5.4.1 FLOOD

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

HAZARD PROFILE

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

Description

Floods are one of the most common natural hazards in the U.S. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (Federal Emergency Management Agency [FEMA], 2006). Most communities in the U.S. have experienced some kind of flooding, after spring rains, heavy thunderstorms, coastal storms, or winter snow thaws (George Washington University, 2001). Floods are the most frequent and costly natural hazards in New York State in terms of human hardship and economic loss, particularly to communities that lie within flood prone areas or flood plains of a major water source.

The FEMA definition for flooding is "a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from the overflow of inland or tidal waters or the rapid accumulation of runoff of surface waters from any source (FEMA, Date Unknown)." The New York State Disaster Preparedness Commission (NYSDPC) and the National Flood Insurance Program (NFIP) indicates that flooding could originate from one of the following:

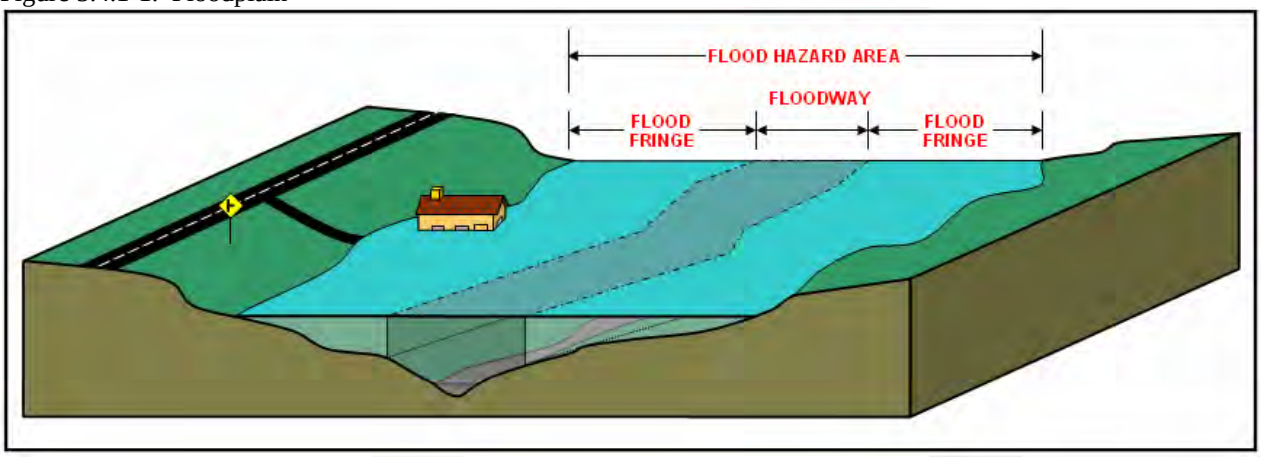
- Riverine flooding, including overflow from river channels, flash floods, alluvial fan floods, ice-jam floods and dam-break floods;
- Local drainage or high groundwater levels;
- Fluctuating lake levels;
- Coastal flooding from storm surge or coastal storms;
- Coastal erosion;
- Unusual and rapid accumulation or runoff of surface waters from any source;
- Mudflows (or mudslides);
- Collapse or subsidence of land along the shore of a lake or similar body of water caused by erosion, waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above (NYSDPC, 2008; Floodsmart.gov, 2008);
- Sea Level Rise; or
- Climate Change (Global Warming)

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is not the flood that will occur once every 100 years, rather it is the flood that has a one-percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. With this term being misleading, FEMA has properly defined it as the 1 percent annual chance flood. This one percent annual

chance flood is now the standard used by most Federal and State agencies and by the National Flood Insurance Program (NFIP) (FEMA, 2002).

Figure 5.4.1-1 depicts the flood hazard area, the flood fringe, and the floodway areas of a floodplain.

