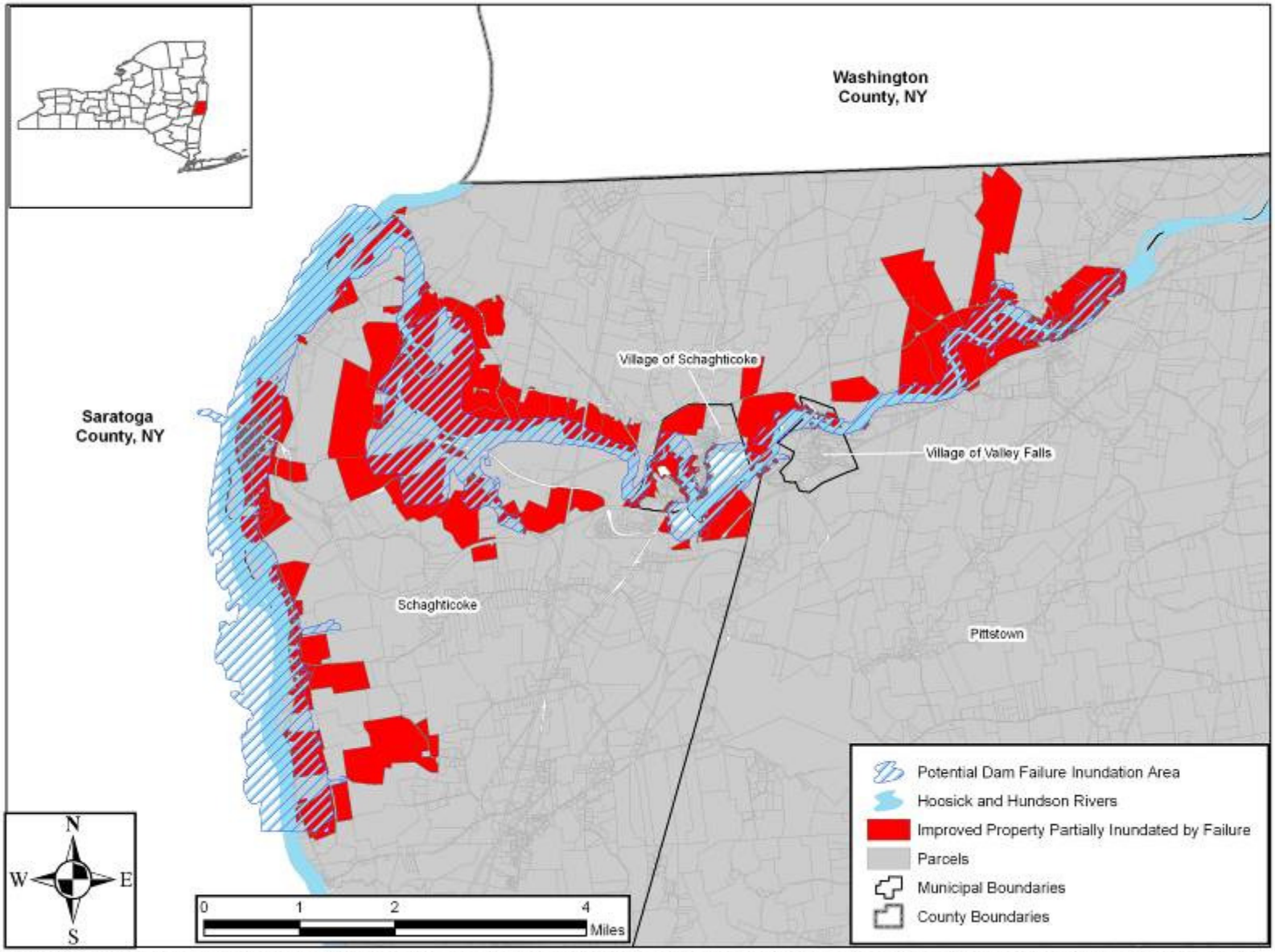
SOURCES: ESRI, U.S. Counties, 2005; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; Parcel data, 2010; Waterbodies; Civil Dynamics, Inundation Limits for Long Pond Dam, 2008

Figure 3a.18: Potential Area Affected by Failure of Martin Dunham Reservoir Dam



SOURCES: ESRI, U.S. Counties, 2005; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; Parcel data, 2010; Waterbodies; Civil Dynamics, Inundation Limits for Martin Dunham Reservoir Dam, 2007

Figure 3a.19: Potential Area Affected by Failure of Johnsonville and Schaghticoke Dams



SOURCES: ESRI, U.S. Counties, 2005; Rensselaer County BRIS. Rensselaer County Municipal Boundaries, 2009; Parcel data, 2010; Rivers; Erie Boulevard Hydropower, L.P. Mohawk, Hoosic & Lower Hudson River, 2004

The potential exposure to damage or loss caused by failure of the mapped dams has been estimated using GIS to compute the value of improved property that is potentially affected by the dam failure inundation envelopes presented in Figures 3a.12 through 3a.19. The potential exposures are presented by municipality in Table 3a.12.

Table 3a.12
Estimated Potential Exposure of Improved Property to Dam Failure
(Source: NYSDEC, Rensselaer County GIS)

Bradley Lake Dam			
Municipality	**Total Municipal Improved Value**	**Exposed Improved Value**	**Exposed Value as % of Municipal Total**
City of Troy	$4,097,481,405	$60,630,486	1.5%
Wright Lake Dam			
Municipality	**Total Municipal Improved Value**	**Exposed Improved Value**	**Exposed Value as % of Municipal Total**
City of Troy	$4,097,481,405	$59,091,299	1.4%
Martin Dunham Reservoir Dam			
Municipality	**Total Municipal Improved Value**	**Exposed Improved Value**	**Exposed Value as % of Municipal Total**
Town of Grafton	$160,142,003	$1,482,528	0.9%
Town of Poestenkill	$315,226,879	$4,233,684	1.3%
Town of Brunswick	$935,076,250	$64,222,781	6.9%
City of Troy	$4,097,481,405	$567,727,201	13.9%
Mill Pond Dam			
Municipality	**Total Municipal Improved Value**	**Exposed Improved Value**	**Exposed Value as % of Municipal Total**
Town of Grafton	$160,142,003	$868,811	0.5%
Second Pond Dam			
Municipality	**Total Municipal Improved Value**	**Exposed Improved Value**	**Exposed Value as % of Municipal Total**
Town of Grafton	$160,142,003	$1,226,164	0.8%
Long Pond Dam			
Municipality	**Total Municipal Improved Value**	**Exposed Improved Value**	**Exposed Value as % of Municipal Total**
Town of Grafton	$160,142,003	$1,317,225	0.8%
Johnsonville and Schaghticoke Dams			
Municipality	**Total Municipal Improved Value**	**Exposed Improved Value**	**Exposed Value as % of Municipal Total**
Town of Pittstown	$296,057,020	$3,402,111	1.2%
Town of Schaghticoke	$393,627,712	$35,537,582	9.0%
Village of Schaghticoke	$48,285,342	$7,729,737	16.0%
Village of Valley Falls	$24,983,624	$3,446,668	13.8%
Lock C-3			
Municipality	**Total Municipal Improved Value**	**Exposed Improved Value**	**Exposed Value as % of Municipal Total**
Town of Schaghticoke	$393,627,712	$2,492,302	0.6%

Note: Exposure has been estimated only for the high/moderate hazard dams affecting Rensselaer County for which adequate inundation mapping was readily available.

The proportion of structure values actually realized as damage following a dam failure will depend on the depth and velocity of the floodwaters, which in turn will depend on the hydrologic conditions leading up

to the failure. For a more detailed discussion of the derivation and use of improved property values, see Section 3b: Risk Assessment – Asset Identification and Characterization.

Table 3a.11 indicates that although there is comparatively little development at risk of economic damage from a failure of the any of these dams when expressed of the total improved value in the municipalities in which they are located, damages from an individual dam failure event could still run into millions of dollars.

Historical Occurrences – Dam Failure

In addition to the NYSDEC inventory, detailed information on dams nationwide is compiled by the National Performance of Dams Program (NPDP) at Stanford University. While the NPDP database records much the same information as NYSDEC, it also includes a performance and event history for each dam which includes descriptions of any safety-related incidents that have occurred.

The NPDP database reports 2 dam safety incidents occurring at Rensselaer County dams since January 1978 and gives basic descriptions of the incidents, their causes and impacts. While neither of the two incidents is recorded as having caused significant damage to property distant from the dams themselves, the details of the two incidents are included below:

Schaghticoke Dam (Moderate Hazard), April 17, 1988:
Failure of the penstock. Four linear feet of the five foot diameter penstock was completely torn away (structural failure). Damage included erosion of side hill and embankment adjacent to the powerhouse, spill of lubricating oil, tipped over transformers, local power outage, flooding of the powerhouse about three to four feet with mud, and extensive damage to one of four generators.

Ida Lake Dam (Low Hazard), June 18, 1997:
The DIN indicates that the incident occurred during 6/18-19/97. This incident involved the failure of a drain, which was caused by age and a deteriorated condition. The size of the breach was 4 feet wide by 6 feet high. Damage included the silting of Poestenkill. Belden Pond elevation dropped about 4 feet. Dam backwatered into pond. Loss of wetland.

Information received from CPG members mentions two additional incidents in which flooding and damage was attributed to dam failure: failure of a dam on Woods Brook caused damage and flooding in the Village of Hoosick Falls in the 1920s, this event may have contributed to a project to remove a dam and construct floodwalls in the village completed by the US Army Corps of Engineers in 1952. Failure of another dam on Quackenkill caused damage in the Town of Brunswick in the 1930s.

Probability of Occurrence – Dam Failure

The probability of a dam failure occurrence in Rensselaer County is relatively low due to routine inspection, repair and maintenance programs carried out by the NYSDEC, which serves to ensure the safety and integrity of dams in New York and, thereby, protect people and property from the consequences of dam failures. However, the possibility of a future failure event is likely increasing due to aging dam structures that may be in need of repair or reconstruction, and occasional problems related to private dam owners' degree of cooperation with State regulatory agencies.

Drought

Description – Drought

The general term "drought" is defined by the US Geological Survey (USGS) as, "a prolonged period of less-than-normal precipitation such that the lack of water causes a serious hydrologic imbalance." As stated in FEMA's, "Multi-Hazard Identification and Risk Assessment" (1997), drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length.

According to the National Oceanic and Atmospheric Administration's (NOAA's) Drought Information Center, there are four types of drought:

- Meteorological Drought – A measure of precipitation departure from normal.
- Agricultural Drought – When the amount of moisture in soil does not meet the needs of a particular crop.
- Hydrological Drought – When both surface and subsurface water supplies are below normal.
- Socioeconomic Drought - When a water shortage begins to affect people.

Meteorological droughts are typically defined by the level of "dryness" when compared to an average, or normal amount of precipitation over a given period of time. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts (when the amount of moisture in soil does not meet the needs of a particular crop). Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that affect people and limit the ability to supply water-dependent products in the marketplace.

Drought conditions typically do not cause property damages or threaten lives, but rather drought effects are most directly felt by agricultural sectors. At times, drought may also cause community-wide impacts as a result of acute water shortages (regulatory use restrictions, drinking water supply and salt water intrusion). The magnitude of such impacts correlates directly with local groundwater supplies, reservoir storage and development densities. In general, impacts of drought can include significant adverse consequences to:

- Public water supplies for human consumption
- Rural water supplies for livestock consumption and agricultural operations
- Water quality
- Natural soil water or irrigation water for agriculture
- Water for forests and for fighting forest fires
- Water for navigation and recreation.

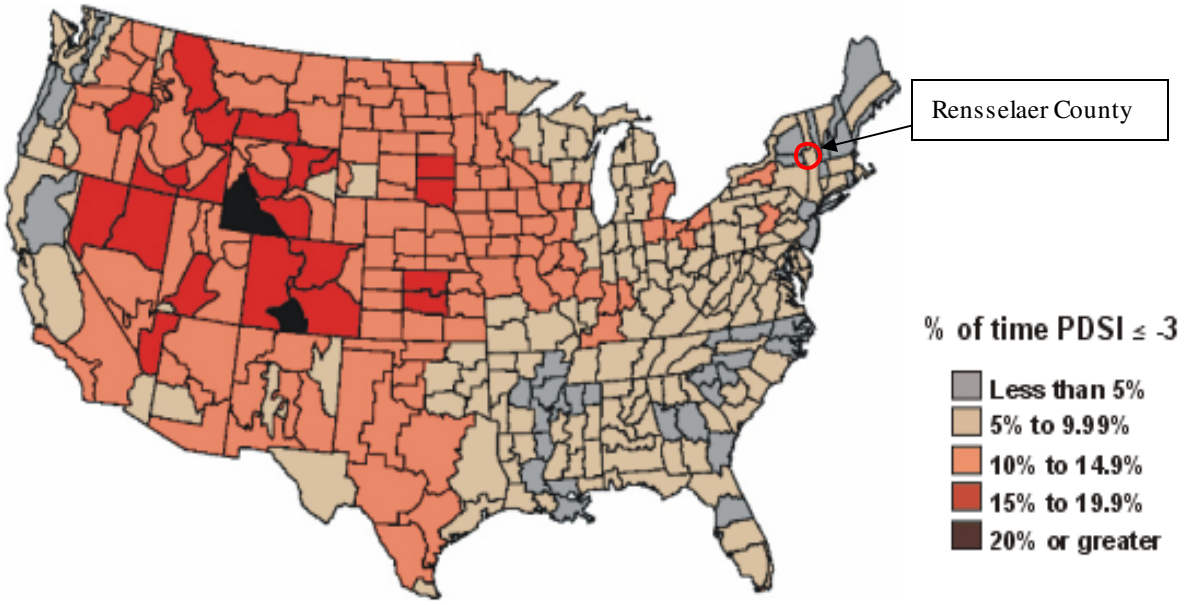
The severity of these impacts depends not only on the duration, intensity, and geographic extent of a specific drought event, but also on the demands made by human activities and vegetation on regional water supplies.

Location and Extent – Drought

Droughts occur in all parts of the country and at any time of year, depending on temperature and precipitation over time. Arid regions are more susceptible to long-term or extreme drought conditions, while other areas (including Rensselaer County) tend to be more susceptible to short-term, less severe droughts.

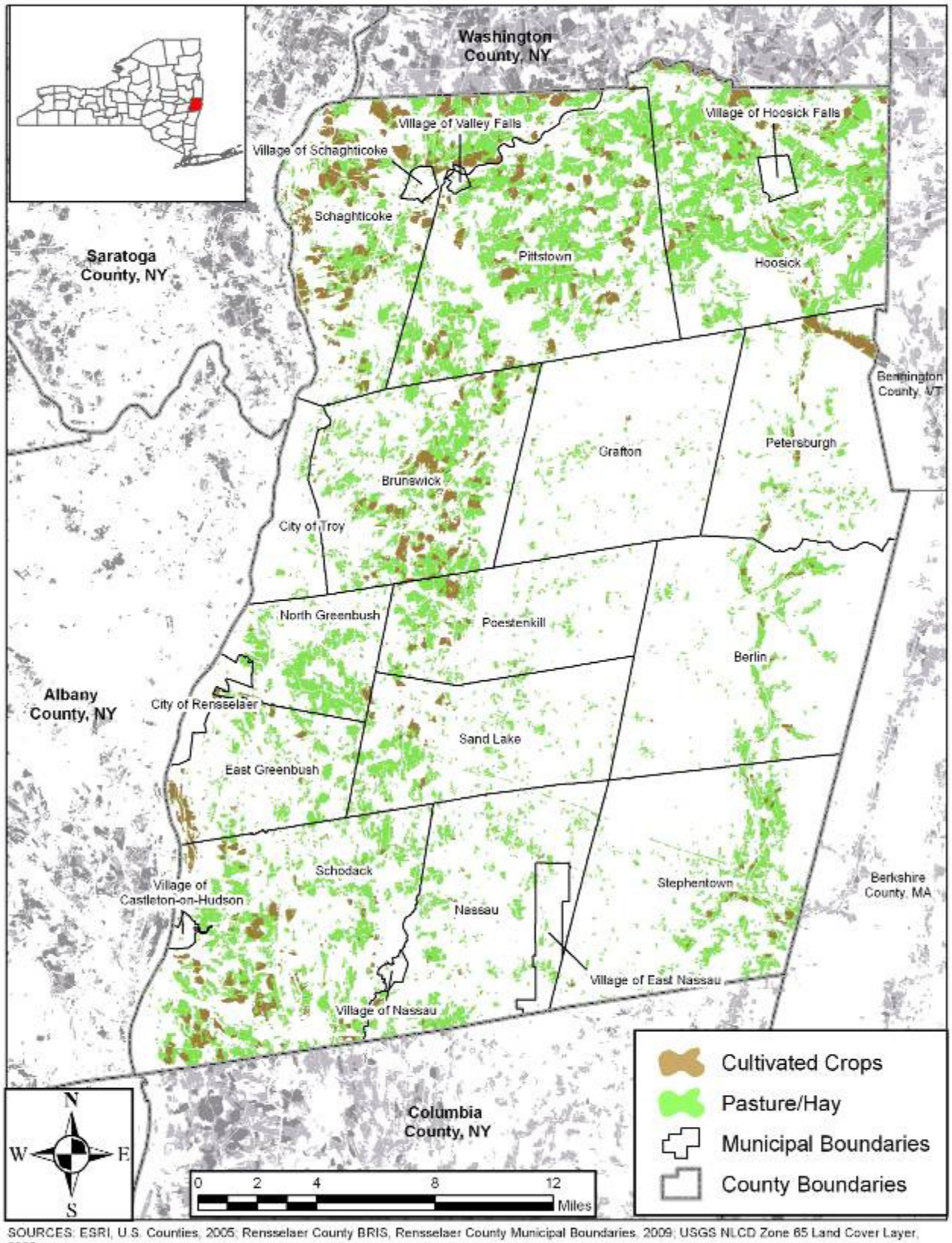
Figure 3a.20 shows the Palmer Drought Severity Index (PDSI) Summary Map for the United States from 1895 to 1995. PDSI drought classifications are based on observed drought conditions and will range from -0.5 (incipient dry spell) to -4.0 (extreme drought). According to the PDSI map, Rensselaer County is in a zone that experienced severe drought conditions between 5 and 10 percent of the 100-year period during 1895 to 1995. It can therefore be assumed that severe drought conditions are a relatively low risk for Rensselaer County. However, short term droughts of less severity are more common and may occur several times in a decade.

Figure 3a.20: Palmer Drought Severity Index Summary Map for the United States



While the extent of drought impacts for Rensselaer County may include all of the issues listed above, some of the most immediately quantifiable effects of drought in the County are likely to be experienced by farmers, who can suffer heavy financial losses due to crop damage or loss. Figure 3a.21 shows the extent, location and distribution of agricultural land across Rensselaer County, and Table 3a.13 presents a breakdown of agricultural land by municipality based on land cover GIS data. It is evident from the figure that a significant proportion of municipality areas are devoted to agriculture in some form. According to the USDA Agricultural Census of 2007, there were 506 farms in Rensselaer County, with a market production value of $37.5 million. Slightly more than half of this value is accounted for by milk and other dairy products, with total crop sales accounting for almost 38%. The most significant recorded category of produce is nursery, greenhouse and floriculture, which in 2007 contributed more than $3.9 million to the total market production value, followed closely by vegetables, melons and potatoes, with $3.8 million. According to the USDA Agricultural Census the County's 506 farms occupy just over 85,000 acres (20% of the County land area), of which around 39,000 acres are classified as harvested cropland by the USDA Agricultural Census.