Figure 5.4.1-1. Floodplain



Source: NJDEP, Date Unknown

As presented by the Association of State Floodplain Managers (ASFPM), FEMA's NFIP Floodplain Management Requirements: A Study Guide and Desk Reference for Local Officials (FEMA-480), indicates that most floods fall into three categories: Riverine, Coastal and Shallow (ASFPM, 2005). Other types of floods could include ice-jam floods, alluvial fan floods, dam failure floods, and floods associated with local drainage or high groundwater (as indicated in the previous flood definition). For the purpose of this HMP and as deemed appropriate by the County; Riverine, Flash, Ice-Jam and Dam Failure flooding are main flood types of concern that could impact the County and are discussed as follows:

Riverine/Flash Floods – Riverine floods, the most common flood type, occur along a channel and include overbank and flash flooding. Channels are defined features on the ground that carry water through and out of a watershed. They may be called rivers, creeks, streams or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas. Theses floods usually occur after heavy rains, heavy thunderstorms, or snowmelt, and can be slow or fast-rising, and generally develop over a period of hours to days (FEMA, Date Unknown; The Illinois Association for Floodplain and Stormwater Management, 2006).

According to the National Weather Service (NWS), flash floods are "a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters" (NWS, 2005). FEMA's "Are You Ready" Flood Preparedness Guide, indicates that flash floods often have a dangerous wall of roaring water that carries rocks, mud, and other debris and can sweep away most things in its path. They usually result from intense storms dropping large amounts of rain within a brief period with little or no warning; can reach their peak in only a few minutes. They normally occur in the summer during the thunderstorm season. The most severe flooding conditions usually occur when direct rainfall is augmented by snowmelt. If the soil is saturated or frozen, stream flow may increase due to the inability of the soil to absorb additional precipitation. Flooding can also occur when a dam fails or breaks, producing effects similar to flash floods. Areas

that are most susceptible to the effects of floods are low-lying areas that are near water or downstream from a dam (FEMA, 2006).

Ice-Jam Floods - As indicated by the Northeast States Emergency Consortium (NESEC), an ice jam is an accumulation of ice in a river that acts as a natural dam and can flood low-lying areas upstream. Downstream areas also can flood if the jam releases suddenly, releasing a wave of ice and water. *Freezeup jams* are composed primarily of frazil ice, with some fragmented ice included, and occur during early winter to midwinter. The floating frazil may slow or stop due to a change in water slope from steep to mild because it reaches an obstruction to movement such as a sheet ice cover, or because some other hydraulic occurrence slows the movement of the frazil. *Breakup jams* occur during periods of thaw, generally in late winter and early spring, and are composed primarily of fragmented ice formed by the breakup of an ice cover or freezeup jam. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river discharge due to a significant rainfall event or snowmelt. Late season breakup is often accelerated by increased air temperatures and solar radiation.

An ice jam occurs when warm temperatures and heavy rains cause rapid snow melt. The melting snow combined with the heavy rain, causes frozen rivers to swell. The rising water breaks the ice layers into large chunks, which float downstream and often pile up near narrow passages and obstructions, such as bridges and dams. The ice jam may then build to a thickness great enough to raise the water level and cause flooding (NESEC, Date Unknown). Some of the most devastating winter floods have been associated with a combination of heavy rainfall, rapid snowmelt, and ice jams. The severity of an ice jam is a function of the preceding rise in water level (and velocity), the amount of ice traveling with the break-up front, and the nature of the obstacle that initiates the jam. Ice jams can be expected when the ice is thick, snow accumulations are heavy, and the temperature increases dramatically or there is a heavy rainfall. As indicated by the U.S. Army Corps of Engineers (USACE) November 1994 Engineer Pamphlet 1110-2-11 "Ice Jam Flooding: Causes and Possible Solutions," the following influence or cause ice jam events:

- River geometries, weather characteristics, and floodplain land-use practices;
- When ice transport capacity or ice conveyance of the river is exceeded by the ice transported to that location by the river's flow;
- Location (the confluence of a tributary stream and a larger river, lake, or reservoir);
- Collection of ice in riverbends limiting movement or flow;
- Obstructions to ice movement, for example closely spaced bridge or dam piers; and/or
- Structural or operational changes in reservoir regulation (USACE, 1994).

It is difficult to identify particular areas that are generally prone to ice jams because the hazard can be very localized. However, based on causal characteristics, ice jam flood hazard is most prevalent in locations of flat terrain but also where climate includes extended periods of below freezing temperatures.

Most ice jam events create significant economic, environmental and social impacts to areas located along rivers, streams, reservoirs and/or tributaries. Impacts can include structural damages, disruption of geomorphology (bank erosion, channel shifting), and natural habitat loss to fish populations and microbial communities. Ice jams can result in damage to infrastructure through direct impact or through associated flooding of roads, bridges, buildings, and homes. This can cost communities thousands to millions of dollars. However, ice jam damages tend to be localized and

often do not meet the requirements for FEMA disaster assistance. Given its responsibility to support water infrastructure (rivers, bridges, etc.), the USACE plays a large role in ice jam emergency response and long-term mitigation (Darling, 2001).

Dam Failure Floods – A "dam" is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water (different types of dams). Dams are man-made structures built for the purpose of power production, agriculture, water supply, recreation, and flood protection. A levee is a natural or artificial barrier that diverts or restrains the flow of a stream or other body of water for the purpose of protecting an area from inundation by flood waters. According to FEMA, dam failure is a catastrophic type of failure characterized by the sudden, rapid, and uncontrolled release of impounded water or the likelihood of such an uncontrolled release. It is recognized that there are lesser degrees of failure and that any malfunction or abnormality outside the design assumptions and parameters that adversely affect a dam's primary function of impounding water is properly considered a failure. These lesser degrees of failure can progressively lead to or heighten the risk of a catastrophic failure. They are, however, normally amenable to corrective action (FEMA, 2008). A dam failure can result in severe loss of life, economic disaster and extensive environmental damage, primarily due to their unexpected nature and high velocity floodwater. According to FEMA, dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam (inadequate spillway capacity);
- Prolonged periods of rainfall and flooding;
- Deliberate acts of sabotage (terrorism);
- Structural failure of materials used in dam construction;
- Movement and/or failure of the foundation supporting the dam;
- Settlement and cracking of concrete or embankment dams;
- Piping and internal erosion of soil in embankment dams;
- Inadequate or negligent operation, maintenance and upkeep;
- Failure of upstream dams on the same waterway; or
- Earthquake (liquefaction / landslides) (FEMA, 2006).

All types of flooding can cause widespread damage throughout rural and urban areas, including but not limited to: water-related damage to the interior and exterior of buildings; destruction of electrical and other expensive and difficult-to-replace equipment; injury and loss of life; proliferation of disease vectors; disruption of utilities, including water, sewer, electricity, communications networks and facilities; loss of agricultural crops and livestock; placement of stress on emergency response and healthcare facilities and personnel; loss of productivity; and displacement of persons from homes and places of employment.

Any type of agricultural, commercial, residential and recreational development and natural communities (e.g., wetlands, marshes) located in a floodplain (inland or coastal) are vulnerable to flooding. Increased urbanization, and thus increase in paved surfaces, enhances the threat of flooding where drainage systems cannot cope with the increased input of stormwater runoff and decrease in natural water infiltration into the soil (increasing runoff). In rural areas, property damage caused by flooding can be devastating to farmers. When flooding occurs during the growing season, farmers can suffer widespread crop loss. Livestock farmers may lose livestock if they are unable to find safe ground during rising floodwaters. This threat to agricultural areas is primarily associated with flash flooding (Foster, Date Unknown).