Figure 3a.21: Rensselaer County Agricultural Land



SOURCES: ESRI, U.S. Counties, 2005; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; USGS NLCD Zone 65 Land Cover Layer, 2003

Table 3a.13
Distribution of Agricultural Land in Rensselaer County
USGS NLCD Land Cover 2003, Lamont-Doherty Earth Observatory (Crop/Pastureland Areas)

Municipality	Total Area (Acres)	Cultivated Cropland (Acres)	Cultivated Cropland (%)	Pasture Land* (Acres)	Pasture Land (%)
Berlin, Town of	38,196	217	1%	2,604	7%
Brunswick, Town of	28,284	2,143	8%	6,809	24%
Castleton-on-Hudson, Village of	533	0	0%	13	2%
East Greenbush, Town of	15,713	559	4%	2,385	15%
East Nassau, Village of	3,031	1	0%	259	9%
Grafton, Town of	29,706	32	0%	805	3%
Hoosick, Town of	950	0	0%	59	6%
Hoosick Falls, Village of	39,364	1,763	4%	14,564	37%
Nassau, Town of	25,597	134	1%	3,295	13%
Nassau, Village of	442		0%	13	3%
North Greenbush, Town of	12,103	139	1%	3,238	27%
Petersburgh, Town of	26,682	796	3%	1,582	6%
Pittstown, Town of	41,256	2,136	5%	13,249	32%
Poestenkill, Town of	20,732	416	2%	2,544	12%
Rensselaer, City of	2,202	19	1%	67	3%
Sand Lake, Town of	23,088	353	2%	2,762	12%
Schaghticoke, Town of	32,507	4,793	15%	7,484	23%
Schaghticoke, Village of	640	6	1%	46	7%
Schodack, Town of	40,243	2,339	6%	9,137	23%
Stephentown, Town of	37,280	385	1%	4,272	11%
Troy, City of	7,056	9	0%	332	5%
Valley Falls, Village of	307	7	2%	57	19%
Rensselaer County Total	*425,915*	*16,246*	*4%*	*75,575*	*18%*

Note: Some hay- or forage-producing pastureland is classified as cropland by the USDA Agricultural Census

Figure 3a.21 and Table 3a.13 indicate that the impact of drought would be experienced most significantly for crop farmers in the north western portion of the County, where the town of Schaghticoke has the largest proportion of land areas given over to cultivated cropland, and for dairy farmers the impact would be most significant in the northern and western parts of the County, where several municipalities have more than a quarter of their land areas given over to pastureland.

As noted by Core Planning Group members, drought conditions could impact local water systems sourced by both surface water and well water (both municipal and non-municipal). The magnitude or severity of the impacts would be exacerbated in the cases of surface water sources, because groundwater tends to be much more resilient to drought conditions.

Previous Occurrences – Drought

Historical occurrences of drought in Rensselaer County have been identified using the NOAA NCDC and SHELDUS databases. The NCDC database records three significant drought events which specifically list Rensselaer County as an affected area since August 1993, the point at which NCDC drought records begin in New York State. Of these droughts, NCDC records details relevant to Rensselaer County for the following events:

August – December, 1993:

A prolonged period of drought starting in the summer of 1993 decimated much of the agriculture in southern and eastern New York State. Counties hit hard by drought included Albany, Rensselaer, Columbia and Greene. Estimates of feed grain losses in affected counties were well over 40 percent and in some cases nearly 100 percent. Especially hard hit were hay and corn crops as well as fruits and vegetables. Total crop damages were estimated at $50 million across the affected area. The SHELDUS database lists crop damages of more than $800,000 specific to Rensselaer County for this event.

August 1999:
August 1999 was the peak of the long term drought across Eastern New York that began in July of 98. The fourteen month stretch, ending in August, saw rainfall and melted snowfall throughout the region only tallying up to about 80 percent of normal. At the Albany International Airport 35.41 inches of water equivalent was recorded from July 1998 through August 1999, compared to the thirty year normal of 42.82 inches. The long term drought combined with the heat of the summer, resulted in a drought warning across much of the region as well as a declaration of agricultural disaster. The Mohawk Valley and Western Adirondacks were especially hard hit. The drought resulted in record low levels of the Mohawk River, numerous forest fires across the Adirondacks, and many wells going completely dry. Most communities implemented voluntary or mandatory water restrictions.

The SHELDUS database records two additional drought events affecting Rensselaer County in June – July 1988 and June 1991, but does not record any details or descriptions beyond estimated crop damages, which were recorded as more than $1.8 million and $185,000 for these events respectively.

During the course of general research, articles were found in the New York Times which referred to an "unprecedented" drought in 1907 and another serious drought in 1909 which threatened to cause serious disruptions to the local milk supply. The New York State Hazard Mitigation Plan also makes reference to a "Statewide" drought event in October 1994, although no further details are given other than that this month equaled the driest month on record at Albany.

Probability of Occurrence – Drought

Based on NCDC and SHELDUS records, Rensselaer County has directly experienced 5 significant drought conditions during the 22-year period from 1988 through 2010, or an average of 0.2 drought events per year. This is consistent with Figure 3a.20 which suggests Rensselaer County is less prone to drought conditions than other parts of the region. However, Rensselaer County may experience an increase in the frequency of drought conditions in the foreseeable future if some of the current predictions regarding climate change prove to be accurate.

Floods

Description – Floods

FEMA's National Flood Insurance Program (NFIP) defines the term "flooding" as "a general and temporary condition of partial or complete inundation…from overflow of inland or tidal waters, unusual and rapid accumulation or runoff of surface waters from any source, or a mudflow." According to FEMA's *NFIP Floodplain Management Requirements: a Study Guide and Desk Reference for Local Officials* (FEMA-480), most floods fall into the following three categories:

- **Riverine Flooding – Flooding that occurs along a channel** (where a "channel" is defined as a feature on the ground that carries water through and out of a watershed, whether natural channels such as rivers and streams, or man-made channels such as drainage ditches).
  - Overbank flooding occurs along a channel as excess flows overflow channel banks. Overbank flooding occurs when downstream channels receive more rain or snowmelt from their watershed than normal, or a channel is blocked by an ice jam or debris.
  - Flash floods are a type of riverine flooding typically caused when a significant amount of rainfall occurs in a very short duration. Flash flooding is characterized by a rapid rise in water level and high velocity flows. Flash floods can also be caused by ice jams (ice jam flooding, which can be upstream of an intact jam or downstream of a jam that has broken downstream) or dam breaks.
- **Coastal Flooding – (not applicable in Rensselaer County) Flooding that occurs along the coasts of oceans, the Gulf of Mexico, and large lakes** (i.e., the Great Lakes). Hurricanes and severe storms cause most coastal flooding, including "Nor'easters" which are severe storms that occur in the Atlantic basin that are extratropical in nature with winds out of the northeast.
  - Storm surge is one characteristic of coastal flooding caused as persistent high winds and changes in air pressure work to push water on shore, often on the order of several feet.
- **Shallow Flooding – Flooding that occurs in flat areas where a lack of channels means water cannot drain away easily.**
  - Sheet flow occurs when there are inadequate or no defined channels, and floodwaters spread out over a large area at a somewhat uniform depth. Sheet flow occurs after intense or prolonged rainfalls during which rain cannot soak into the ground.
  - Ponding occurs when runoff collects in a depression and cannot drain out. Ponding floodwaters do not move or flow away; they will remain until the water infiltrates into the soil, evaporates, or is pumped away.
  - Urban drainage flooding occurs when the capacity of an urban drainage system is exceeded. An urban drainage system comprises the ditches, storm sewers, retention ponds and other facilities constructed to store runoff or carry it to a receiving stream, lake or the ocean. Urban drainage flooding can also occur in areas protected by levees, as water collects on the protected side of the levee when pump capacities are exceeded during severe storms.

Floods are considered hazards when people and property are affected. Historically, development in floodplains was often a necessity, as water bodies provided a means of transportation, electricity, water supply, and often supported the livelihood of local residents (i.e., fishing, farming, etc.). Today, development in floodplains is more often spurred by the aesthetic and recreational value of the floodplain. Flooding is widely regarded as the most common major natural hazard in New York State.

The **National Flood Insurance Program (NFIP)** was established by Congress with the passage of the National Flood Insurance Reform Act of 1968. Through this program, Federally-backed flood insurance is made available to homeowners, renters, and businesses in a community if that community adopts and enforces a floodplain management ordinance to reduce future flood damages within its floodplains. This includes not only preventative measures for new development, but also corrective measures for existing development. FEMA also administers the Community Rating System (CRS), a program under which communities choosing to implement floodplain management actions that go beyond the minimum requirements of the NFIP become eligible for discounts on flood insurance premiums for properties within that community. At present, every individual municipality in Rensselaer County is an active member of the NFIP (See Table 3a.13), although none have so far become eligible for the CRS.

In addition to providing flood insurance, the NFIP also studies and maps the nation's floodplains, preparing its findings in Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies (FISs). FEMA also prepares digital Q3 Flood Data files, which contain digital flood hazard mapping. Using GIS, these digital maps can be overlaid upon a community's existing GIS base map. FEMA Q3 Flood Data and the Rensselaer County GIS formed the basis of this analysis of the flood hazard for Rensselaer County.

Location and Extent – Floods

While Rensselaer County and its jurisdictions experience several types of flooding, the vast majority of flooding in the County is caused by from riverine flooding, shallow flooding resulting from urban drainage issues, and occasional ice jams. Core Planning Group members indicated that due to the County's generally hilly terrain, low-lying areas generally experience flooding during excessive rain events.

The extent of flooding associated with a 1 percent probability of occurrence – the "100-year flood" or "base flood" – is used as regulatory boundaries by a number of federal, state and local agencies. Also referred to as the "special flood hazard area", this boundary is a convenient tool for assessing vulnerability and risk in flood prone. FEMA's Q3 Flood Data was used to identify the location of flood hazard areas in Rensselaer County. According to the Q3 data, high/moderate flood risk zones exist in most Rensselaer County Municipalities. Figure 3a.22 illustrates the mapped flood risk using FEMA zone designations, which are explained in more detail below:

High Risk Areas Zones A, AE, V, and VE: These are areas with a 1% chance of being flooded in any given year (the "100-year" floodplain). AE zones are those areas where the Base Flood Elevation (BFE – the "100-year flood) has been determined analytically. A Zones are areas where the base floodplain has been mapped by approximate methods and the BFE has not been determined. V/VE Zones are coastal areas with a 1% annual chance of being flooded which are also susceptible to a velocity hazard (i.e. wave action). There are no V or VE zones on any Rensselaer County FIRMs.

Moderate Risk Areas Zone X500 (Zone B on older maps): These are areas lying between the "100-year" and "500-year" (0.2% annual chance of flooding) floodplain limits. They also include areas of shallow flooding with average depths of less than one foot, or drainage areas less than one square mile.

Low Risk Areas Zone X (Zone C on older maps): These are areas outside of the 500-year floodplain, where the flood hazard is minimal. They may include areas of ponding or with local drainage problems not significant enough to warrant detailed study or designation as base floodplain.

Possible Risk Areas Zone D: Areas where there are possible but undetermined flood hazards. There are no Zone D areas on Rensselaer County FIRMs.

The mapped Q3 flood data is not exact, and in some cases flood hazard area boundaries may not match landform boundaries. While limitations in the data should be recognized, this represents best readily available GIS data at the time of the study and is generally deemed suitable for mitigation planning purposes. Rensselaer County is currently not on the list of counties to be included in FEMA's Map Modernization Program and therefore, Digital Flood Insurance Rate Maps (DFIRMs) were not available for this initial version of the plan and are not currently scheduled to be developed in the immediate future. When and if DFIRMs become available for Rensselaer County at some point in the future, sections of the plan dealing with flooding should be revised accordingly and incorporated into the next plan update.

FEMA's Q3 flood mapping was overlaid upon the Rensselaer County GIS parcel mapping to identify the flood risk areas for all municipalities in Rensselaer County, and the collated data is presented in Tables 3a.14 and 3a.15. In the absence of GIS size and location data for individual structures, impacted improved property values were calculated by adjusting the structure values according to the percentage of the improved parcel intersected by the flood risk zone. A more detailed breakdown of property exposed to the flood hazard by land use types is presented in Appendix A.

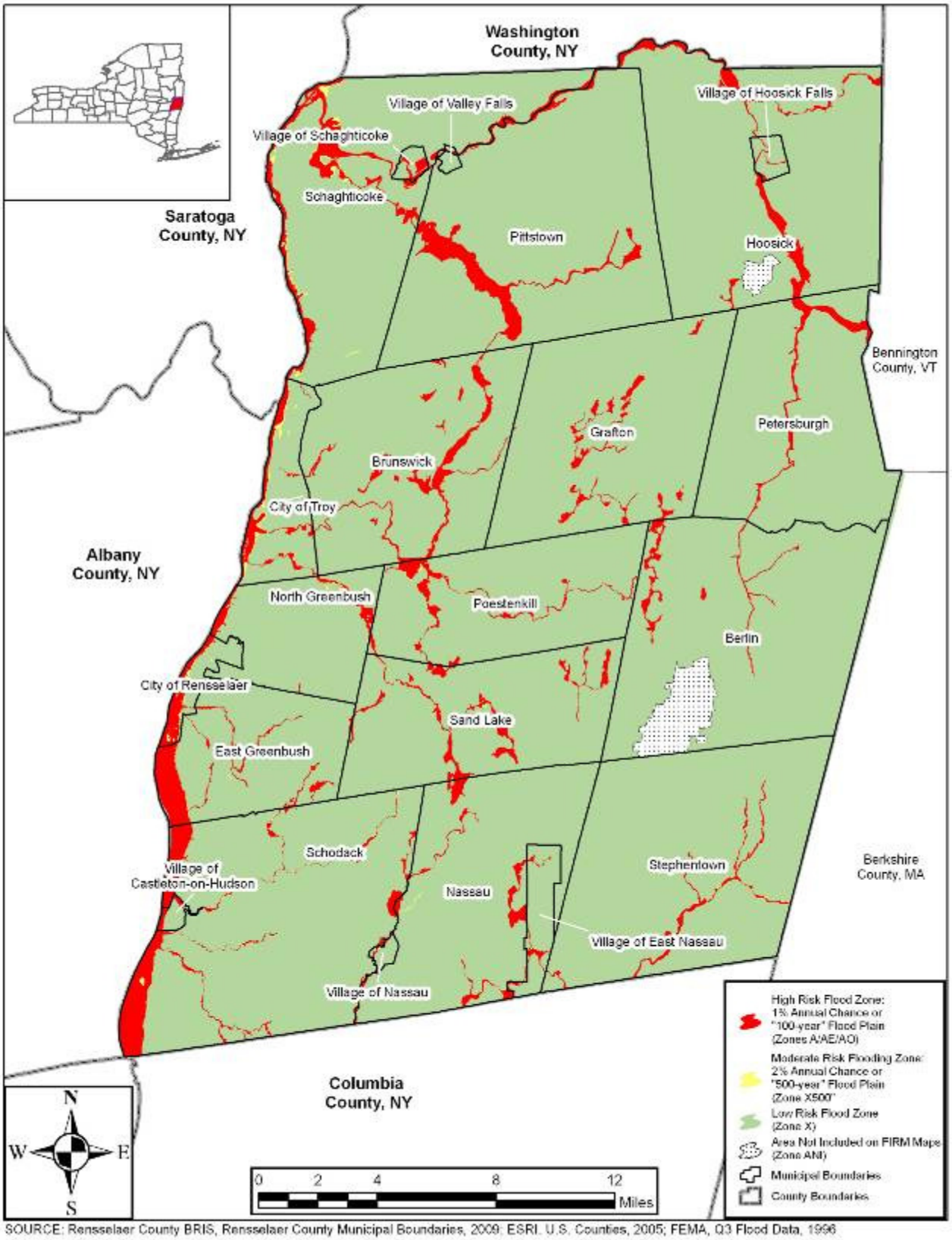
In total only around 6% of the County area lies within high or moderate flood risk zones, according to current Q3 mapping data. The City of Rensselaer has the highest proportion of land area within a high flood risk zone, followed by the Villages of Schaghticoke and Castleton-on Hudson. The Towns of Berlin and Stephentown have the lowest proportions of land within high risk flood zones.

The GIS analysis indicates that the City of Rensselaer and the Village of Castleton-on-Hudson have the greatest proportions of improved property values in high flood risk zones, with just under 25% in each municipality. For almost every other municipality in the County, the proportion of improved property within the mapped high flood risk zone is less than 10%. The Cities of Troy and Rensselaer have the greatest dollar amounts of improved property within high flood risk zone, followed by the Town of North Greenbush.

Appendix 1 of the New York State Hazard Mitigation Plan of January 2008 contains estimates of improved property values in the 100-year floodplain for all municipalities derived from Q3 data similar to those presented in Table 3a.12 and Appendix A. The analyses presented in this plan have used more up to date improved property data sourced directly from the County and the latest local equalization rates from the State office of Real Property Services. Minor differences in analysis methodology* notwithstanding, this approach is considered to result in a more accurate and up to date depiction of the exposure to the flood hazard than that presented in the January 2008 State Plan. Figure 3-55 from the New York State Plan, which summarizes residential property exposure in the 100-year floodplain for Rensselaer County, has been included in Appendix A for comparison. Some additional discussion of the methodology used to analyze the value of improved property exposed to delineable hazards is included in Section 3b.

*Note: The methodology used to compile the State Plan figures differed from that used in this plan in that it was based on the inclusion of the full improved value of all parcels whose center points fell inside the Q3 flood hazard zones, while the analyses presented in Table 3a.12 counted all parcels which were intersected at any point by the hazard area shape files and applied the percentage of the parcel area within the hazard area to the total improved value associated with that value to account for the uncertainty regarding the location of the structure(s) within each parcel, since without building footprint data it cannot be automatically assumed that all improvements lie exactly at the center of their associated parcels.

Figure 3a.22: Rensselaer County Flood Hazard Areas



SOURCE: Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; ESRI U.S. Counties, 2005; FEMA, Q3 Flood Data, 1996

Table 3a.14
Summary of FEMA Q3 Flood Data by Municipality: Land in Hazard Areas *

Municipality	Total Land Area (Acres)	Land in High Flood Risk Areas (Acres)	Land in Moderate Flood Risk Areas (Acres)	Land in Low Flood Risk Areas (Acres)	Land in High Flood Risk Areas (%)	Land in Moderate Flood Risk Areas (%)	Land in Low Flood Risk Areas (%)
		A, AE	X500	X	A, AE	X500	X
Berlin, Town of	38,196	745	0	34,009	2%	0%	89%
Brunswick, Town of	28,284	1,765	27	26,492	6%	0.1%	94%
Castleton-on-Hudson, Village of	533	143	4	386	27%	1%	72%
East Greenbush, Town of	15,713	1,757	39	13,868	11%	0.3%	88%
East Nassau, Village of	3,031	178	21	2,830	6%	1%	93%
Grafton, Town of	29,706	966	0	28,740	3%	0%	97%
Hoosick, Town of	950	87	0	863	9%	0%	91%
Hoosick Falls, Village of	39,364	1,831	0	36,804	5%	0%	93%
Nassau, Town of	25,597	1,066	53	24,452	4%	0%	96%
Nassau, Village of	442	50	0	392	11%	0%	89%
North Greenbush, Town of	12,103	489	106	11,494	4%	1%	95%
Petersburgh, Town of	26,682	944	0	25,680	4%	0%	96%
Pittstown, Town of	41,256	2,723	17	38,516	7%	0.04%	93%
Poestenkill, Town of	20,732	991	60	19,681	5%	0.3%	95%
Rensselaer, City of	2,202	755	132	1,288	34%	6%	58%
Sand Lake, Town of	23,088	1,305	42	21,742	6%	0.2%	94%
Schaghticoke, Town of	32,507	2,776	427	29,260	9%	1%	90%
Schaghticoke, Village of	640	202	3	435	32%	1%	68%
Schodack, Town of	40,243	3,443	139	36,552	9%	0.3%	91%
Stephentown, Town of	37,280	671	52	36,440	2%	0.1%	98%
Troy, City of	7,056	1,037	276	5,730	15%	4%	81%
Valley Falls, Village of	307	23	1	284	7%	0.3%	92%
Rensselaer County Total	*425,915*	*23,947*	*1,400*	*395,938*	*6%*	*0.3%*	*93%*

** Does not include areas designated "ANI: Area Not Included" on FIRMs therefore total percentages may not add up to 100% for all communities. In particular, two large ANI areas are the Capital District Wildlife Management Area in Berlin; Cherry Plain State Park in Berlin/Stephentown; and Tibbetts State Forest in Hoosick.*

Table 3a.14
Summary of FEMA Q3 Flood Data by Municipality: Improved Property in Hazard Areas *