Flooding can also pose several threats to industrial, residential and commercial properties. Industrial facilities of all types, typically handle and store various quantities of hazardous materials for their operations. These materials can potentially come into contact with flood waters and be released into the environment impacting local water sources, natural resources and threaten public health. Buildings can experience significant water-related damage, sometimes beyond repair, due to flooding. Household furnishings and business inventories can be lost if there is not adequate time to remove items to safe locations. In addition to being at risk because of floodwater, people face the threat of explosions and fires caused by leaking gas lines along with the possibility of being electrocuted. Even wild animals, forced out of their homes and brought into contact with humans by floodwaters, can be a threat. Post-flood concerns could include mold growth on structures, creating an increased health concern (Foster, Date Unknown).

Severe flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications can be expected. Drinking water and wastewater treatment facilities may be temporarily out of operation. Impacts of flooding on transportation are particularly noteworthy. Flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can washout sections of roadway and bridges. Most importantly, the majority of fatalities that occur in floods are the result of people trying to drive on roads covered by floodwaters (Foster, Date Unknown).

Extent

In the case of riverine or flash flooding, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- Minor Flooding - minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding - some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations (NWS, 2008).

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. One element is the size of rivers and streams in an area; but an equally important factor is the land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris, 2008).

Flood severity from a dam failure can be measured with a low, medium or high severity, which are further defined as follows:

- Low severity - No buildings are washed off their foundations; structures are exposed to depths of less than 10 feet (3.3 meters).
- Medium severity - Homes are destroyed but trees or mangled homes remain for people to seek refuge in or on; structures are exposed to depths of more than 10 feet (3.3 meters).
- High severity - Floodwaters sweep the area clean and nothing remains. Locations are flooded by the near instantaneous failure of a concrete dam, or an earthfill dam that turns into "jello" and washes out in seconds rather than minutes or hours. In addition, the flooding caused by the dam

failure sweeps the area clean and little or no evidence of the prior human habitation remains after the floodwater recedes (Graham, Date Unknown).

Two factors which influence the potential severity of a full or partial dam failure include (1) The amount of water impounded; and (2) The density, type, and value of development and infrastructure located downstream (City of Sacramento Development Service Department, 2005).

Location

Flooding has always been and continues to be a statewide concern for New York State. Although some areas are more prone to certain types of flooding than others, there is no area of the State that is exempt from flood hazards altogether, including Greene County. In New York State, there are over 52,000 miles of river and streams, and along their banks there are 1,480 communities that are designated as flood prone. It is estimated that 1.5 million people live in these flood prone areas. Millions more work, travel through or use recreational facilities located in these areas. Areas outside recognized and mapped flood hazard zones can also experience flooding (NYSDPC, 2008).

Flooding is the primary natural hazard in New York State because the State exhibits a unique blend of weather (climatological and meteorological) features that influence the potential for flooding. Factors include: temperature, which is affected by latitude, elevation, proximity to water bodies and source of air masses; and precipitation which includes snowfall and rainfall. Precipitation intensities and effects are influenced by temperature, proximity to water bodies, and general frequency of storm systems. The Cornell Climate Report indicates that the geographic position of New York State (Northeast U.S.) makes it vulnerable to frequent precipitation events. This is because nearly all storms and frontal systems moving eastward across the continent pass through, or in close proximity to, New York State. Additionally, the potential for prolonged periods of heavy precipitation is increased due to the available moisture from the Atlantic Ocean. The heavy rain can quickly saturate the ground, leading to increased runoff and flooding. Heavy rain in New York State is subject to come in the form of coastal storms (Nor'Easters, Tropical Storms, and Hurricanes) as well as thunderstorms. Flood problems in the State are most acute in the Susquehanna, Genessee, Chemung, Hudson, Mohawk, and Alleghany River Basins. These major waterways, along with their tributary streams in the basins, are subject to direct flooding throughout the New York State (NYSDPC, 2008).

As indicated in the Greene County Profile (Section 4), the Mohawk River and Middle Hudson River sub-basins of the major Hudson River watershed extend through large portions of the County. These sub-basins consist of many tributaries that fall within Greene County and experience frequent flooding events, including the Schoharie Creek (Main Stem), Manor Kill, Batavia Kill, West Kill, East Kill (within the Mohawk River Basin) and the Stony Clove Brook, Broadstreet Hollow Brook, Catskill Creek, Coxsackie Creek, Hollister Lake, Kaaterskill Creek, Shingle Kill, Potic Creek, Hans Vosen Kill and Sleepy Hollow Lake (within the Middle Hudson River Basin). As a result of the flooding that has historically occurred within these sub-basins, Greene County is ranked as the 20th most flood vulnerable county in New York State, based on potential flood exposure and vulnerability to loss (NYSDPC, 2008). Details regarding the Mohawk River and Middle Hudson River Basins within Greene County are further defined below.

Mohawk River Basin

Flooding within the Mohawk River Basin has been a common occurrence almost every year for those living within its drainage basin since their settlement. Flooding in this river basin is associated with two main types, "free water" flood events and "break-up" events. "Free-water" flood events commonly occur in late summer and early fall, during the peak of hurricane season and are associated with large amounts

of precipitation. "Break-up" events are associated with the break-up of river ice, resulting from rising temperatures, melting snow, and heavy rains and commonly occur during winter and early spring. "Break-up" events are exacerbated by the formation of ice jams and account for the majority of the large scale flooding events (greater than 15 feet) (Environmental Science and Policy Program-Union College, Date Unknown; Scheller et al., 2001).

Flooding within the Mohawk River Basin throughout Greene County occurs along Schoharie Creek (Main Stem), Batavia Kill, West Kill and East Kill (Table 5.4.1-1). The Schoharie Creek and Batavia Kill within Greene County tend to experience the most impact during flood events, which are discussed in more detail following Table 5.4.1-1.

Table 5.4.1-1. Mohawk River Basin – Tributaries in Greene County Impacted by Flooding

Waterbody	Location within Greene County	Description
Schoharie Creek (Main Stem)	Prattsville, Lexington, Jewett, Hunter, Ashland, Windham and the Villages of Hunter and Tannersville	One of two major tributaries of the Mohawk River Basin, extending from the southeast to the north through Greene County. Encompassing approximately 315 square miles, 80-percent of the Schoharie Creek watershed is located in Greene County. The Schoharie Creek drains eight Greene County municipalities. The Schoharie Creek watershed averages approximately 46 inches of precipitation per year in the upper reaches (Hunter), 42 inches per year in the mid-sections (Lexington) and 38.5 inches per year near the reservoir (Prattsville). This rainfall often comes in dramatic summer downbursts, remnants of autumn hurricanes, or late winter rain-on-snow events. Average slope of the upper watershed is 22-percent (watershed elevation drops 22 feet for every 100 feet horizontal distance), 18-percent in the mid-section and 15-percent near the reservoir. Drainage density, or how much stream length is available to carry water off the landscape per unit area of watershed is slightly lower than average for the Catskills (GCSWCD, 2007).
Batavia Kill	Prattsville, Ashland and Windham	The Batavia Kill is a tributary to the Schoharie Creek. The Batavia Kill's watershed represents approximately 33-percent of the Schoharie Reservoir watershed. The Batavia Kill watershed is located entirely within Greene County. The majority of the watershed is located in the Town of Windham. Historically, flooding has been an ongoing problem in the Batavia Kill watershed. Main Street in the Village of Windham, is at the confluence of the Batavia Kill and Mad Brook, and has been the site of significant flooding. Two major flood events in 1955 and 1960 reportedly inflicted such great damage in the watershed that a permanent solution to flooding was sought. Particularly the event of September 1960, associated with Hurricane Donna, is considered to be the most damaging on record within the watershed. This event produced over $750,000 in damages (1960 U.S. Dollars) to over 75 residences, 27 businesses, state, county, and town roads and bridges throughout the watershed. Three flood control structures built in the late 1960s and 1970s have greatly reduced the amount of damage from floods in the watershed (further discussed below) (GCSWCD, 2003).
West Kill	Lexington and Hunter	The West Kill is a tributary to the Schoharie Creek. Precipitation in the mountains that surround the West Kill watershed average 45.2 inches (1,149 millimeters) each year, which is high for the Catskills, and often comes in dramatic summer downbursts, remnants of autumn hurricanes, or late winter rain-on-snow events. Average slope of the watershed is the steepest of any sub-basin in the Schoharie Creek basin at 28.9-percent (watershed elevation drops 28.9 feet for every 100 feet horizontal distance). Given the average drainage density, combined with steep side slopes, short tributaries and high precipitation, the West Kill stream system is relatively flashy, that is, stream levels rise and fall quickly in response to storm events. The