Municipality	Total Improved Property Value	Improved Property in High Flood Risk Area	Improved Property in Moderate Flood Risk Area	Improved Property in Low Flood Risk Area	Improved Property in High Flood Risk (%)	Improved Property in Moderate Flood Risk (%)	Improved Property in Low Flood Risk (%)
		A, AE	X500	X	A, AE	X500	X
Berlin, Town of	$161,460,296	$7,360,983	$0	$153,918,460	5%	0%	95%
Brunswick, Town of	$935,076,250	$41,246,252	$666,151	$893,163,831	4%	0.1%	96%
Castleton-on-Hudson, Village of	$173,218,901	$42,107,756	$2,043,551	$129,067,592	24%	1%	75%
East Greenbush, Town of	$1,478,535,900	$40,485,331	$661,755	$1,437,388,812	3%	0.04%	97%
East Nassau, Village of	$36,635,844	$3,574,931	$405,969	$32,654,862	10%	1%	89%
Grafton, Town of	$160,142,003	$4,706,800	$0	$155,435,203	3%	0%	97%
Hoosick, Town of	$276,325,323	$6,462,770	$0	$269,291,973	2%	0%	97%
Hoosick Falls, Village of	$335,334,980	$16,069,381	$0	$319,265,593	5%	0%	95%
Nassau, Town of	$207,267,186	$6,404,721	$537,201	$200,134,141	3%	0.3%	97%
Nassau, Village of	$101,812,537	$6,880,164	$0	$94,932,368	7%	0%	93%
North Greenbush, Town of	$1,126,168,100	$54,158,943	$31,268,415	$1,040,740,734	5%	3%	92%
Petersburgh, Town of	$85,588,579	$5,892,023	$0	$79,682,986	7%	0%	93%
Pittstown, Town of	$296,057,020	$9,976,431	$57,528	$286,023,047	3%	0.02%	97%
Poestenkill, Town of	$315,226,879	$17,127,575	$1,882,887	$296,216,417	5%	1%	94%
Rensselaer, City of	$527,411,852	$123,812,754	$28,963,526	$374,635,557	23%	5%	71%
Sand Lake, Town of	$618,731,110	$33,867,439	$2,862,558	$582,001,109	5%	0.5%	94%
Schaghticoke, Town of	$393,627,712	$16,952,644	$14,796,910	$361,855,234	4%	4%	92%
Schaghticoke, Village of	$48,285,342	$990,359	$25,082	$47,269,901	2%	0.1%	98%
Schodack, Town of	$846,788,002	$18,401,402	$2,252,977	$826,033,795	2%	0.3%	98%
Stephentown, Town of	$187,025,080	$5,411,373	$444,371	$180,962,326	3%	0.2%	97%
Troy, City of	$4,097,481,405	$323,453,520	$192,613,262	$3,581,414,645	8%	5%	87%
Valley Falls, Village of	$24,983,624	$543,986	$7,662	$24,431,974	2%	0.03%	98%
Rensselaer County Total	*$12,433,183,925*	*$785,887,538*	*$279,489,805*	*$11,366,520,560*	*6%*	*2.2%*	*91%*

** Does not include areas designated "ANI: Area Not Included" on FIRMs therefore total percentages may not add up to 100% for all communities. In particular, two large ANI areas are the Capital District Wildlife Management Area in Berlin; Cherry Plain State Park in Berlin/Stephentown; and Tibbetts State Forest in Hoosick.*

Previous Occurrences – Floods

Floods have occurred in Rensselaer County's communities in the past, and will continue to do so in the future. Rensselaer County and its component municipalities have generally been impacted by riverine flooding and shallow flooding. A picture of the flooding history of Rensselaer County in terms of damage to private property over the last three decades or so can be derived from the recorded flood losses and payments data from the NFIP. This data is presented in Table 3a.13, along with the total number of current policies, the total coverage values, and key dates associated with the municipalities' participation in the NFIP. The policy and loss data presented in Table 3a.13 is accurate as of June 30, 2010. At the time of writing, none of the municipalities in Rensselaer County were eligible for participation in FEMA's Community Rating System (CRS), under which municipalities implementing and enforcing floodplain management measures above beyond the NFIP minimum requirements are rewarded with discounted flood insurance premiums.

The table shows that Rensselaer County NFIP insured flood losses have totaled almost $1.5 million since the 1970s, or approximately $50,000 per year (given that most municipalities entered the NFIP in the period 1978 - 1982. Actual property flood losses community-wide are likely to be higher, since this value only includes NFIP payouts and does not include losses incurred on properties the owners of which do not participate in the NFIP, losses for which a claim was not submitted, or losses for which payment on a claim was denied. FEMA records also record include a further 120 flood damage claims against the NFIP in Rensselaer County for which no payment was made.

The average individual paid NFIP loss for the County overall was approximately $7,400 per event, with an average coverage of almost $150,000 per policy. The municipalities with the greatest number of paid losses are the City of Troy, the City of Rensselaer, and the Town of Nassau. The highest average payment per loss in any single municipality is in the City of Rensselaer, closely followed by the City of Troy, where payments have been more than $9,000 per loss event in both cases. Of the 22 municipalities participating in the NFIP, two have no individual NFIP policies in place, and six have not experienced any flood damage resulting in NFIP payments.

Table 3a.16 also includes the name of the person in the administrative structure of each municipality to which the responsibilities of Floodplain Administrator are delegated by each locally adopted floodplain management ordinance, where this information is on file at FEMA. The names and contact details as currently held on record by Rensselaer County (with supplemental information from FEMA Region 2) are included in Appendix F.

Table 3a.16
FEMA NFIP Policy and Claim Information for Rensselaer County Jurisdictions
Source: www.fema.gov/cis/NY, www.bsa.nfipstat.com, as of 6/30/2010, and Rensselaer County Planning Department

NFIP Participating Communities in Rensselaer County, NY	Community Number	Date Entered NFIP*	Current Effective FIRM Date	Local Floodplain Administrator On Record At FEMA**	NFIP Policies In Force	Insurance in Force ($)	Total Number of Paid Losses	Total Payments ($)
Berlin, Town of	360672#	8/17/71979	8/17/71979	Joseph Rabatoy	10	$1,045,400	0	$0
Brunswick, Town of	361130#	6/4/1980	12/6/2000	John Kreiger	13	$2,557,100	3	$9,742
Castleton-on-Hudson, Village of	360673#	11/15/1984	11/15/1984	Robert Schanck	26	$3,260,600	9	$35,071
East Greenbush, Town of	361133#	3/18/1980	3/18/1980	Rick McCabe	13	$3,049,700	2	$5,455
East Nassau, Village of	360257#	9/5/1984	9/5/1984	Rudy Jahn	0	$0	0	$0
Grafton, Town of	361150#	10/13/1978	10/13/1978	L.F. Sawyer	5	$751,700	0	$0
Hoosick, Town of	361154	8/1/1987	8/1/1987	Not listed	6	$1,407,100	4	$8,246
Hoosick Falls, Village of	360674#	5/16/1980	2/4/2005	Not listed	13	$2,063,100	12	$107,429
Nassau, Town of	361155#	9/5/1984	9/5/1984	Robert Severance	47	$9,874,300	40	$301,740
Nassau, Village of	360675	8/11/1978	5/18/1979	Jeffrey Conlin	19	$5,012,000	14	$40,228
North Greenbush, Town of	361164#	6/18/1980	6/18/1980	Thomas Murley	43	$6,532,600	3	$5,042
Petersburgh, Town of	361165#	9/1/1978	9/1/1978	David Miller	6	$837,600	0	$0
Pittstown, Town of	361166#	2/1/1988	9/5/1990	Not listed	7	$711,200	1	$4,169
Poestenkill, Town of	360676#	9/2/1981	9/2/1981	Eugene Bechard	16	$2,682,200	4	$36,135
Rensselaer, City of	361032#	3/18/1980	3/18/1980	Louis Lourina	144	$20,006,400	38	$354,936
Sand Lake, Town of	361167#	5/15/1980	5/15/1980	Steve Robelotto	24	$3,981,600	1	$3,934
Schaghticoke, Town of	361168#	7/16/1984	7/16/1984	John Molen	38	$6,022,500	17	$106,963
Schaghticoke, Village of	361058#	6/11/1982	6/5/1985	Not listed	0	$0	0	$0
Schodack, Town of	361169#	8/15/1984	8/15/1984	Not listed	35	$6,682,000	1	$8,759
Stephentown, Town of	361170#	8/3/1981	8/3/1981	Deon Herrick	9	$2,211,700	0	$0
Troy, City of	360677#	3/18/1980	3/18/1980	Terry Dubois	656	$89,830,900	50	$459,584
Valley Falls, Village of	361469#	6/5/1985	6/5/1985	Janet Weber	1	$210,000	1	$647
Rensselaer County Totals					*1,131*	*$168,729,700*	*200*	*$1,488,080*

* i.e. Initial Firm identified

** From *Region 2 Community Listing of CEO and FPA of 11/7/07* on FEMA Region 2 Hazard Mitigation Planning ToolKit CD. Core Planning Group Members provided additional information; see Appendix F for more details.

Repetitive Losses

FEMA defines a Repetitive Loss (RL) property as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period, since 1978. A repetitive loss property may or may not be currently insured by the NFIP. Currently there are over 122,000 repetitive loss properties nationwide, and approximately 7,000 in New York State. According to FEMA's repetitive loss property records, there were 12 "non-mitigated" repetitive loss properties located in Rensselaer County as of July 2010. These properties are associated with a total of 37 individual losses and $405,000 in claims payments under the NFIP since March1979 (the earliest recorded date of loss). The distribution of RL properties throughout the County is presented in Figure 3a.23, while the approximate locations of individual RL properties are plotted in Figures 3a.24 through 3a.26. Of the 12 recorded RL properties, 11 are single family residential structures and one is non-residential. More details regarding these properties are presented in Table 3a.17.

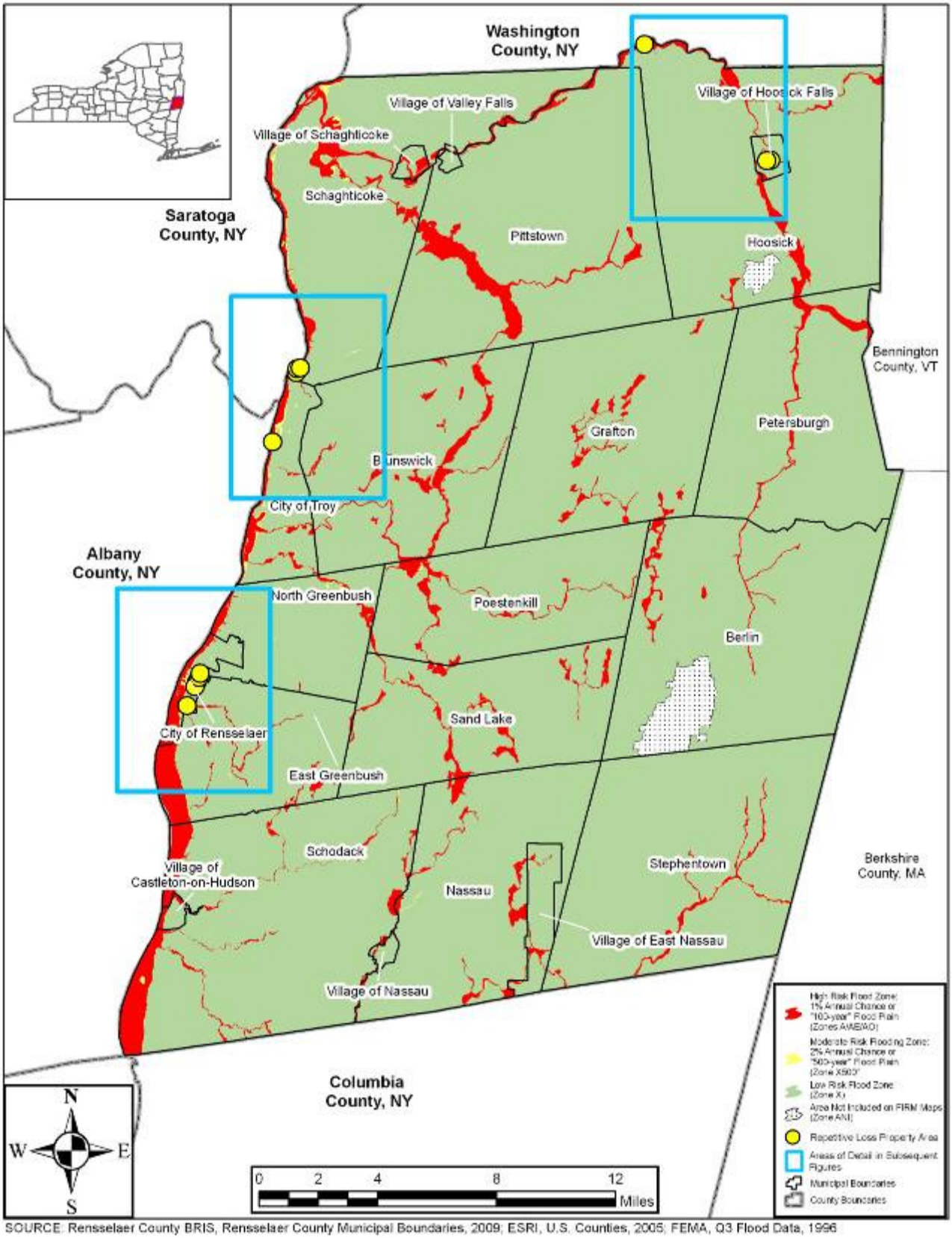
More specific data regarding the exact locations of these structures is subject to the 1974 Privacy Act. This legislation prohibits the public release of any information regarding individual NFIP claims or information which may lead to the identification of associated individual addresses and property owners. However, while this information is not available to the general public, municipal authorities may obtain comprehensive RL property data directly from FEMA Region 2 for the purposes of targeted mitigation of RL areas or individual RL structures, on the condition that all such data is treated as strictly confidential and the required privacy procedures are strictly followed.

Table 3a.17
NFIP Repetitive Loss Properties in Rensselaer County
(Source: FEMA Region 2)

Municipality		Property Type	Flood Hazard Zone	Paid Losses	Total Paid Losses	Average Paid Loss
Rensselaer	City	Single-Family Residential	AE	2	$2,799	$1,399
Rensselaer	City	Single-Family Residential	A05	3	$21,858	$7,286
Rensselaer	City	Single-Family Residential	A02	3	$18,793	$6,264
Rensselaer	City	Single-Family Residential	C	2	$73,830	$36,915
Rensselaer	City	Single-Family Residential	A05	4	$29,599	$7,400
Schaghticoke	Town	Single-Family Residential	B	2	$10,058	$5,029
Schaghticoke	Town	Single-Family Residential	A	8	$61,669	$7,709
Schaghticoke	Town	Single-Family Residential	A	2	$30,016	$15,008
Hoosick Falls	Village	Single-Family Residential	X	3	$43,751	$14,584
Hoosick Falls	Village	Single-Family Residential	X	2	$10,948	$5,474
Hoosick	Town	Single-Family Residential	A	4	$44,004	$11,001
Troy	City	Non-Residential	B	2	$58,159	$29,079
Totals				*37*	*$405,483*	*$10,959*

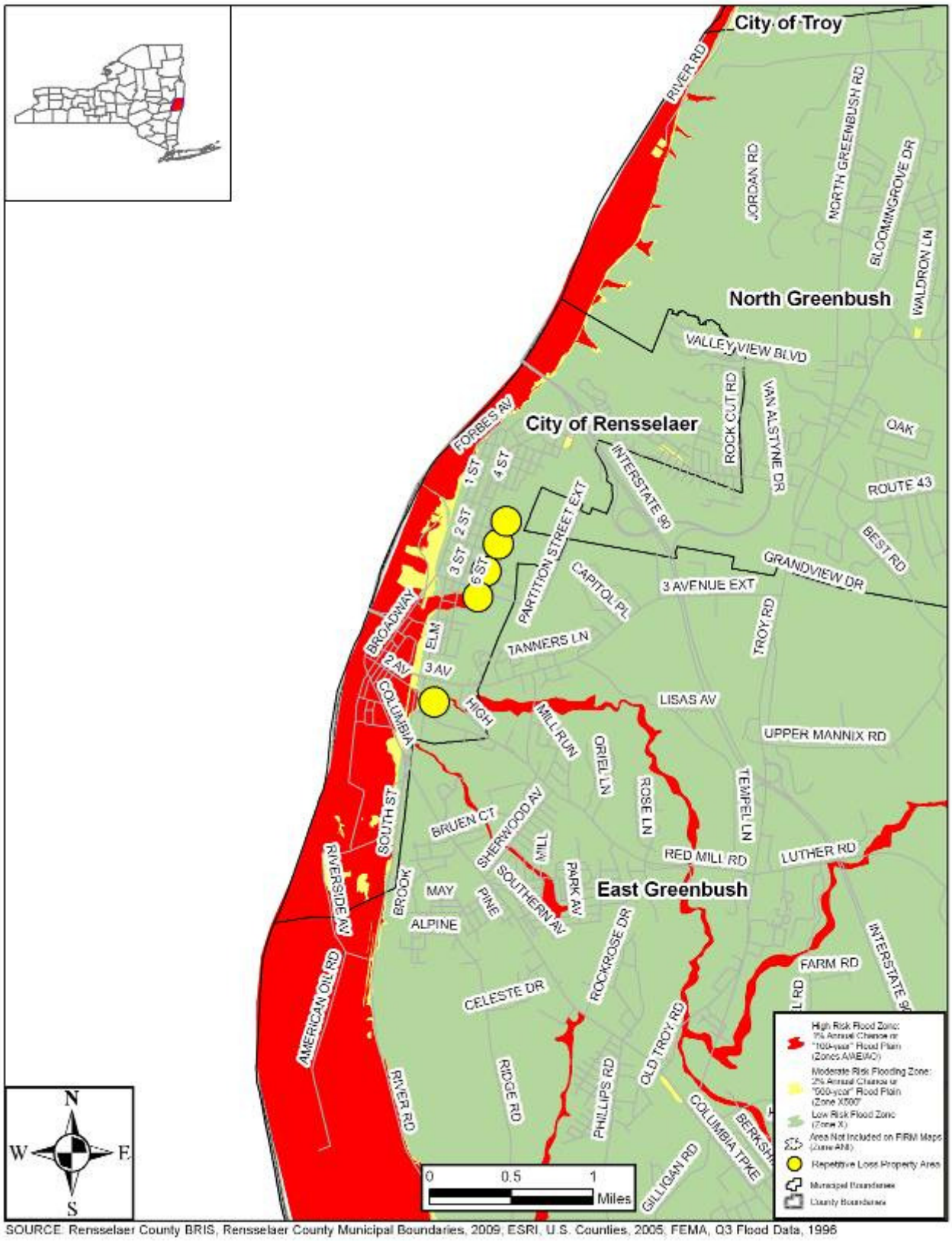
The average repetitive loss property in Rensselaer County has experienced 3.1 loss events, with an average paid claim of almost $11,000 for each event. The Repetitive Loss Property data suggests that 27% of all the NFIP payments in Rensselaer County may be attributable to just 1% of insured properties in the County (depending on how many of these properties remain insured by the NFIP). Figures 3a.23 through 26 are intended to illustrate the general extent of areas in which RL properties are particularly concentrated, to act as pointers to areas where flooding of structures may be the most severe. It is possible that in these areas there also exist other properties that suffer significantly from flooding but, for a variety of possible reasons do not meet RL criteria or have not participated in the NFIP, and which may also benefit from mitigation actions.