Waterbody	Location within Greene County	Description
		highest flows are generally associated with the hurricane season in the fall, followed by winter and spring snowmelt or rain-on-snow events. Recent events in April 1987, 1996 and 1999 really impacted the stream corridor, resulting in damages primarily in the form of collapsed bridges and extreme stream bank failure which damaged the adjacent roadways. Long sections of the stream corridor were found to be highly unstable (New York State Floodplain and Stormwater Managers Association, 2002). Flood hazard mitigation projects have been initiated or completed in the West Kill since the Flood of 1996, including the Melodywood Condominium Project in the Village of Hunter, which was completed at a cost of $727,000 in 1997 (GCSWCD, 2005; GCSWCD, Date Unknown).
East Kill	Jewett	The East Kill is a tributary to the Schoharie Creek. The East Kill watershed averages approximately 44 inches of precipitation per year that often comes in dramatic summer downbursts, remnants of autumn hurricanes, or late winter rain-on-snow events. Given the average drainage density, combined with steep mountainous slopes, and high precipitation, the East Kill stream system is relatively flashy, that is, stream levels rise and fall quickly in response to storm events. As a mountain stream, the East Kill rises quickly as precipitation falls. Between 1951and 2006, the East Kill at Jewett Center has gone over 10,000 cubic feet per second (cfs) five times. Flood events have not been as well documented for the East Kill Valley as other areas due to its relatively small population. However, considering its location and relationship with the Schoharie Creek, it is safe to assume that flooding has historically been a problem in the East Kill (GCSWCD, 2007).

Source(s): Greene County Soil and Water Conservation District (GCSWCD, Date Unknown; Catskill Streams, Date Unknown; New York State Floodplain and Stormwater Managers Association, 2002

Greene County Stream Management Plans (SMPs)

Comprehensive Stream Management Plans (SMPs) for the Batavia Kill (2003), West Kill (2005), East Kill (2007), Schoharie Creek (2007) and Manor Kill (2009) were completed by the GCSWCD, New York City Department of Environmental Protection (NYCDEP) and Schoharie County SWCD and Planning Department (Manor Kill). The stream management plans document the built and natural characteristics of the stream corridors and provide a blueprint for communities to address systemic concerns related to protecting public and private property, fisheries habitat, and water quality. The materials created through this detailed assessment and planning process can now be used as a tool for municipal officials, residents and other interested parties to manage streams consistent with science-based principles.

Throughout the development of each plan, project advisory committees were formed to represent the interests of local officials, residents, businesses, and agencies working in the watershed. Upon completion of the Schoharie and East Kill plans in 2006, the focus began to move towards implementation of plan recommendations with the understanding that some level of assessment would continue. After meeting with the smaller advisory committees from the Schoharie-East Kill, West Kill and Batavia Kill, the decision was made to move towards a single Schoharie basin-wide advisory committee due to overlap of participants from overlapping watershed boundaries. The Schoharie Watershed Advisory Committee (SWAC) was formed in 2008 and is designed to represent the collective interests of local government, property owners, watershed agencies, and non-profit organizations during the implementation of stream management plan recommendations.

The SWAC consists of appointed representatives from each Schoharie Basin municipality, representatives from three subcommittees (Highway Superintendents, Education and Outreach and Recreation and

Habitat), a Greene County Legislator and other local, state and federal agencies. The NYCDEP and the GCSWCD have committed considerable resources as well. Working collaboratively the SWAC capitalized on the knowledge and diversity of committee members and fostered a holistic, science-based, cooperative approach to watershed management (D. Burns, NYC DEP, 2009).

A summary of projects implemented as part of the regional planning effort as of May 2009 are listed below in Table 5.4.1-2.

Table 5.4.1-2. Regional Stream Management Plan Projects

Site Name	Watershed	Project Description	Year Built
Ashland Connector	Batavia Kill	Full channel restoration	2006
Big Hollow	Batavia Kill	Full channel restoration	2001
Brandywine	Batavia Kill	Full channel restoration	1999
Conine	Batavia Kill	Full channel restoration	2007
Maier Farm	Batavia Kill	Full channel restoration	1999
Sugar Maples Stream Rest.	Batavia Kill	Flood Wall removal	2008-2009
Sugar Maples Riparian Buffer	Batavia Kill	Riparian Buffer enhancement and stormwater practices	2008-2009
Holden Project	Batavia Kill	Added natural channel design components to NYSDOT project	2007
Windham Mtn	Batavia Kill	Stormwater retrofit project	2009
Carr Road	Schoharie	Tapered bank and established riparian buffer	2007-2008
Lexington Culvert	Schoharie	Upsized culvert/added floodplain drains	2007
Schoharie Avenue	Schoharie	Rockery wall with two willow beds	2008
Faulkey Road	Schoharie	Added vegetation to FEMA project	2008
Tannersville Office	Schoharie	Installed creative stormwater practices	2008-2009
Prattsville Flood Control	Schoharie	Berm Removal	2005
Prattsville Riparian Project	Schoharie	Riparian planting, floodplain restoration	2009-2010
Hunter Highway	Schoharie	Stormwater – basin pump out	2008
RAH Stables	West Kill	Full channel restoration	2006
Shoemaker	West Kill	Full channel restoration	2005
Long Road	West Kill	Full channel restoration	2009
Cty Rte 6	West Kill	Riparian Planting on highway project	2008
Farber Farm	East Kill	Full channel restoration	2000
Curtain Planting	East Kill	Planted and staked bank	2007
Shadow Mountain	East Kill	Added trees, hydro-seeded and interplant rip rap	2007
Suttons	East Kill	Planted trees	2007
Conesville Town Hall	Manor Kill	Riparian Planting - RPM Trees	2008
Broadstreet Hollow	Esopus	Full channel restoration	2005
Lanesville	Esopus	Full channel restoration	2005
Stony Clove Plantings	Esopus	Riparian Plantings - 2 sites	2005