Figure 3a.23: Rensselaer County NFIP Repetitive Loss Properties



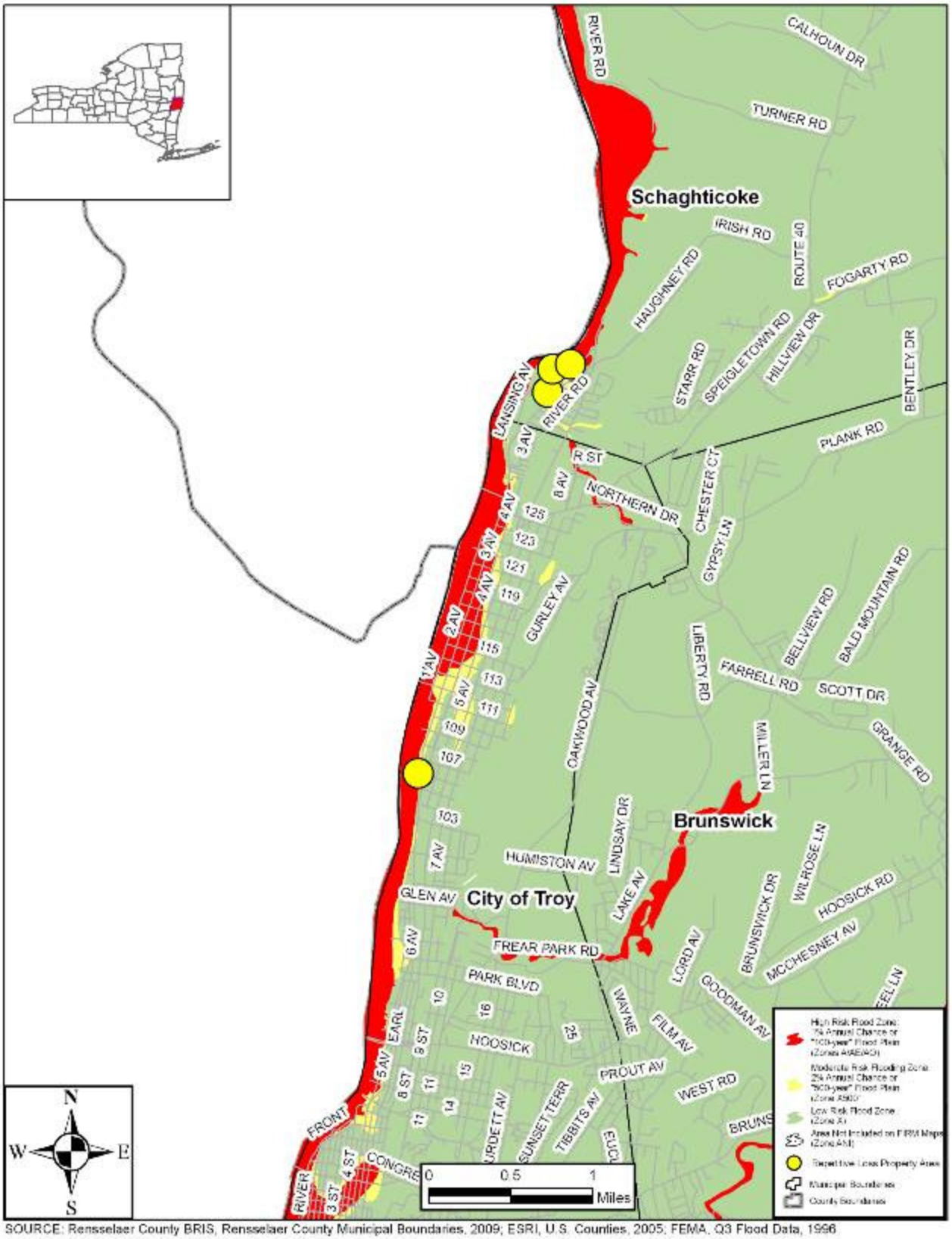
SOURCE: Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; ESRI, U.S. Counties, 2005; FEMA, Q3 Flood Data, 1996

Figure 3a.24: NFIP Repetitive Loss Property Locations – City of Rensselaer



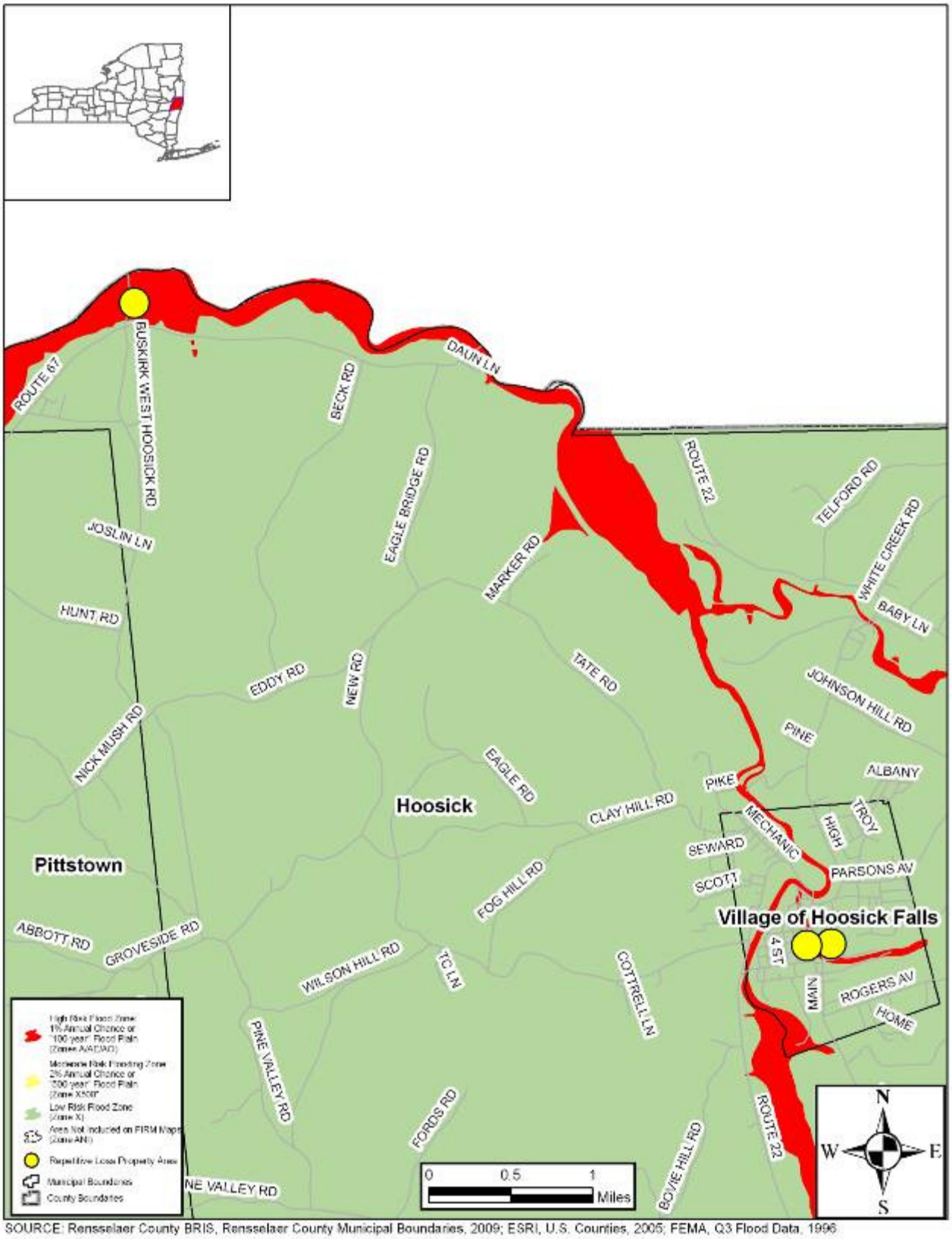
SOURCE: Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009, ESRI, U.S. Counties, 2005, FEMA, Q3 Flood Data, 1996

Figure 3a.25: NFIP Repetitive Loss Property Locations – City of Troy, Town of Schaghticoke



SOURCE: Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; ESRI, U.S. Counties, 2005; FEMA, Q3 Flood Data, 1996

Figure 3a.26: NFIP Repetitive Loss Property Locations – Town and Village of Hoosick



None of the seven Repetitive Loss Properties listed in Rensselaer County have been identified as "Severe" Repetitive Loss Properties, where a Severe RLP is defined by FEMA as a residential property:

(a) That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
(b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

Flood Disaster and Emergency Declarations

The New York State Emergency Management Office reports Rensselaer County as having been affected by seven Presidential Disaster Declarations related to flooding from 1953 to July 2010, as detailed in Table 3a.18. Rensselaer County is not listed by FEMA or the New York State Office of Emergency Management as having been affected by any separate Emergency Declarations involving flooding over the same period.

Through the Public Assistance (PA) Program, FEMA provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain Private Non-Profit (PNP) organizations. The Individual Assistance Program (IA) provides money or direct assistance to individuals, families and businesses in an area whose property has been damaged or destroyed and whose losses are not covered by insurance. It is meant to assist with critical expenses that cannot be covered in other ways, rather than to restore damaged property to its condition before the disaster.

Table 3a.18
Declared Disasters due to Flooding in Rensselaer County
(Source: FEMA/NYSEMO)

Disaster #	Description	Declared Date (and Incident Period)	Eligible Assistance
DR-1650	Severe Storms/Flooding	10/24/2006 (1/19/1996 – 1/30/1996)	IA and PA
DR-1589	Severe Rains/Floods	4/19/2005 (4/2/2005 – 4/4/2005)	IA and PA
DR-1486	Summer Storms	8/29/2003 (7/21/2003 – 8/11/2003)	IA
DR-1335	Severe Storms/Flooding	07/21/2000 (5/3/200-9/14/200)	PA
DR-1296	Tropical Storm Floyd	9/19/1999 (9/15/1999 – 9/18/1999)	IA
DR-1095	Flooding	1/24/1996 (1/19/1996 – 1/30/1996)	IA and PA
DR-401	Severe Storms and Flooding	7/20/1973	IA and PA

The NCDC database records flood events in Rensselaer County from March 1993 (when detailed NCDC records begin in this area) to June 2010, and there have been 42 significant recorded flood events affecting the County in this period, causing reported damages totaling just over $14.5 million, including some damages incurred outside Rensselaer County. Table 3a.19 presents selected significant flood events recorded for the County in the NCDC database for which some detailed information was available, supplemented with information from Flood Insurance Studies and core planning group members.

Table 3a.19
Selected Significant Flood Events in Rensselaer County
(Source: NOAA NCDC / FISs/ Local sources)

Date	Affected Municipalities	Description	Reported Property Damage*
1/19/1996	Countywide, in particular City of Troy, City of Rensselaer, Town of East Greenbush, Village of Castleton-on-Hudson	An intense area of low pressure which was located over the Mid-Atlantic region on Friday morning January 19th produced unseasonably warm temperatures, high dewpoints and strong winds. This resulted in rapid melting of one to three feet of snow. In addition to the rapid snowmelt one to three inches of rain fell as the system moved northeast along the coast. This resulted in widespread flooding across Rensselaer County. Small streams flooded across the entire county which resulted in several road washouts. Extensive flooding also occurred along the Hudson and Hoosic Rivers. The hardest hit areas within the county were East Greenbush and the Cities of Troy and Rensselaer. In the City of Troy extensive damage occurred along the Hudson River where fifteen businesses were flooded. Some of the businesses included Troy Brew Pub, Castaway Grille, City Hall, Taylor Apartments and a submerged mobile home park in Lansingburgh. Severe damage also occurred to the city marina and Riverfront Park. At Leonard Hospital located in Lansingburgh, 50 patients were evacuated due to basement flooding. In Castleton several residents were evacuated and route 9J near Castleton was closed due to flooding. This event resulted in Federal Disaster Declaration DR-1095.	$6,000,000
5/1/1996	Town of Hoosick	Heavy rain on Tuesday evening April 30 caused the Hoosic River to flood. County route 103 was flooded between route 67 and the covered bridge. Several homes were also affected by the flood waters in Washington and Rensselaer Counties.	$9,000
6/8/1996	Town of Pittstown, Town of Hoosick	A stationary front which extended across eastern New York on June 9 produced isolated severe thunderstorms and flooding. In northern Rensselaer County training showers and thunderstorms resulted in flash flooding when approximately 6 inches of rain fell during the late afternoon. Dirt roads were washed out in Pittstown, Raymertown and Boyntonville. Homes were evacuated and flooded in Pittstown and Boyntonville. Around 20 families were evacuated at Pittstown in the County Acres Trailer Park.	$300,000
1/8/1998	City of Troy, Town of Hoosick	From January 8 to January 12, the Hudson River flooded from its headwaters to where it crosses into Greene and Columbia Counties, due to a combination of significant rain and snowmelt. In Rensselaer County, flooding occurred along Riverfront Park behind City Hall and in low lying areas especially in Lansingburgh. Approximately 34 homes in the City of Troy sustained flood damage. Several roads were flooded elsewhere in the county. The Hoosic River in northern Rensselaer also flooded, due to a combination of significant rain and snowmelt. The river crested approximately one foot over flood stage at Eagle Bridge during the morning of January 9. Flooding occurred along State Highways 7 and 22 in Rensselaer County. County Highway 103 was also flooded from route 67 to the covered bridge. The Hoosic River spilled into the Buskirk Fire House and Circuit Materials Plant	$815,000
5/6/1998	Town of Schodack	Thunderstorms with torrential rain produced flash flooding across the southwest portion of Rensselaer County. Significant road flooding occurred at Schodack and Schodack Landing.	$40,000
1/24/1999	Town of Pittstown, Town of Hoosick, Town of	An area of low pressure brought up to an inch of rain over portions of eastern New York. The rainfall combined with very mild temperatures lead to rapid snowmelt. The runoff caused some small	$105,000

Table 3a.19
Selected Significant Flood Events in Rensselaer County
(Source: NOAA NCDC / FISs/ Local sources)

Date	Affected Municipalities	Description	Reported Property Damage*
	Schaghticoke	creeks and small rivers to come out of their banks. Also drainage systems clogged with ice and snow allowed water to build up on city streets. Rensselaer county was the hardest hit area. Serious flooding took place near Buskirk on the Hoosic River and near Pittstown on the Sunkauissia. Several dozen people were evacuated from their homes in Buskirk as well as Pittstown. Heavy rainfall and rapid snowmelt lead to a culvert breaking during the evening of January 24. Nearly 1,000,000 gallons of water was released into Pleasantdale.	
9/16/1999	Countywide	Tropical Storm Floyd: Declared Disaster DR-1296. The storm brought both high winds and exceptionally heavy rainfall to eastern New York, which included 6.12 inches at Albany Airport. Widespread flooding was reported across the region.	$1,500,000
7/15/2000	City of Rensselaer, Town of Schodack, Town of Nassau, Village of Nassau, Town of East Greenbush	A stalled frontal boundary across eastern New York interacted with a strong upper level and resulted in the second widespread heavy rainstorm of the summer. In Rensselaer County a state of emergency was declared in the city of Rensselaer. The worst hit area in the city was The Hollow where many places were flooded. A man had to be evacuated by boat from his house. Meanwhile, the city's pumping equipment was damaged. Rapid movement of water uprooted trees and severe flood damage resulted in the loss of power, natural gas, and water to many streets in Rensselaer. Roads also flooded in Schodack and were closed in Nassau. Six roads were impassable in East Greenbush and several homes were endangered by rising water. *This event occurred during a pattern of severe weather in the summer of 2000. A series of severe storms impacted the area during this time, resulting in Federal disaster declaration DR-1335. The Village of Castleton noted street and sidewalk washouts throughout the Village, mostly in hilly areas.	$>235,000 *
8/16/2002	Town of Schaghticoke	Torrential rains from the storm produced flash flooding in Schaghticoke and one road was washed out due to flooding.	$5,000
12/27/2002	Towns of East Greenbush and North Greenbush	Unusual flooding along the Wynants Kill. Large tree limbs, broken by the weight of the heavy snow, fell into the creek, floated, and formed a dam behind a supermarket on Main Street. The result was that the Wynants Kill overflowed its banks, flooding many basements in the Elm Court section of East Greenbush. The town declared a state of emergency by late morning.	$1,000
7/9/2008	Town of Berlin	Localized flash flooding was reported in Rensselaer County due to thunderstorms containing very heavy rainfall. Plank Road near County Route 41 was washed out.	$5,000
8/11/2008	City of Rensselaer, Town of East Greenbush	Very heavy rainfall from training thunderstorms led to significant urban and small stream flash flooding in and near the City of Rensselaer. A State of Emergency was declared in the City of Rensselaer as numerous roads were closed, with 6 or more feet of standing water reported on city streets. Evacuations of 50 to 75 homes occurred due to the flooding. Flooding was mainly concentrated along and near the banks of Quackenberry Creek, as well as near Mill Creek. The Amtrak Station in Rensselaer was also closed due to the flooding. Flash flooding also closed Routes 9 and 20, a portion of Route 151, and Luther Road, in East Greenbush.	$4,000,000
7/29/2009	Town of Nassau, Town of Schodack, Town of	Significant flash flooding occurred in central and southern Rensselaer County as a result of training thunderstorms which produced excessive rainfall, and caused Kinderhook Creek to	Not reported

Table 3a.19
Selected Significant Flood Events in Rensselaer County
(Source: NOAA NCDC / FISs/ Local sources)

Date	Affected Municipalities	Description	Reported Property Damage*
	Stephentown, Town of Sand Lake	overflow its banks. Numerous roadways and bridges were closed, some of which were washed out. The hardest hit areas included, but were not limited to, Nassau, Stephentown, Schodack, and Sand Lake. In Nassau, a state of emergency was declared, and State Route 43 between Pikes Pond Road and Reno Road was closed due to flooding. In Stephentown, the bridge at State Route 22 and Provost Road was deemed unsafe, resulting in the closure of a portion of Route 22. In addition, flooding closed a portion of South Stephentown Road between Garfield Road and Andrews Lane. In Sand Lake, Bauer Road was closed due to a bridge washout. In Schodack, Clove Road was closed to due flooding. Many basement pumpouts were also required during this time.	

*May include damage incurred outside Rensselaer County

In addition to the events listed by NCDC, the SHELDUS database lists a further 21 flood events causing damage in Rensselaer County between April 1960 and April 1987 to which more than $45 million in property damages was attributed. Since the SHELDUS database does not provide descriptions or locations of the impacts of individual events, the NCDC descriptions above will suffice to illustrate the effects of flooding in Rensselaer County, and the SHELDUS data has been primarily used in the estimation of potential damages arising due to floods in Section 3c.

Core planning group members have also reported flooding events affecting the Village of Nassau in December 2000, April 2004, and June 2006.

Probability of Occurrence – Floods

The probability of occurrence of a flood at a given location (the odds of being flooded) is expressed in percentages as the chance of a flood of a specific magnitude occurring in any given year. The "100-year flood" has a 1% chance of occurring in any given year. The 100-year flood is often also referred to as the "base flood". This probability of occurrence might imply that a 100-year flood would reoccur only once every 100 years; in reality, this is not the case. A 100-year flood can happen multiple times in a single year, or not at all for more than 100 years. Properties located in FEMA-mapped A- and V-Zones are within the footprint of the 100-year floodplain. FEMA A-Zones represent the 100-year floodplain.

For all floodplains, there is an associated water surface elevation. This elevation is unique to any given location on the map (in other words, 100-year flood levels vary from one community to the next throughout Rensselaer County, and also within individual communities).

Within the 100-year floodplain, flooding can occur at less than the 100-year flood level, and also more than the 100-year flood level. The 100-year flood represents a flood of high magnitude – it is a deep and widespread event. The 500-year flood is of a greater magnitude, and would be deeper and more widespread than a 100-year event. However, it is not as likely to occur. Smaller floods, with magnitudes of 10-years or 50-years for example, are also possible within the 100-year floodplain. These are not as deep or as widespread as a 100-year flood would be, however, they are much more likely to occur.

The term "100-year flood" can often be confusing to someone not intimately familiar with flooding or statistics. FEMA's *NFIP Floodplain Management Requirements: a Study Guide and Desk Reference for Local Officials* (FEMA-480), suggests that another way to look at flood risk is to think of the odds that a 100-year flood will happen some time during the life of a 30-year mortgage of a home in the floodplain. Figure 3a.27 illustrates these odds, over various time periods for different size floods. In any given year, a property in the 100-year floodplain has a 10 percent chance of being flooded by a 10-year flood, and a 1 percent chance of being flooded by a 100-year flood. This may not sound particularly risky at first glance. However, over a 30–year period, that same location has a 96 percent chance of being flooded by a 10-year flood and a 26 percent chance of being flooded by a 100-year flood.

Figure 3a.27: Odds of Being Flooded

WHAT ARE THE ODDS OF BEING FLOODED?

The term "100-year flood" has caused much confusion for people not familiar with statistics. Another way to look at flood risk is to think of the odds that a 100-year flood will happen sometime during the life of a 30-year mortgage—a 26% chance for a structure located in the SFHA.

Chance of Flooding over a Period of Years

Time Period	Flood Size 10-year	25-year	50-year	100-year
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Even these numbers do not convey the true flood risk because they focus on the larger, less frequent, floods. If a house is low enough, it may be subject to the 10- or 25-year flood. During a 30-year mortgage, it may have a 26% chance of being hit by the 100-year flood, but the odds are 96% (nearly guaranteed) that it will be hit by a 10-year flood. Compare those odds to the only 1-2% chance that the house will catch fire during the same 30-year mortgage.

Ice Jams

Description

Ice jams form when ice floating downstream in a river stalls and begins to build into a jam, forming a dam. The "reservoir" behind the dam quickly fills with water until out of bank flooding occurs. The observed effect can be very similar to flash flooding, and sudden flooding downstream may be caused by the sudden failure or release of the ice jam. Ice jams generally form at locations where the ice transport downstream is reduced by an obstruction or a significant hydrologic change. Natural obstructions in the river can include bends, intact sheet ice cover, or a decrease in channel slope. Man-made obstructions can include bridges, existing dams, waterline crossings, and other constructions in the channel.

Ice jams and resulting floods can occur during fall freeze-up from the formation of frazil ice (a collection of loose, randomly oriented needle-shaped ice crystals) during midwinter periods when stream channels freeze solid forming anchor ice, and during spring breakup when rising water levels from snowmelt or rainfall break existing ice cover into large floating masses that lodge at bridges or other constructions. Damage from ice jam flooding may exceed that caused by open water flooding – flood elevations are usually higher than predicted for free-flow conditions and water levels may change rapidly. During cold weather, there is a reduction in evapotranspiration, infiltration (due to frozen ground) and surface storage, (due to the filling of ground depressions with snow and ice), which result in more water being delivered to the channel. Therefore for equal amounts of total available water during cold and warm seasons, the amount of excess water available for runoff will be greater during the cold season. Additional damage may be caused by the force of floating ice colliding with buildings, other structures, and automobiles.

Location and Extent – Ice Jams

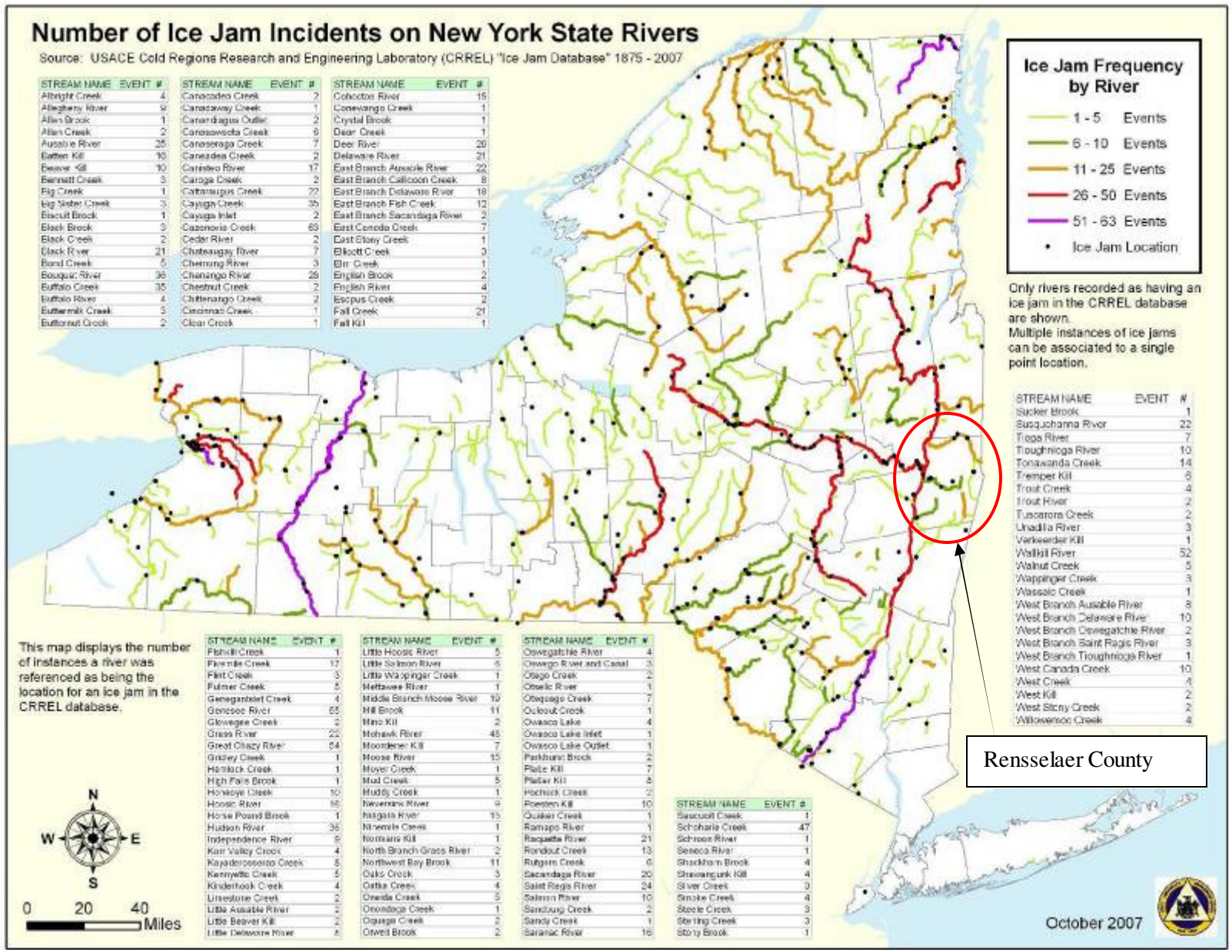
The identification of particular areas prone to ice jam flooding is difficult since the hazard is usually unpredictable and can be extremely localized. However, available research and historic data suggests that ice jam flood hazard is most common in areas of flat terrain where the climate included extended periods of temperature below zero. Ice jams are very common in the north east United States, and according to data from the USACE Cold Region Research and Engineering Laboratory (USACE CRREL), 1,442 ice jam events have been recorded in New York State between 1867 and 2008, a number exceeded only by the State of Montana.

Figure 3a.28 shows the locations of ice jam incidents that have been recorded by the CRREL in New York State from 1875 to 2007. Multiple instances of ice jams may be associated with a single point location. This figure identifies three locations in Rensselaer County where ice jams have been recorded.

Previous Occurrences – Ice Jams

The USACE CRREL mapping indicates that ice jam incidents for which some details are available have been recorded at 10 locations within or adjacent to Rensselaer County since 1875. Details have been recorded by CRREL for 38 ice jam incidents on six different watercourses in Rensselaer County since 1920, but the database only includes descriptions of the impacts for three of these events. The NCDC database also includes a flood event in Rensselaer County the cause of which was specifically identified as flooding. The available descriptions of the impacts of these incidents are presented following Figure 3a.28.

Figure 3a.28: Ice Jam Incidents in New York State



March 13, 1936
As reported in The Middletown Press on Friday evening, March 13, 1936, "Tons of ice jammed in the Hudson River near Castleton early today, threatening to back up water into communities of the lower Hudson. ... Tons of ice, released when jams in the upper Hudson and the Mohawk rivers broke yesterday, piled up today near Castleton, creating a grave threat to the safety of communities along the lower Hudson. In the Southern tier of New York counties which bore the brunt of last July's floods, conditions remained uncertain with ice jams forming and breaking. The condition along the lower Hudson was made more serious by the ice not having gone today. If the vast store of water being impounded by the Castleton jam is released suddenly villages and towns along the river front probably will be flooded. The Castleton jam backed up water as far North as Albany, which was inundated along the river front to a depth of two to three feet."

February 22, 1996
The NWS reported an ice jam on the Poestenkill Creek in Poestenkill, New York flooded Plank Road on 2/22/96. Two more ice jams were reported on the creek between Fifty Six Road and Cropsey Road in Poestenkill. Plank Road (Route 40) was closed from Barbersville to the hamlet of East Poestenkill due to several washed out sections. Twenty-five families were also evacuated along Plank Road as several homes were flooded. By February 24 the jams were decreasing in size and water receded to within its banks.

January 19, 1999
The Rensselaer County Sheriff's office reported an ice jam on the Hoosic River at Buskirk. As a result of this ice jam, and also rain and snowmelt, water overflowed onto Route 103 and River Road near the Buskirk covered bridge. Ice extended from Buskirk most of the way to Eagle Bridge and was clogging parts of the river. The flood waters affected some low lying homes in the area and there was minor flooding along River Road and Route 103 near Buskirk.

February 13, 2003
Rensselaer County Emergency Management officials reported water flowing over the banks of the Hoosic River near the Buskirk Bridge. The water flowed through a cornfield and affected several buildings near Buskirk. The flooding was the result of an ice jam that obstructed the flow of water in the Hoosic River, causing the water to back up behind the jam and overflow the banks of the river. Heavy rain exacerbated this situation. The ice jam resulted in flooding on County Route 103

Of the 38 ice jam incidents recorded by CRREL, 14 were on the Hoosic River, nine on Poesten Kill, seven on Moordener Kill, five on the Little Hoosic River, two on the Hudson River, and one on Poesten Creek. Core planning group members also report floods due to ice jams causing damage to residential properties on the Tackawasick and South Kinderhook Creeks in the Town of Nassau.

Probability of Occurrence – Ice Jams

Due to the nature of the terrain and the climate in Rensselaer County, ice jam events are essentially certain to occur in the future, although whether or not such events will cause significant damage is less easy to predict, since detailed records of actual damage caused by ice jams are scarce. While Core Planning Group members have reported that ice jam flooding is common on the County, the available data also does not easily allow for a meaningful average number of damage-causing occurrences per year to be computed, since the recorded number of relevant incidents is quite low.

Earthquakes

Description – Earthquakes

FEMA defines the term "earthquake" as a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface. This movement forces the gradual buildup and accumulation of energy. Eventually, strain becomes so great that the energy is abruptly released, causing the shaking at the earth's surface which we know as an earthquake.

According to the USGS Earthquake Hazards Program, most earthquakes (approximately 90%) occur at the boundaries where the plates meet, although it is possible for earthquakes to occur entirely within plates. Rensselaer County is significantly distant from any plate boundaries. Regardless of where they are centered, earthquakes can impact locations at – and well beyond – their point of origin. They are often accompanied by "aftershocks" – secondary quakes in the earthquake sequence. Aftershocks are typically smaller than the main shock, and can continue over a period of weeks, months, or years from the main shock. In addition to the effects of ground shaking, earthquakes can also cause landslides and liquefaction under certain conditions. Liquefaction occurs when unconsolidated, saturated soils exhibit fluid-like properties due to intense shaking and vibrations experienced during an earthquake. Together, ground shaking, landslides, and liquefaction can damage or destroy buildings, disrupt utilities (i.e., gas, electric, phone, water), and sometimes trigger fires.

Location and Extent– Earthquakes

Earthquakes may affect any of Rensselaer County's communities. Figures 3a.29 and 3a.30 show the earthquake hazard maps for the conterminous United States and also New York State, which are prepared by the USGS Earthquake Hazards Program. It shows that the earthquake hazard in New York State is low relative to other parts of the country (for example the west coast of the USA), but the possibility for noticeable earthquakes does exist in the State.

Figure 3a.29: Earthquake Hazard Map of the Conterminous United States

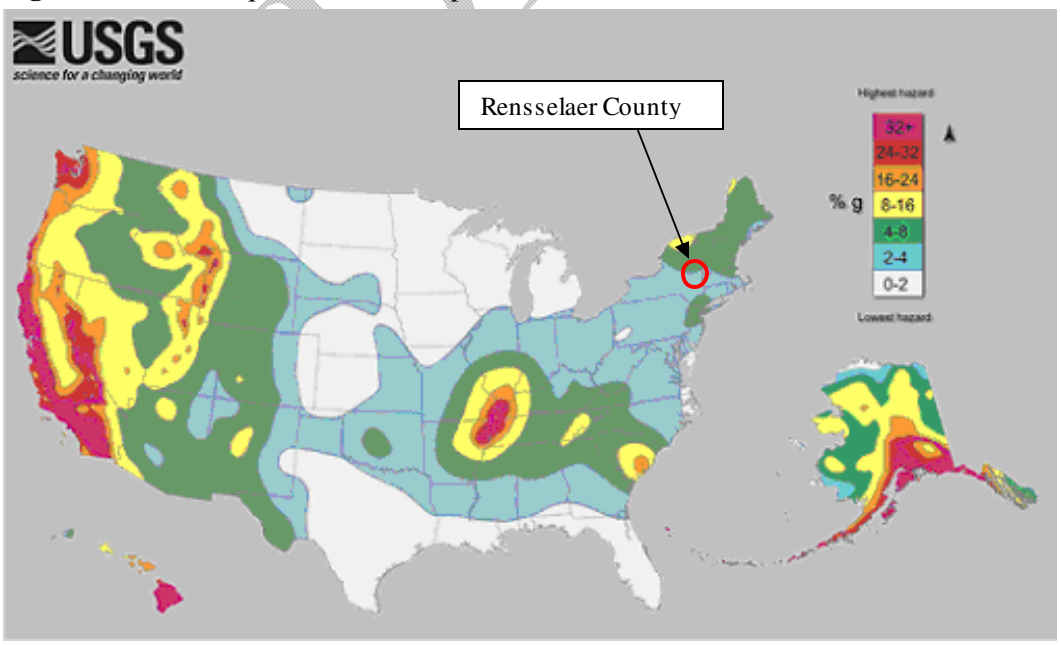
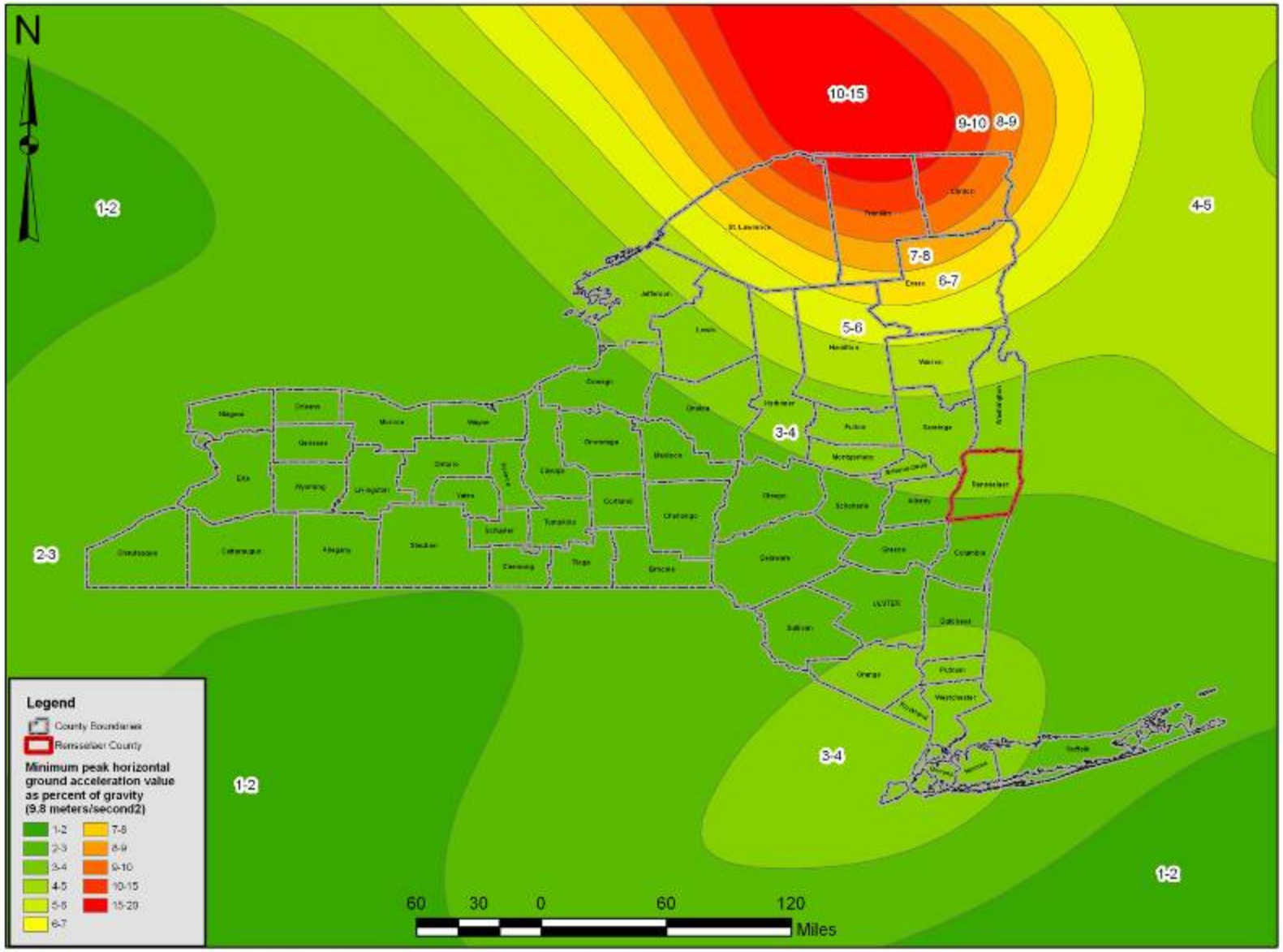


Figure 3a.30: Earthquake Hazard Map of New York State



Source: U.S.G.S. National Seismic Hazard Maps. 2008; ESRI, US Counties, 2005.

The severity of an earthquake at a given location depends on the amount of energy released at the epicenter, and the location's distance from the epicenter. The terms "magnitude" and "intensity" are two terms used to describe the severity of an earthquake. An earthquake's "magnitude" is a measurement of the total amount of energy released while its "intensity" is a measure of the effects of an earthquake at a particular place. Another way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. Peak Ground Acceleration (PGA) measures the rate of change in motion of the earth's surface and expresses it as a percent of the established rate of acceleration due to gravity (9.8 m/sec^2). Figure 3a.30 shows that, for the northern two-thirds Rensselaer County, PGA values of between 3 and 4% of gravity have a 10 percent chance of being exceeded over 50 years. The remainder of Rensselaer County also has a slightly lesser degree of exposure to the earthquake hazard.

An approximate relationship between PGA, magnitude, and intensity is shown in Table 3a.20. Using Table 3a.17, one can approximate that, for an earthquake of expected severity for most of Rensselaer County (PGA values of 3 to 4%g), perceived shaking would be light to moderate (depending upon the distance from the epicenter) and potential damage could range from none to very light (also depending upon the distance from the epicenter).

Table 3a.20
Earthquake Magnitude/Intensity Comparison

PGA	Magnitude	Intensity	Perceived Shaking	Potential Damage
< 0.17	1.0 - 3.0	I	Not Felt	None
0.17 – 1.4	3.0 – 3.9	II - III	Weak	None
1.4 – 9.2	**4.0 – 4.9**	**IV – V**	**IV. Light** **V. Moderate**	**IV. None** **V. Very Light**
9.2 - 34	5.0 – 5.9	VI – VII	VI. Strong VII. Very Strong	VI. Light VII. Moderate
34 - 124	6.0 – 6.9	VIII - IX	VIII. Severe IX. Violent	VIII. Moderate/Heavy IX. Heavy
> 124	7.0 and higher	X and higher	Extreme	Very Heavy

Sources: (1) FEMA Mitigation Planning "How-To" Guide 386-2 (as reported in the New York State Hazard Mitigation Plan 2005; (2) Wald, D., et al., 1999, Relationship between Peak Ground Acceleration, Peak Ground Motion, and Modified Mercalli Intensity in California", Earthquake Spectra, V. 15, p. 557-564; (3) Community Internet Intensity, USGS Modified Mercalli Intensity, and Instrumental Intensity. 1999. http://www-socal.wr.usgs.gov/ciim/pubs/ciim/node5.html (July 27, 2003).

An earthquake with a 10 percent chance of exceedance over 50 years in most of Rensselaer County would have a PGA of 3 to 4%g and an intensity ranging from only IV to V, which would result in light to moderate perceived shaking, and damages ranging from none to very light. For comparison purposes, an earthquake of intensity IV on the Modified Mercalli Scale would most likely cause vibrations similar to heavy trucks driving over roads, or the sensation of a jolt. Hanging objects would swing; standing cars would rock; windows, dishes and doors would rattle; and, in the upper ranges of intensity IV, wooden walls and frames would creak. An earthquake of intensity V on the Modified Mercalli Scale would be felt outdoors, awaken sleepers, disturb or spill liquids, displace small unstable objects, swing doors, and cause shutters and pictures to move. Less frequent earthquakes of high magnitude with much higher PGA's and, in turn, substantially higher damage potentials, are possible in Rensselaer County - with return periods of 100 to 2500 years. As shown in Figure 3a.25, when soil type is taken into account, the PGAs with a 2% probability of exceedance in any given year ranges from 25 to 94, depending on location; this corresponds to very strong to violent perceived shaking and moderate to heavy damages.

As noted in the New York State Hazard Mitigation Plan, soil type can have an impact on the severity of an earthquake at a given location. For example, soft soils (i.e., fill, sand) are more likely to amplify ground motion during an earthquake. Liquefaction is also more likely to occur in areas of soft soils. In contrast, harder soils (i.e., granite) tend to reduce ground motion during an earthquake. Figure 3a.31

shows soil types in five basic categories with varying degrees in likelihood of amplifying the affects of an earthquake, with Category A being far less likely to amplify the seismic motion than Category E.

The soil types and surficial materials have been combined with the seismic hazards by the New York State Emergency Management office and the State Geological Survey in Figure 3a.32 to provide an adjusted, more refined picture of the earthquake hazard in terms of earthquake spectral acceleration*, which is a more accurate indicator of damage to buildings, which in some areas of the state results in a significantly higher earthquake hazard than is evident from the simple USGS mapping of Figure 3a.30.

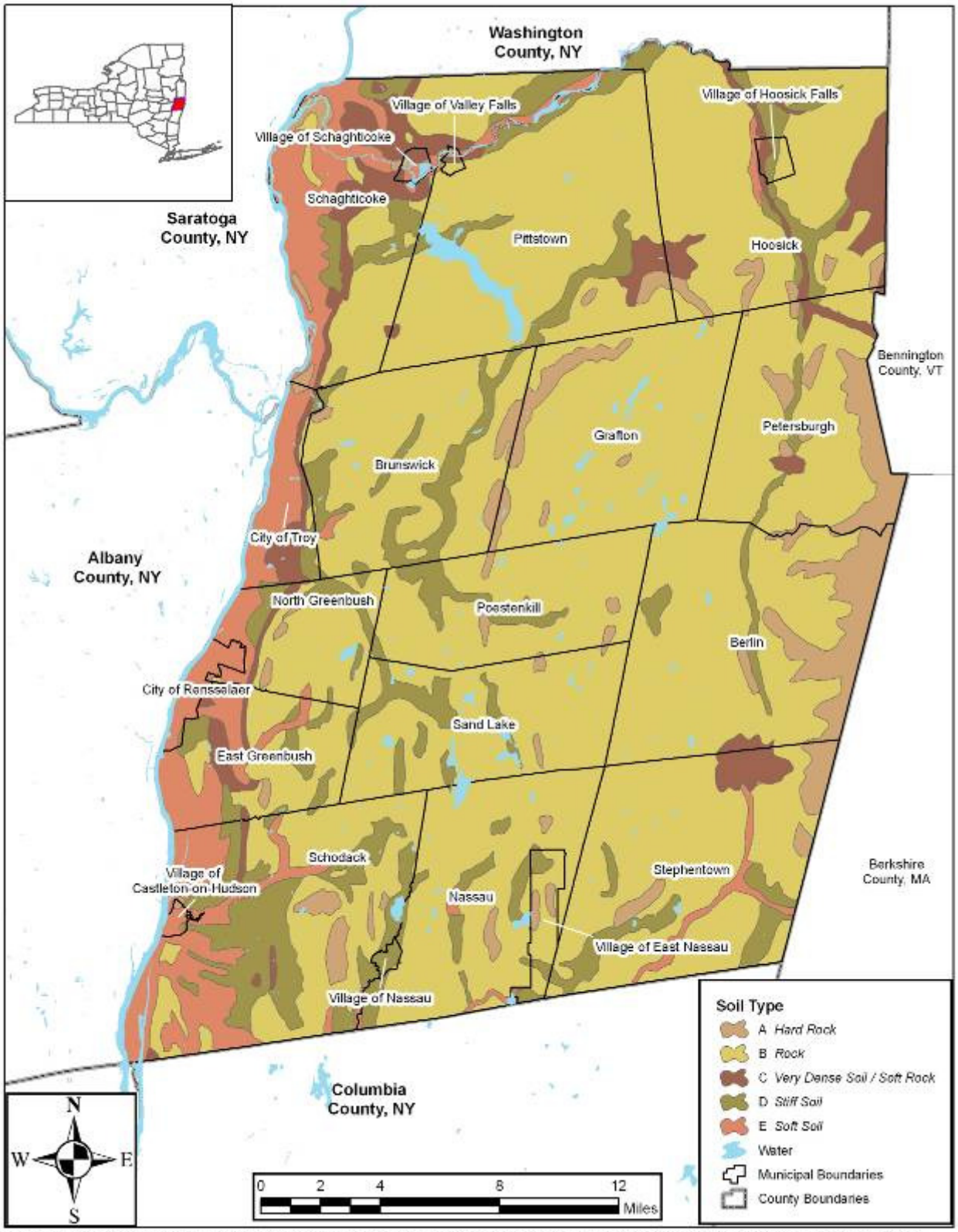
Table 3a.21 presents the areas of earthquake hazard risk in each municipality by the adjusted spectral acceleration (SA) with a 2% probability of occurrence in 50 years. Table 3a.22 presents the values of improved property within those hazard areas for each municipality. For clarity and conciseness Tables 3a.21 and 3a.22 have omitted the acreages and improved values in areas of the two lowest risk hazard bands included in Figure 3a.32.

Over the County as a whole, the vast majority of the County's land area and improved property value is located in the lowest earthquake risk bands designated in the NYSHMP: Only 21% of the County is located in the 35-45%, 55-65%, and 65-75% Spectral Acceleration risk areas. However, these areas contain almost 60% of the County's improved value, with both the Cities of Troy and Rensselaer having more than half of their improved property within the second highest Spectral Acceleration risk zone (65-75%) as designated in the NYSHMP. Almost all the remaining improved property in the City of Rensselaer is located in the third highest risk zone (SA 55-65%). The Village of Castleton-on-Hudson is the only other municipality in the County to have more than half of its improved property (88%) in the two highest Spectral Acceleration risk zones present in the County.

A more detailed breakdown of parcels and property exposed to the earthquake hazard by land use types is presented in Appendix A.

*While PGA (peak ground acceleration) is what is experienced by a particle on the ground, **spectral acceleration** is approximately what is experienced by a building, as modeled by a particle on a massless vertical rod having the same natural period of vibration as the building (USGS).

Figure 3a.31: Rensselaer County Geological Soil Classification



SOURCE: NYS Geological Survey, NEHRP Soil Class Data; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; U.S. Census Bureau, Population Data, 2000, Census Railroads, New York State, 2001, Rensselaer, Columbia, Albany, Saratoga, Washington Counties, Area Hydrography, 2007

Figure 3a.32: Rensselaer County Earthquake Hazard: Combined Seismic Risk/Soils Type

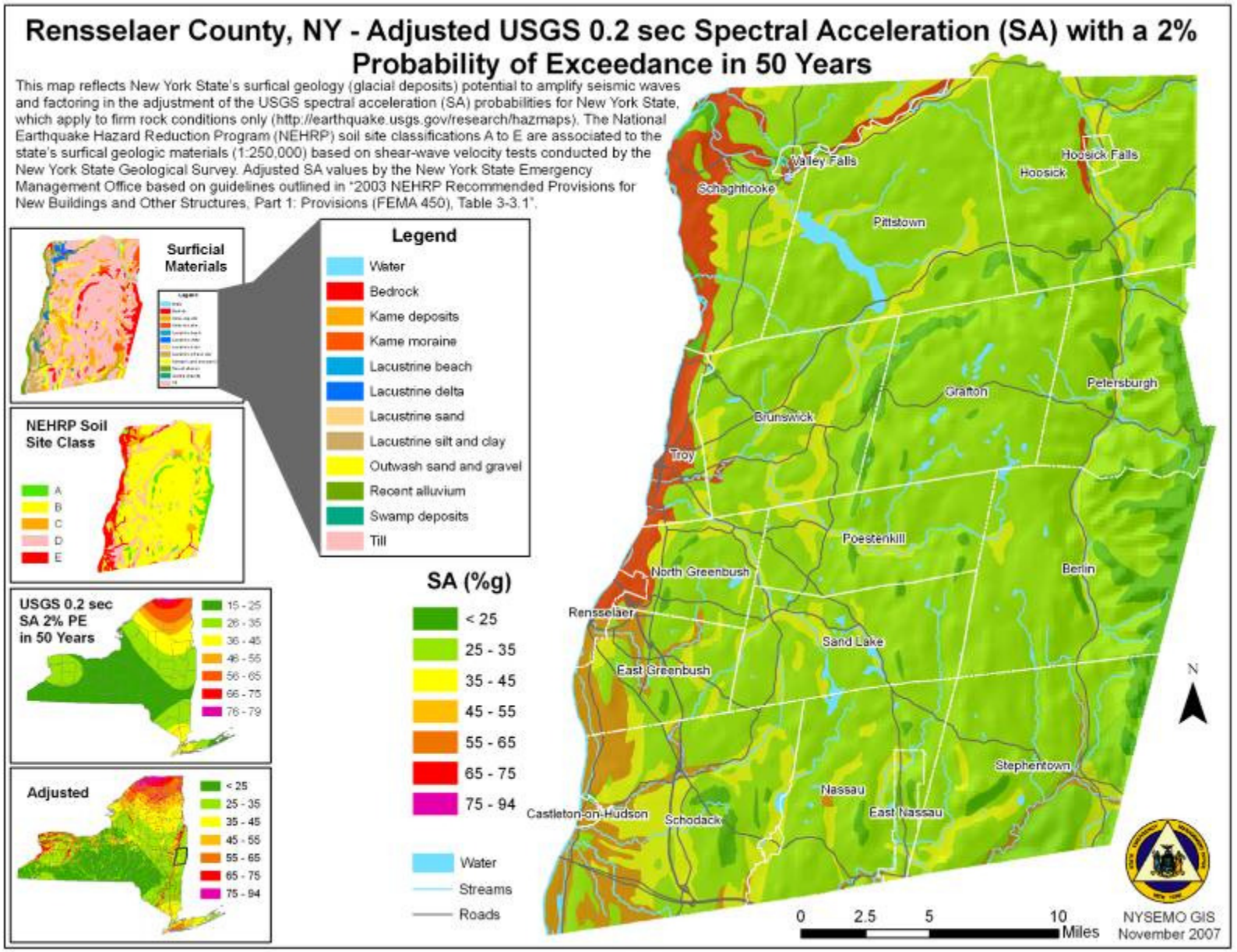


Table 3a.21
Rensselaer County Earthquake Hazard: Adjusted USGS 0.2 Sec Spectral Acceleration With a 2% Probability of Exceedance over 50 Years - Acreages
(Source: NYSEMO/NYS Geological Survey)

Municipality	Total Acres	SA (%g) 35-45		SA (%g) 45-55		SA (%g) 65-75	
		Acres	%	Acres	%	Acres	%
Berlin, Town of	38,196	1,583	4%	0	0%	0	0%
Brunswick, Town of	28,284	5,346	19%	0	0%	230	1%
Castleton-on-Hudson, Village of	533	33	6%	457	86%	0	0%
East Greenbush, Town of	15,713	2,333	15%	4,912	31%	29	0%
East Nassau, Village of	3,031	637	21%	34	1%	0	0%
Grafton, Town of	29,706	5	0%	0	0%	0	0%
Hoosick, Town of	39,364	3,339	8%	0	0%	442	1%
Hoosick Falls, Village of	950	300	32%	0	0%	45	5%
Nassau, Town of	25,597	2,662	10%	515	2%	0	0%
Nassau, Village of	442	410	93%	0	0%	0	0%
North Greenbush, Town of	12,103	1,969	16%	182	2%	1,613	13%
Petersburgh, Town of	26,682	1,004	4%	0	0%	0	0%
Pittstown, Town of	41,256	4,139	10%	0	0%	379	1%
Poestenkill, Town of	20,732	2,407	12%	0	0%	0	0%
Rensselaer, City of	2,202	49	2%	787	36%	1,360	62%
Sand Lake, Town of	23,088	3,126	14%	0	0%	0	0%
Schaghticoke, Town of	32,507	4,485	14%	0	0%	9,795	30%
Schaghticoke, Village of	640	0	0%	0	0%	299	47%
Schodack, Town of	40,243	11,542	29%	11,158	28%	0	0%
Stephentown, Town of	37,280	3,896	10%	1,571	4%	0	0%
Troy, City of	7,056	636	9%	0	0%	4,364	62%
Valley Falls, Village of	307	0	0%	0	0%	4	1%
County Totals	*425,915*	*49,903*	*12%*	*19,616*	*5%*	*18,559*	*4%*

Low risk SA categories (<25 and 25 – 35) omitted for clarity

Table 3a.22
Rensselaer County Earthquake Hazard: Adjusted USGS 0.2 Sec Spectral Acceleration With a 2% Probability of Exceedance over 50 Years – Improved Property
(Source: NYSEMO/NYS Geological Survey)

Municipality	Total Improved Property	SA (%g) 35-45		SA (%g) 55-65		SA (%g) 65-75	
		Improved Property	%	Improved Property	%	Improved Property	%
Berlin, Town of	$161,460,296	$24,433,411	15%	$0	0%	$0	0%
Brunswick, Town of	$935,076,250	$310,277,134	33%	$0	0%	$6,682,959	1%
Castleton-on-Hudson, Village of	$173,218,901	$14,673,482	8%	$152,402,387	88%	$0	0%
East Greenbush, Town of	$1,478,535,900	$324,395,758	22%	$287,266,581	19%	$751,535	0%
East Nassau, Village of	$36,635,844	$18,971,607	52%	$637,927	2%	$0	0%
Grafton, Town of	$160,142,003	$84,860	0%	$0	0%	$0	0%
Hoosick, Town of	$276,325,323	$66,399,092	24%	$0	0%	$17,289,715	6%
Hoosick Falls, Village of	$335,334,980	$171,983,884	51%	$0	0%	$11,457,740	3%
Nassau, Town of	$207,267,186	$44,390,472	21%	$4,344,386	2%	$0	0%
Nassau, Village of	$101,812,537	$101,248,334	99%	$0	0%	$0	0%
North Greenbush, Town of	$1,126,168,100	$354,275,301	31%	$22,703,248	2%	$184,728,819	16%
Petersburgh, Town of	$85,588,579	$8,620,964	10%	$0	0%	$0	0%
Pittstown, Town of	$296,057,020	$54,218,305	18%	$0	0%	$3,128,919	1%
Poestenkill, Town of	$315,226,879	$74,838,547	24%	$0	0%	$0	0%
Rensselaer, City of	$527,411,852	$3,927,501	1%	$213,614,202	41%	$304,975,930	58%
Sand Lake, Town of	$618,731,110	$176,714,228	29%	$0	0%	$0	0%
Schaghticoke, Town of	$393,627,712	$51,271,879	13%	$0	0%	$75,855,781	19%
Schaghticoke, Village of	$48,285,342	$0	0%	$0	0%	$18,735,449	39%
Schodack, Town of	$846,788,002	$329,735,681	39%	$117,344,879	14%	$0	0%
Stephentown, Town of	$187,025,080	$31,483,950	17%	$17,972,782	10%	$0	0%
Troy, City of	$4,097,481,405	$343,157,608	8%	$0	0%	$3,179,819,227	78%
Valley Falls, Village of	$24,983,624	$0	0%	$0	0%	$4,207	0%
County Totals	*$12,433,183,925*	*$2,505,101,998*	*20%*	*$816,286,392*	*7%*	*$3,803,430,283*	*31%*

Low risk SA categories (<25 and 25 – 35) omitted for clarity

Previous Occurrences - Earthquakes

As noted in the New York State Mitigation Plan, although the probability of damaging earthquakes in New York State is low, earthquakes do occur on a regular basis in New York. Figure 3a.33 illustrates the location of earthquake epicenters in New York, as obtained from the New York State Hazard Mitigation Plan, for earthquakes that occurred between 1737 and May 1986. Table 3a.23 presents details for earthquakes recorded in New York State since 1737 that were recorded in the 2006 NYS statistical yearbook. The list records one significant seismic event in the vicinity of Rensselaer County: An event of reported magnitude 4.8 – 5.0 (depending on the source) centered on Warrensburg in Warren County in April 1931.

Figure 3a.33: Significant Earthquake Epicenters in New York State (1737-1986)

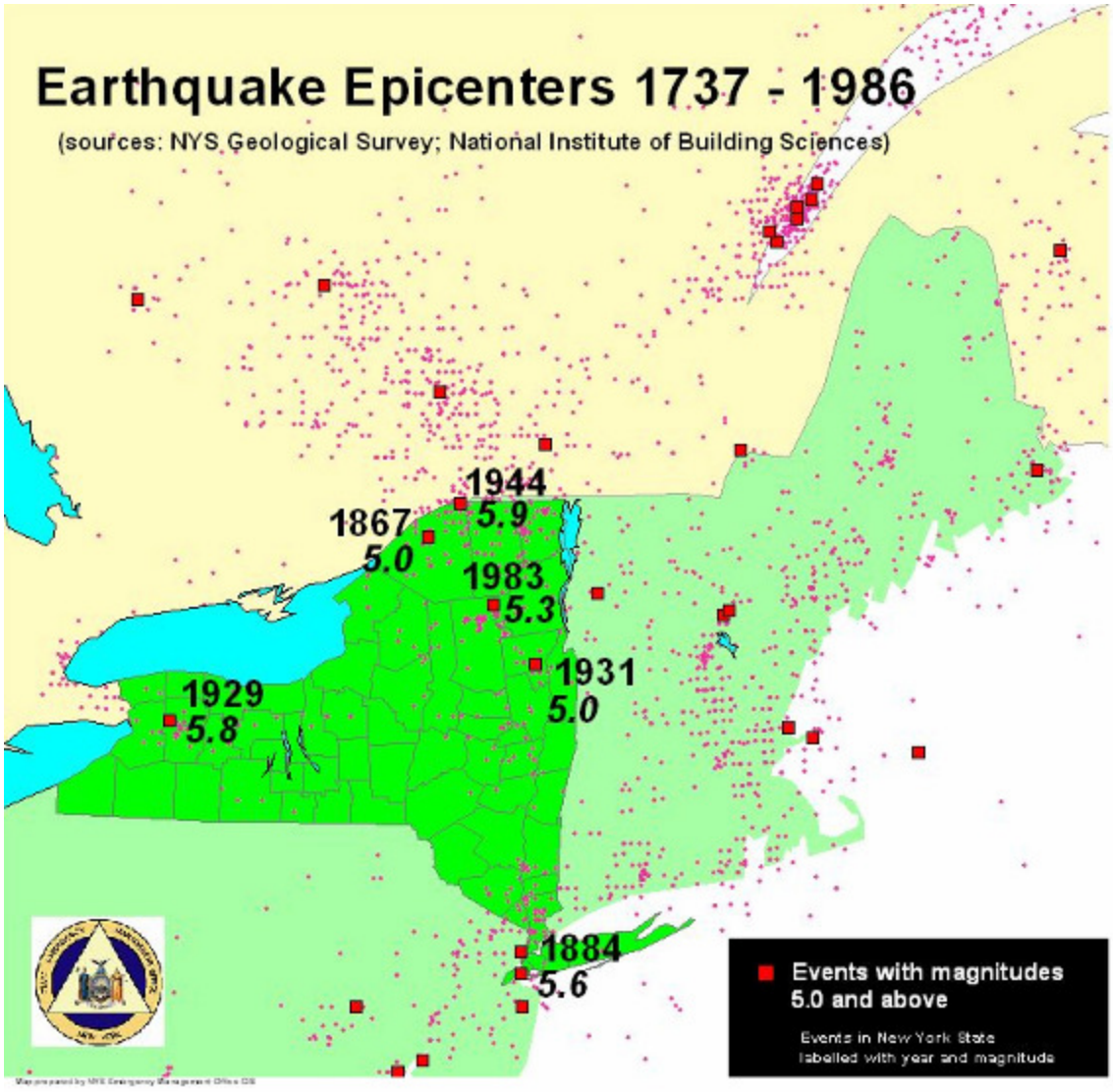


Figure 3a.33 indicates that a handful of additional minor earthquakes have been epicentered in Neighboring Counties (particularly Albany County) since 1737, although details of these events were not readily available. .

There has been one Federally-declared disaster in New York State due to an earthquake, following an event of Magnitude 3.1 that occurred in the far north eastern part of the state in April 2002 (with aftershocks in May 2002). Rensselaer County was not affected by this event.

Table 3a.23
Earthquake History Throughout New York State (1737 – 2005)
(Source: NYSEMO / NYS Statistical Yearbook 2006)

Date	Location	Size	Damage Description
December 18, 1737	New York City	5.2	Bells rang, several chimneys fell
January 16, 1840	Herkimer	3.7	No reference and/or No damage reported
September 2, 1847	Offshore NYC	3.5	No reference and/or No damage reported
September 9, 1848	Rockland Lake	V	Felt by many
March 12, 1853	Lowville	VI	Machinery knocked over
February 7, 1855	Saugerties	VI	Cryoseism
October 23, 1857	Buffalo (Lockport)	4.0	Bells rang, crocks fell from shelves
December 18, 1867	Canton, St. Lawrence County	4.7	Sleepers awakened
December 11, 1874	Tarrytown*	3.4	No reference and/or No damage reported
November 4, 1877	Lyon Mountain	VII	Chimneys down, walls cracked, window damaged, crocks overturned
August 10, 1884	New York Bight (NYC)	5.2	Chimneys and bricks fell, walls cracked
May 28, 1897	Dannemora	4.5	No reference and/or No damage reported
February 3, 1916	Schenectady	3.8	Broke windows, people thrown out of bed
March 18, 1928	Saranac Lake	4.0	No reference and/or No damage reported
August 12, 1929	Attica	5.2	250 chimneys fell, brick buildings damaged, Attica prison walls, wells went dry
April 20, 1931	**Warrensburg**	**4.8**	**Chimneys fell, church spire twisted**
April 15, 1934	Dannemora	3.9	House shifted
July 9, 1937	Brooklyn	3.5	No reference and/or No damage reported
September 5, 1944	Corwall, Ontario/Massena, NY	5.8	Nearly all chimneys fell, buildings damaged, $2 million damage
September 5, 1944	Corwall, Ontario/Massena, NY	4.5	Chimneys destroyed, houses damaged
September 3, 1951	Rockland County	3.6	No reference and/or No damage reported
January 1, 1966	Attica	4.7	Chimneys and walls damaged
June 13, 1967	Attica	3.9	Chimneys and walls damaged
May 23, 1971	Blue Mountain Lake	4.1	No reference and/or No damage reported
May 23, 1971	Blue Mountain Lake	3.5	No reference and/or No damage reported
June 7, 1974	Wappingers Falls	3.0	Windows broken

Table 3a.23
Earthquake History Throughout New York State (1737 – 2005)
(Source: NYSEMO / NYS Statistical Yearbook 2006)

Date	Location	Size	Damage Description
June 9, 1975	Plattsburgh (Altona)	3.5	Chimneys and fireplaces cracked
November 3, 1975	Raquette Lake	4.0	No reference and/or No damage reported
February 2, 1983	Scarsdale-Lagrangeville	3.0	Chimneys cracked
October 7, 1983	Goodnow, Adirondack Mountains	5.1	Tombstones rotated, some cracked chimneys, windows broken, walls damaged
October 19, 1985	Ardsley	4.0	Windows broken, walls damaged
June 17, 1991	Richmondville	4.0	No reference and/or No damage reported
March 10, 1992	East Hampton, Suffolk County	4.1	No reference and/or No damage reported
April 20, 2000	Newcomb	3.8	No damage reported
April 20, 2002	Au Sable Forks	5.1	Cracked walls, chimneys fell, road collapsed, power outages. Federal Disaster DR-1415 was declared as a result.
May 24, 2002	Au Sable Forks	3.1	Aftershock of the April 20, 2002 event, no damage reported

Probability of Occurrence – Earthquakes

Earthquakes cannot be predicted. They strike without warning, at any time of the year, and at any time of the day or night. Earthquake hazard maps – sometimes referred to as "PGA maps" – are used as a tool to project the likelihood of a various intensity quake being exceed at a certain location over a given period of time. They depict the Peak Ground Acceleration (PGA), expressed as a percentage of the force of gravity that can be expected to be exceeded at a given location for a particular probability of exceedance over a specific time frame. Figure 3a.30 is an example of a basic earthquake hazard map as prepared by the USGS Earthquake Hazards Program. It shows PGA values that have a 10 percent chance of being exceeded over 50 years.

As Figure 3a.30 shows, the earthquake hazard is relatively low but increases north to south across the County. Therefore, according to the currently available earthquake hazard mapping of New York State, there is a 10 percent chance over 50 years that an earthquake with a minimum PGA of 3%g to 4%g will be centered within Rensselaer County and its component jurisdictions. This earthquake, if it were to occur, would likely have associated with it light to moderate perceived shaking and little to no significant damage. While earthquakes causing greater damage within Rensselaer County are still possible, they have a less than 10% probability of occurrence in any 50-year period.

Landslides

Description - Landslides

According to the USGS National Landslide Information Center (NLIC), the term "landslide" is defined as the movement of a mass of rock, debris, or earth down a slope. The force of gravity acting upon a steep (or sometimes, even a moderately steep) slope is the primary cause of a landslide. Slope failure occurs when the force of gravity pulling the slope downward exceeds the strength of the earth materials that comprise the slope to hold it in place. In addition to the force of gravity, other contributing factors to landslides can include rainfall and/or rapid snowmelt, earthquakes, volcanic activity, changes in groundwater, and human-induced modifications to existing slopes.

The potential for a landslide to occur exists in every state in the country wherever very weak or fractured materials are resting on a moderate to steep slope (typically, a slope steep enough to make walking difficult). However, not all moderate to steep slopes are prone to landslides. As slope stability increases, the susceptibility to landslides decreases. Key factors in slope stability are:

- Soil Type. Certain types of soil are more stable on slopes than others. For example, as noted in the New York State Hazard Mitigation Plan, glacial till is one type of soil that tends to stand up well to the landslide tendency while glacial lake clay soils tend to have a higher risk for landslides.
- Terrain. The degree of the slope and the height from top of the slope to its toe also affect slope stability. The New York State Hazard Mitigation Plan indicates that the steeper the slope the higher the risk for landslides to occur (all other things being equal). It notes that minor landslides called "slumps" can occur with very minor slopes, and that landslides are most likely on slopes greater than or equal to 10 degrees. In terms of the height of the slope, the State Plan notes that relief greater than 40 feet is generally accepted to be the threshold where the potential becomes more significant.
- Vegetative Cover. Slopes with little or no vegetative cover are more prone to landslides than other more vegetated slopes.
- Soil Water Content. As soil water content increases, slope stability decreases. Periods of sustained above-average precipitation, short duration rainfall events with significant precipitation, and snowmelt events can all add to soil water content and increase susceptibility to landslides.

Landslides can be triggered by natural events or by humans. Natural events include erosion, decreases in vegetative cover due to natural causes and/or seasonal changes, and ground shaking from earthquakes. Human caused triggers include altering the slope gradient, increasing the soil water content, and removal of vegetative cover.

Location and Extent - Landslides

Areas that are commonly considered to be safe from landslides include areas that have not experienced landslides in the past, areas of minimal slope, and areas set back from the tops of slopes. Conversely, areas that are commonly considered to be more prone to landslides tend to be areas where a landslide has occurred in the past, bases of steep slopes or drainage channels, and developed hillsides where leach field septic systems are used.

The potential for landslides exists across the whole of New York State, although according to USGS and NYGS the vast majority of the state (80%) has a low susceptibility to landslide hazard. Landslide hazard mapping has been completed for New York State. In general the highest potential for landslides can be found along major river and lake valleys that were formerly occupied by glacial lakes resulting in glacial lake deposits (glacial lake clays) and usually associated with steeper slopes, such as the Lake Ontario Region. USGS landslide susceptibility mapping uses three basic classifications to communicate the risk, in conjunction with three further classifications to communicate the combinations of susceptibility and incidence:

- High incidence (Greater than 15 % of the area involved)
- Moderate incidence (1.5% - 15% of the area involved)
- Low incidence (Less than 1.5% of the area involved)
- High susceptibility/moderate incidence
- High susceptibility/low incidence
- Moderate susceptibility/low incidence

The USGS provides the following supporting narrative for the landslide hazard classifications:

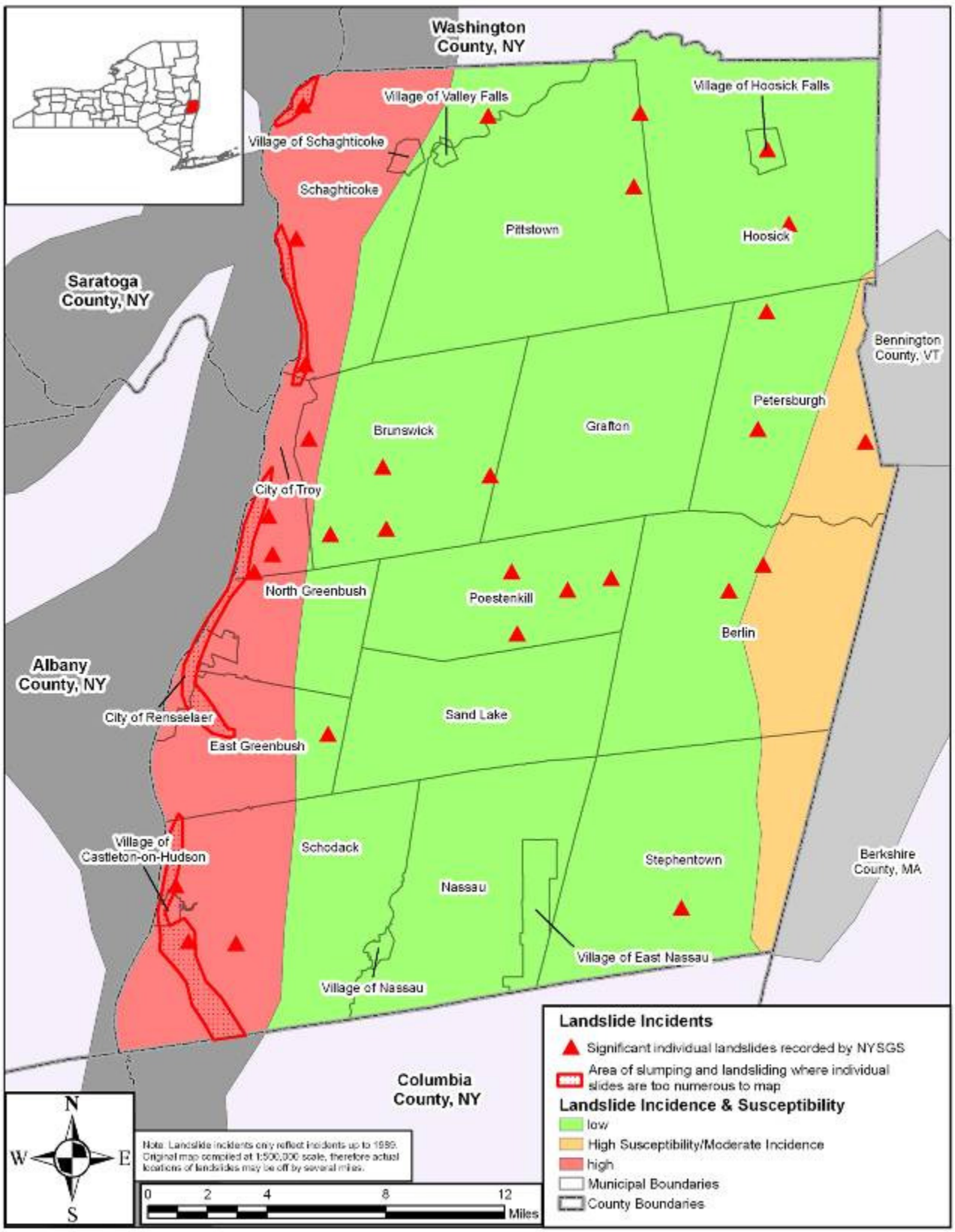
> *"Susceptibility not indicated where same or lower than incidence. Susceptibility to land sliding was defined as the probably degree of response of [the areal] rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of land sliding. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated."*

USGS landslide susceptibility mapping for Rensselaer County is presented in Figure 3a.27. The figure shows that the area with the highest identified risk of landslides is the western side of the County in an area mapped as "High Incidence" generally within 2-5 miles of the Hudson River. Another portion of the County along its eastern boundary is identified as "High Susceptibility/Moderate Incidence. The remainder of the County is mapped as "Low Incidence", although the majority of individual landslide incidents in the County for which records are available have been recorded in this zone. Of the six categories of incidence and susceptibility listed above, only these three have been identified in Rensselaer County.

The severity of a landslide depends in large part on the degree of development in the area in which it occurs and the geographic area of slide itself. Generally speaking, landslides often result in devastating consequences, but only in very localized areas. A landslide occurring in an undeveloped area would be less severe because lives and property would not be affected; the only impacts would be to land, vegetation, and possibly some wildlife. On the contrary, a landslide occurring in a developed area could have devastating affects, ranging from structure and infrastructure damage to injury and/or loss of life. Structures or infrastructure built on susceptible land would likely collapse as their footings slide downhill, while those below the land failure would likely be crushed. Landslides in the area of roadways could have the potential to fall and damage or destroy vehicles, and force other drivers to have accidents.

The GIS data used to generate Figure 3a.34 was used to estimate the extent of land areas vulnerable to landslides and the value of improved property within those areas in each municipality, as presented in Table 3a.24. It should be noted that this mapping represents the overall risk of landslides, and occasional areas more vulnerable to landslides may exist within low risk or incidence areas due to local topographical conditions.

Figure 3a.34: Landslide Incidence in Rensselaer County



SOURCES: ESRI, U.S. Counties, 2005; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; USGS, National Seismic Hazard Maps, 2008 Robert H. Fickles NYSGS & Earl E. Brabb USGS, Landslide Inventory Map of New York, 1989

Table 3a.24
Landslide Risk by Municipality

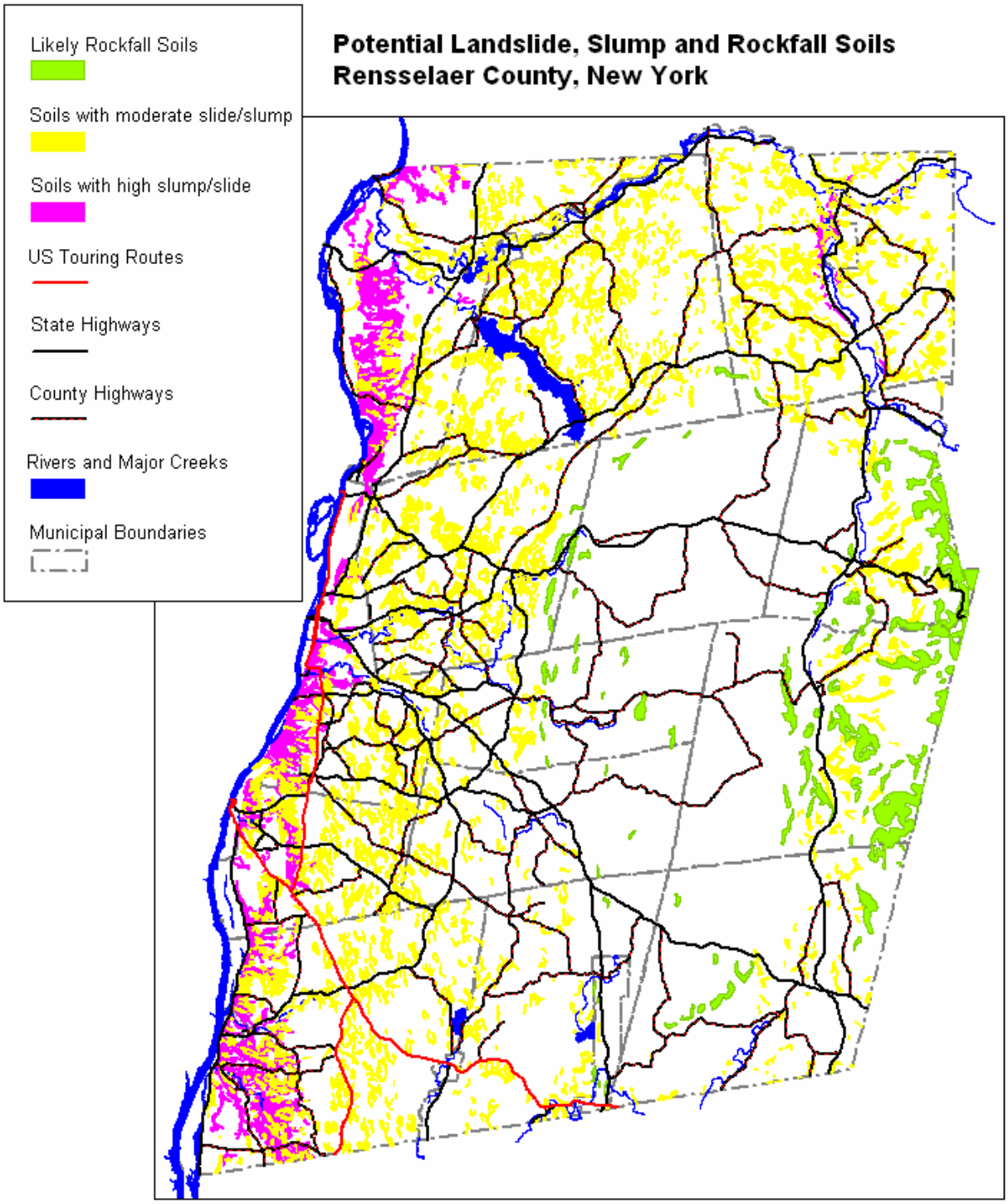
Municipality	Total Area (Acres)	Total Improved Value	High Incidence				High Susceptibility/Moderate Incidence			
			Area (Acres)	%	Improved Value	%	Area (Acres)	%	Improved Value	%
Berlin, Town of	38,196	$161,460,296	0	0%	$0	0%	15,774	41%	$62,754,099	39%
Brunswick, Town of	28,284	$935,076,250	2,189	8%	$222,193,789	24%	0	0%	$0	0%
Castleton-on-Hudson, Village of	533	$173,218,901	533	100%	$173,218,901	100%	0	0%	$0	0%
East Greenbush, Town of	15,713	$1,478,535,900	12,208	78%	$1,422,482,069	96%	0	0%	$0	0%
East Nassau, Village of	3,031	$36,635,844	0	0%	$0	0%	0	0%	$0	0%
Grafton, Town of	29,706	$160,142,003	0	0%	$0	0%	0	0%	$0	0%
Hoosick, Town of	39,364	$276,325,323	0	0%	$0	0%	64	0%	$0	0%
Hoosick Falls, Village of	950	$335,334,980	0	0%	$0	0%	0	0%	$0	0%
Nassau, Town of	25,597	$207,267,186	0	0%	$0	0%	0	0%	$0	0%
Nassau, Village of	442	$101,812,537	0	0%	$0	0%	0	0%	$0	0%
North Greenbush, Town of	12,103	$1,126,168,100	6,026	50%	$767,789,236	68%	0	0%	$0	0%
Petersburgh, Town of	26,682	$85,588,579	0	0%	$0	0%	8,916	33%	$14,444,056	17%
Pittstown, Town of	41,256	$296,057,020	0	0%	$0	0%	0	0%	$0	0%
Poestenkill, Town of	20,732	$315,226,879	0	0%	$0	0%	0	0%	$0	0%
Rensselaer, City of	2,202	$527,411,852	2,202	100%	$527,411,845	100%	0	0%	$0	0%
Sand Lake, Town of	23,088	$618,731,110	0	0%	$0	0%	0	0%	$0	0%
Schaghticoke, Town of	32,507	$393,627,712	22,281	69%	$303,358,307	77%	0	0%	$0	0%
Schaghticoke, Village of	640	$48,285,342	474	74%	$44,403,730	92%	0	0%	$0	0%
Schodack, Town of	40,243	$846,788,002	23,084	57%	$518,241,575	61%	0	0%	$0	0%
Stephentown, Town of	37,280	$187,025,080	0	0%	$0	0%	6,931	19%	$27,629,219	15%
Troy, City of	7,056	$4,097,481,405	6,972	99%	$4,087,410,140	100%	0	0%	$0	0%
Valley Falls, Village of	307	$24,983,624	0	0%	$0	0%	0	0%	$0	0%
County Totals	*425,915*	*$12,433,183,925*	*75,970*	*18%*	*$8,066,509,592*	*65%*	*31,685*	*7%*	*$104,827,374*	*1%*

In terms of the land area covered by moderate susceptibility/low incidence landslide zones, Table 3a.21 shows clearly that the municipalities most at risk from landslides are those immediately adjacent to the Hudson River: the Cities of Troy and Rensselaer, the Towns of Schaghticoke, North Greenbush, East Greenbush and Schodack, and the Villages of Schaghticoke and Castleton-on-Hudson. Three of these municipalities (Troy, Rensselaer, and Castleton-on-Hudson) lie entirely within the highest risk mapped landslide zone, while two others (East Greenbush and the Village of Schaghticoke) have more than 90% of their improved property within the highest risk zone, and three more (North Greenbush, Schodack, and the Town of Schaghticoke) have more than 60% in this zone.

A more detailed breakdown of property exposed to the mapped landslide hazard by land use types is presented in Appendix A.

Also of note is Figure 3a.35, provided by the Rensselaer County Department of Economic Development and Planning on December 30, 2010, which shows the US Department of Agriculture Natural Resource Conservation Service Soils Map for Rensselaer County, and highlights soil types with likely, moderate, and high slump/slide potential.

Figure 3a.35: Potential Landslide, Slump and Rockfall Soils in Rensselaer County



Source: U.S. Department of Agriculture Natural Resource Conservation Service
Soils Map, Rensselaer County, New York

Previous Occurrences – Landslides

The "Landslide Inventory Map of New York" produced by the New York State Geological Survey (NYSGS) in cooperation with the United States Geological Survey, plots the location of 30 landslide events in Rensselaer County between 1837 and 1989, as well as several areas in the "High Incidence" risk zone near the Hudson River where individual slides are too numerous to map. Data sheets obtained from the NYSGS for most of the individual mapped landslide events also record the dollar damages caused by many of these events, with average losses of approximately $25,000 per event (1980s dollars). The details available for landslides in Rensselaer County recorded by NYSGS are presented in Table 3a.25.

Table 3a.25
Landslide Events Recorded by NYSGS in Rensselaer County 1837 – 1989
(Source: New York State Geological Survey)

Date	Municipality Affected	Description	Damage Estimate
1837	City of Troy	Corner of Washington/Fourth Streets: Large landslide destroyed three houses and two stables, five people killed.	not recorded
1843	City of Troy	Nine residential structures and several other buildings destroyed by large landslide, 17 people killed.	not recorded
1854	City of Troy	Construction site of St Peter's College destroyed by landslide	not recorded
1930s	City of Troy	Landslide destroyed three buildings on RPI campus	not recorded
1950s	City of Troy	Proudfit Laboratory building south of Sage Avenue damaged by landslide, subsequently removed	not recorded
1951	City of Troy	Main approach road to RPI damaged by landslide	not recorded
1970	City of Troy	Thompson Street, Troy: Housing development on top of slope, slide destroyed one housing unit and damaged city road	not recorded
1981	City of Troy	Stanton Street: Major slide in sand/clay destroyed foundations of several housing unis under construction	not recorded
1983	City of Troy	Major debris flow on steep slope (100 feet high) into Poestenkill Creek. Top of Congress Street behind old Wooltex factory. Significant part of construction site lost, creek blocked.	not recorded
pre-1985	Town of Stephentown	Soil slump caused by undercutting stream, affects highway (County Route 26)	$35,000
pre-1985	Town of Schodack	Soil slump, portion of highway undercut by stream (County Route 4 at South Schodack)	$20,000
pre-1985	Town of Schodack	Soil slump caused by undercutting stream, affects highway (County Route 4 near Castleton-on-Hudson)	$25,000
pre-1985	Town of Schodack	Soil slump caused by undercutting stream, affects highway (County Route 8 at Stony Point)	$20,000
pre-1985	Town of East Greenbush	Soil slump caused by undercutting stream, affects highway (County Route 53 at Best)	$25,000
pre-1985	Town of Poestenkill	Failure of Cut slope near County Route 40, East Poestenkill	$5,000
pre-1985	Town of Poestenkill	Soil slump caused by undercutting stream, affects highway (County Route 79)	$20,000

Table 3a.25
Landslide Events Recorded by NYSGS in Rensselaer County 1837 – 1989
(Source: New York State Geological Survey)

Date	Municipality Affected	Description	Damage Estimate
pre-1985	Town of Brunswick	Failure of Cut slope on County Route 139 at Eagle Mills	$10,000
pre-1985	Town of Brunswick	Soil slump caused by undercutting stream, affects highway (County Route 79 at Cropseyville)	$30,000
pre-1985	Town of Brunswick	Soil slump caused by undercutting stream, encroaching on highway (County Route 134 at Eagle Mills)	$120,000
pre-1985	City of Troy	Oakwood Avenue: housing development "lost"	not recorded
pre-1985	Town of Schaghticoke	Soil slump caused by undercutting stream, affects highway (County Route 121 at Speigletown)	$20,000
pre-1985	Town of Schaghticoke	Soil slump caused by undercutting stream, affects highway (County Route 121 west of Melrose)	$15,000
pre-1985	Town of Schaghticoke	Soil slump caused by undercutting stream, affects highway (County Route 125)	$15,000
pre-1985	Town of Schaghticoke	Soil slump caused by undercutting stream, affects highway (County Route 114)	$20,000
pre-1985	Town of Hoosick	Failure of cut slope on County Route 103, southwest of Eagle Bridge	$10,000
pre-1985	Town of Pittstown	Failure of cut slope on County Route 109, west of West Hoosick	$10,000
pre-1985	Town of Hoosick	Soil slump in clay undercut by stream, affecting State Route 7	not recorded
pre-1985	Town of Petersburgh	Soil slump caused by undercutting stream, affects highway (County Route 98 at North Petersburgh)	$20,000
pre-1985	Town of Petersburgh	Soil slump caused by undercutting stream, affects highway (County Route 94)	$30,000
pre-1985	Town of Berlin	Soil slump caused by undercutting stream, affects highway (County Route 38)	$20,000
pre-1985	City of Troy	South end of Troy in the vicinity of Menands Bridge: 12 homes reported lost in two separate slides	not recorded
1986	City of Troy	Many slides in Lake Albany clays in Prospect Park/RPI area	$1,000,000
1986	City of Troy	South end of Troy in the vicinity of Menands Bridge: group of slides in Lake Albany clays	not recorded
1987	City of Troy	Southwest corner of RPI campus, slumping of corner of new parking lot	$10,000
1987	City of Troy	Between Lexington Avenue and Spring Avenue: one home destroyed by slide, portions of Lexington Avenue closed	$50,000
1987	City of Troy	Hawthorne Street overlooking Spring Avenue: slide on steep slope did not impact buildings but one house later condemned as a result	$115,000

In addition to events recorded by NYSGS up to 1989, general research has also uncovered several additional landslide incidents;

Date Unspecified
A Core Planning Group Member reported that in the early 1970s NYS Route 2 in the Town of Brunswick slumped in the Poestenkill requiring the road to be closed and major work to be done which is still visible to this day.

May 6, 1998
Following torrential rain, four sections of State Highway 9 from Castleton-on-the-Hudson to the Columbia County line, were blocked by mud slides.

March 2008
A landslide occurred in Troy south of Thomson Street near Delaware Avenue. No details of the impacts were available but a photograph of the slide indicates some damage did result:

February 26, 2010
After a period of heavy rains, a landslide occurred behind the Castleton Volunteer Fire Department forcing the evacuation of the firehouse and its equipment, and burying a basketball court located behind the firehouse on Green Street. Heavy rains weakened the hillside and for a time it was feared that there were signs that a more severe landslide was on its way. The firehouse and its equipment were evacuated. At a subsequent meeting between the village and the Rensselaer County Soil and Water Conservation Service (RCSWCS) the Village indicates that they were advised by RCSWCS that the best approach for moving forward would be to allow the material to remain intact at the base of the slope, and fence in the area. Local regulations exist in the Village to protect against slumping, sliding, and erosion regarding activities that can be taken on slopes of greater than 25% where HUE (250e) soils are present. More formal mitigation activities for this particular site were not recommended.

Probability of Occurrence – Landslides

While it is certainly possible for landslides to occur within Rensselaer County, the current readily available data regarding historic occurrences does not permit any reliable estimation of the frequency of future occurrences. While the overall probability of future occurrence is assumed to be low for much of the central portion of the County, there are significant areas (basically comprising the municipalities adjacent to the Hudson River) where landslides are assumed to be comparatively frequent: the available records suggest that landslides have been occurring at a rate of at least one every five years or so in the County overall, with an assumed higher rate in the areas identified as of "high incidence" and "Areas of slumping and landsliding where individual slides are too numerous to map" by USGS and NYSGS.

Based on overall landslide susceptibility, the number of local historic events and the number of vulnerable structures, Rensselaer County is ranked in the New York State Hazard Mitigation Plan as the County most threatened by landslides out of all 62 counties in the state.

Wildfires

Description – Wildfires

A wildfire is an uncontrolled fire burning in an area of vegetative fuels such as grasslands, brush, or woodlands. Wildfires can occur in areas essentially void of development, or in areas where development intermingles with these natural areas (known as the "urban-wildland interface"). Many wildfires occur in locations that abound in dense forests, grasslands and shrubs. Heavier fuels with high continuity, steep slopes, high temperatures, low humidity, low rainfall, and high winds all work to increase risk.

Wildfires can occur at any time of the year, but will usually occur during warmer and dryer months. Wildfires are most commonly caused by people (i.e., arson, debris burns, and carelessness). Lightning is the next most common cause of wildfires. As reported by the Wildland Fire Assessment System (WFAS) wildfires resulting from a lightning strike largely depend on the duration of the current and the kind of fuel the lightning hits. Spread of the wildfire after ignition usually depends primarily on fuel moisture.

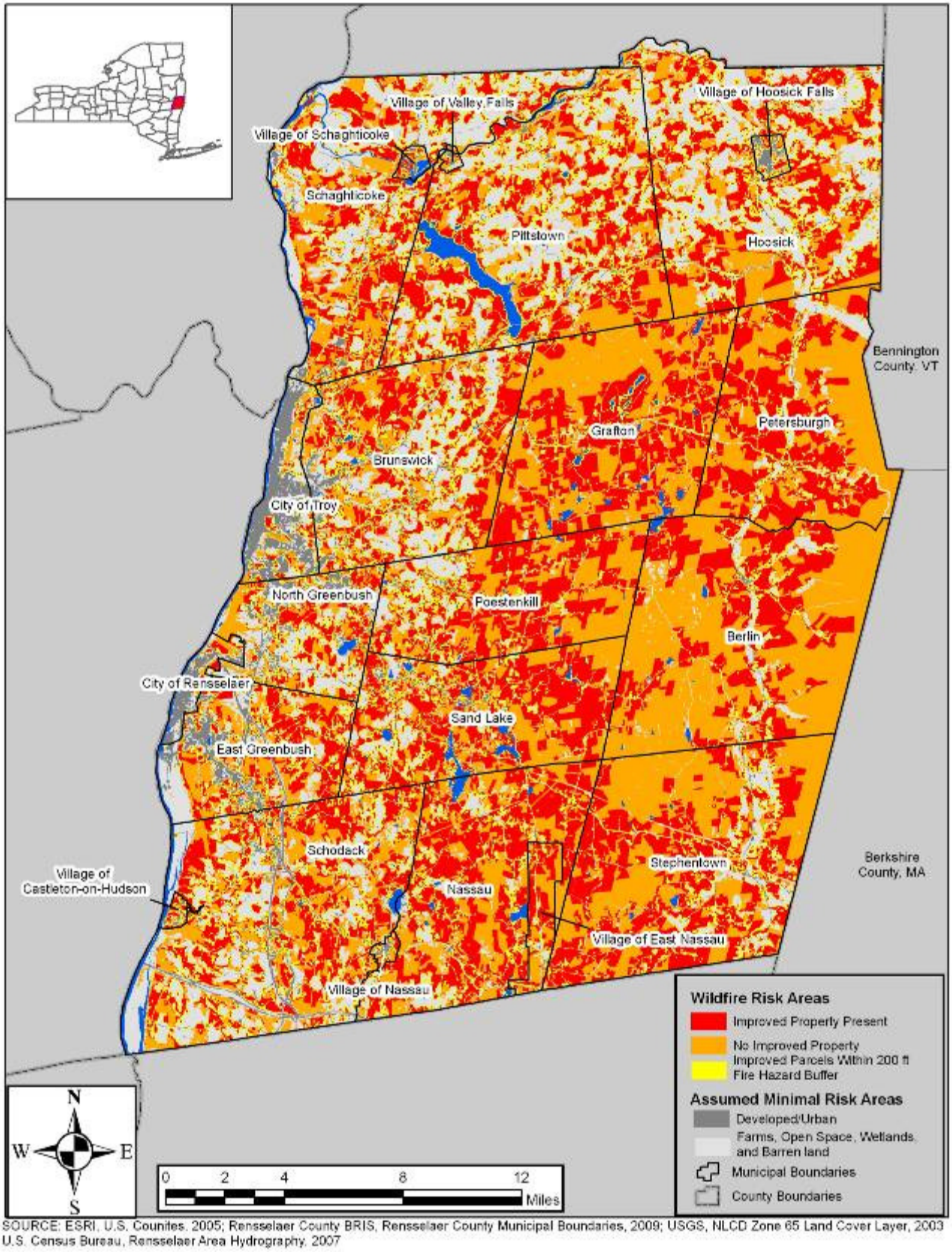
Location and Extent – Wildfires

Areas that are typically considered to be safe from wildfires include highly urbanized, developed areas that are not contiguous with large areas of wild lands. Areas typically considered to be prone to wildfires include large tracts of wild lands containing heavier fuels (i.e. forested or otherwise naturally vegetated) with high continuity, at steeper slopes.

Wildfires are a significant hazard in Rensselaer County, particularly in the forested areas of the county. Many of the areas at risk from wildfires are also popular with hikers and campers. Several locally important transportation routes such as State Routes 2, 7 and 43 pass through potentially vulnerable areas, leaving them vulnerable to closure during forest fire due to smoke conditions. Areas in Rensselaer County where the magnitude and severity of the hazard are the greatest tend to exhibit the lowest population densities in the County; as a result, exposure of people living and working in the highest hazard areas is often relatively low.

Figure 3a.36 shows the areas of Rensselaer County that are considered to be at risk from wildfire colored green and urban/developed areas colored red. At-risk areas include deciduous, evergreen, and mixed forest, shrub land, and grassland. It should be noted that the majority of the wildfire risk areas consist of deciduous woodland (approximately 38% of the County land area and 60% of the wildfire risk area) while evergreen forest, mixed forest, shrub and grassland areas together make up approximately 25% of the County land area and 40% of the area vulnerable to wildfire. Cultivated agricultural land and pastureland, and vegetated developed open space such as golf courses are not considered to be at significant risk from wildfire for the purposes of this plan and its component risk assessment. For the purposes of this plan, it is estimated that approximately 64% of the County area lies within a wildfire hazard zone.

Figure 3a.36: Wildfire Risk Areas in Rensselaer County



SOURCE: ESRI, U.S. Counites, 2005; Rensselaer County BRIS, Rensselaer County Municipal Boundaries, 2009; USGS, NLCD Zone 65 Land Cover Layer, 2003 U.S. Census Bureau, Rensselaer Area Hydrography, 2007

The wildfire risk areas in Figure 3a.36 have been color-coded as follows:

- Red: those areas in which the component parcels include some improved value; i.e. structures are present.
- Orange: those areas for which no improved value and hence no structures are associated with the component parcels.
- Yellow: Areas containing improved property within 200 feet of wildfire risk zones.

This allows a general determination to be made regarding those areas at risk from wildfire in which there is a higher likelihood that such fires could also pose a threat to lives and structures, in addition to developed areas (colored grey) which have a direct interface with the wildfire risk areas.

The wildfire risk for the individual municipalities within Rensselaer County has been quantified by measuring the length of the urban-wildland interface and the total value of improved property located in the areas considered to be vulnerable to wildfires, and these estimations are presented in Table 3a.26. The urban-wildland interface measurements were estimated incorporating a 200 ft buffer extending from the wildfire risk areas into the developed areas, to account for the likelihood that structures in the developed area are at risk of combustion even if they are not immediately adjacent to sources of fuel for wildfires.

Including the buffer applied to wildfire risk areas, 84% of the County's land area is in some way vulnerable to wildfire, with more than 50% of the land area vulnerable in all municipalities except for the Cities of Troy and Rensselaer. In terms of vulnerability of development and structures to wildfire, all the municipalities in the more rural south east of the County have more than 75% of their improved property in wildfire hazard areas. In the Town of Grafton, 97% of development is considered vulnerable to wildfire by the definitions used in this plan, and the Town of Petersburgh also has more than 90% of its development vulnerable to wildfire. While in the County overall 46% of development is considered vulnerable to wildfire, only four individual municipalities in the County have less than 50% of their total improved property value vulnerable to wildfire. A more detailed breakdown of property exposed to the mapped wildfire hazard by land use types is presented in Appendix A.

In terms of the urban-wildland interface, the Town of Schodack exhibits the biggest vulnerability to wildfires, with an interface more than 70 miles in length. The Towns of Brunswick and Sand Lake each have interfaces of more than 40 miles. Several municipalities in the more forested parts of the County have interfaces of less than 10 miles. While this may appear low, it is explained by assuming that in such areas developed land/improved property tends to lie within the expansive areas vulnerable to wildfire rather than adjacent to them.

Table 3a.26
Exposure to Wildfire Risk in Rensselaer County

Municipality	Urban-Wildland Interface (Miles)	Wildfire Risk Zones with no Improved Property (Acres)	Wildfire Risk Zones with Improved Property (Acres)	Total Municipal Area (Acres)	Wildfire Risk Zones (%)	Total Value of Improvements in Municipal Areas	Improved Property Value Vulnerable to Wildfire*	Improved Property Value Vulnerable to Wildfire (%)
Berlin, Town of	6.1	24,319	12,255	38,196	96%	$161,460,296	$132,903,665	82%
Brunswick, Town of	43.8	7,330	13,914	28,284	75%	$935,076,250	$551,204,656	59%
Castleton-on-Hudson, Village of	4.6	43	312	533	67%	$173,218,901	$117,922,469	68%
East Greenbush, Town of	38.8	4,507	6,344	15,713	69%	$1,478,535,900	$687,899,674	47%
East Nassau, Village of	2.5	1,261	1,563	3,031	93%	$36,635,844	$31,850,637	87%
Grafton, Town of	4.2	15,041	13,560	29,706	96%	$160,142,003	$155,527,946	97%
Hoosick, Town of	19.1	9,557	18,845	39,364	72%	$276,325,323	$209,209,443	76%
Hoosick Falls, Village of	8.4	152	378	950	56%	$335,334,980	$127,832,334	38%
Nassau, Town of	11.0	8,388	14,611	25,597	90%	$207,267,186	$177,774,978	86%
Nassau, Village of	3.6	103	219	442	73%	$101,812,537	$54,539,985	54%
North Greenbush, Town of	33.1	3,401	4,494	12,103	65%	$1,126,168,100	$591,383,787	53%
Petersburgh, Town of	6.1	12,553	12,424	26,682	94%	$85,588,579	$77,472,364	91%
Pittstown, Town of	24.7	9,310	20,537	41,256	72%	$296,057,020	$219,199,155	74%
Poestenkill, Town of	26.5	7,978	10,700	20,732	90%	$315,226,879	$270,354,415	86%
Rensselaer, City of	2.7	368	320	2,202	31%	$527,411,852	$137,344,492	26%
Sand Lake, Town of	41.3	7,261	13,223	23,088	89%	$618,731,110	$531,631,045	86%
Schaghticoke, Town of	37.3	7,440	14,461	32,507	67%	$393,627,712	$262,463,393	67%
Schaghticoke, Village of	4.1	110	256	640	57%	$48,285,342	$32,148,874	67%
Schodack, Town of	71.0	11,926	17,207	40,243	72%	$846,788,002	$633,378,734	75%
Stephentown, Town of	10.6	17,248	17,377	37,280	93%	$187,025,080	$159,778,510	85%
Troy, City of	14.8	1,048	1,228	7,056	32%	$4,097,481,405	$500,890,061	12%
Valley Falls, Village of	1.6	100	98	307	64%	$24,983,624	$12,788,945	51%
County Totals	*415.8*	*149,447*	*194,326*	*425,915*	*84%*	*$12,433,183,925*	$5,675,499,562	*46%*

Previous Occurrences – Wildfires

While wildfires are considered by local sources to be a significant hazard in Rensselaer County, occurring on an annual basis in some areas, few detailed records of individual occurrences were found in the course of research for this plan. The NCDC database records a wildfire incident in April 2001 near Route 67 in the Town of Schaghticoke in which $2,000 in damages was recorded, and the SHELDUS database records a fire in April 1962 which caused more to which more than $8,000 in damages were attributed, but does not specify the location. The New York State Hazard Mitigation Plan does not report any specific historical instances of wildfires in Rensselaer County. The Rensselaer County Department of Economic Development and Planning noted that the most recent event to their knowledge was a larger brush fire in approximately 2007 in the Town of Berlin.

Probability of Occurrence - Wildfires

Wildfire events will remain at least an occasional occurrence in Rensselaer County, and although there is insufficient readily available data that could be used to calculate actual probabilities, future occurrences of wildfires in the County is considered to be certain, particularly if drought conditions become more prevalent in the future. The likelihood of increased future development (particularly residential) can only result in an increase in the length of the urban-wildland interface, an increase in the improved value of property within wildfire hazard zones, and a greater risk of property damage and danger to the public in future years. However, most wildfire events in the County are typically contained and extinguished rather quickly and those events causing major property damage or life/safety threats are much less likely to occur.

A Distinction Between "Hazards" and "Events"

This section of the plan speaks to hurricanes and tropical storms, tornadoes, and winter storms/ice storms. These are severe weather events (not hazards themselves). Severe weather events have specific hazards associated with them. The unique hazards associated with the severe weather events discussed in this section are addressed specifically elsewhere in the plan; they are summarized briefly here. While HAZARDS are fully identified and profiled, with vulnerability assessments completed, EVENTS are merely summarized here for information only. EVENTS are not fully profiled and a vulnerability assessment has not been completed. The reader is, however, directed to the HAZARDS associated with these EVENTS (for profile/vulnerability assessment/etc.).