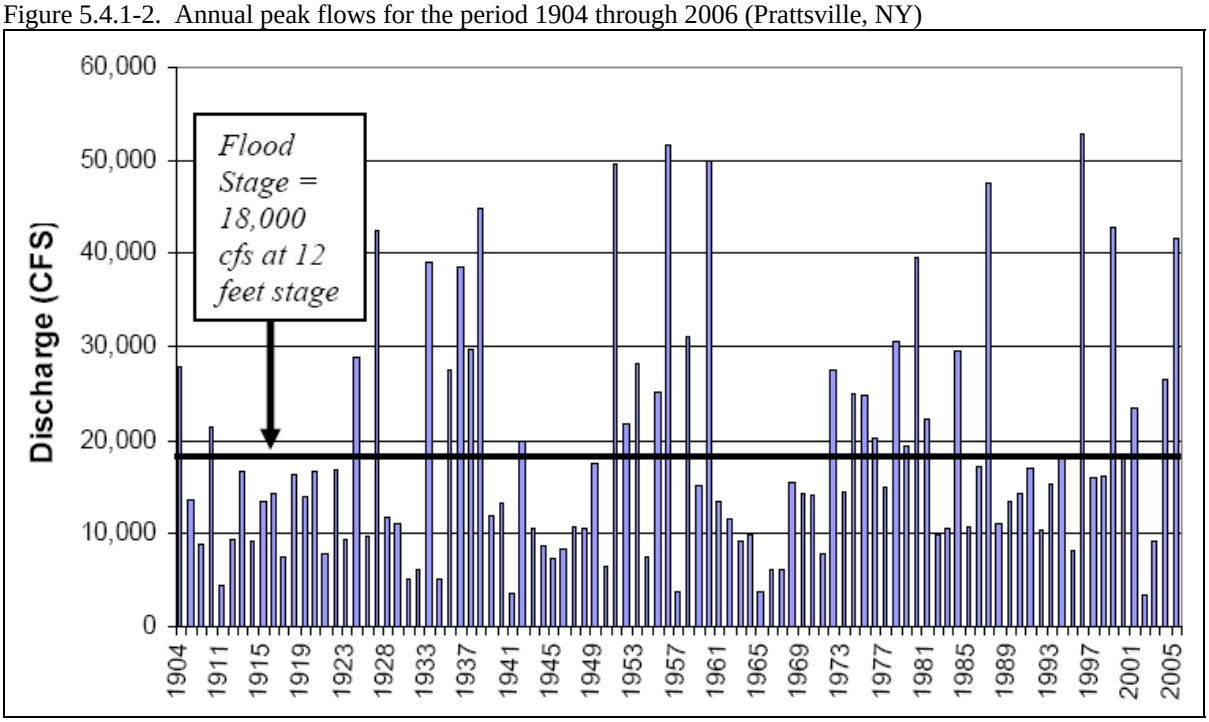
Source: D. Burns, NYC DEP, 2009

According to the April 2007 Schoharie Creek SMP and as indicated in Table 5.4.1-1, given the average drainage density, combined with steep mountainous slopes, and high precipitation, the Schoharie Creek system is relatively flashy (stream water levels rise and fall quickly in response to storm events). If enough precipitation falls, the Schoharie Creek will rise to a "flood stage" (GCSWCD, 2007). Typically, flood stage along the Schoharie Creek in Greene County can be determined at two continuously-recording

streamflow gages or stations located in Prattsville and Lexington, maintained by the United States Geological Survey (USGS). USGS Gage #01350000 is located in Prattsville upstream from the State Route 23 Bridge (established in 1902 with a drainage area of 237 square miles). USGS Gage # 01349705 is located in Lexington, downstream from the Bush Road Bridge (established in 1999 with a drainage area of 96.8 square miles) (GCSWCD, Date Unknown). These stations represent two of 12 continuous-recording stream gages in the entire Schoharie Creek watershed above the Schoharie Reservoir. Fifteen additional stations are located throughout Greene County along the Batavia Kill, West Kill, East Kill, Catskill Creek, Hollow Tree Brook, Hannacroix Creek, Bear Kill and Sugarloaf Brook South. These gages measure the stage (or height) of the water surface at a specific location (updating the measurement every 15 minutes) (Catskill Streams, Date Unknown; USGS, 2008). Further details regarding all USGS gages throughout the County are presented in Table 5.4.1-4 in the "Previous Occurrences" section of this hazard profile.

The Prattsville station is one of the oldest stations along the Creek, and within Greene County, and has the longest recorded flow data history (96 years) over any other station within the Schoharie Creek watershed. With many other USGS stations within the surrounding area having limited periods of record, the Prattsville station is frequently used to study stream hydrology in the contributing sub-basins of Schoharie Creek (GCSWCD, 2003). Flood frequency analysis of the Schoharie at the Prattsville gage indicates a 50-year flood event of 50,000 cubic feet per second (cfs) and a 100-year flood event of 72,000 cfs (GCSWCD, 2003). Flood stage for the Schoharie Creek at this gage is considered by the NWS to be at 12-feet, which corresponds to approximately 18,000 cfs (Figure 5.4.1-2).

Figure 5.4.1-2. Annual peak flows for the period 1904 through 2006 (Prattsville, NY)



Source: GCSWCD, 2007

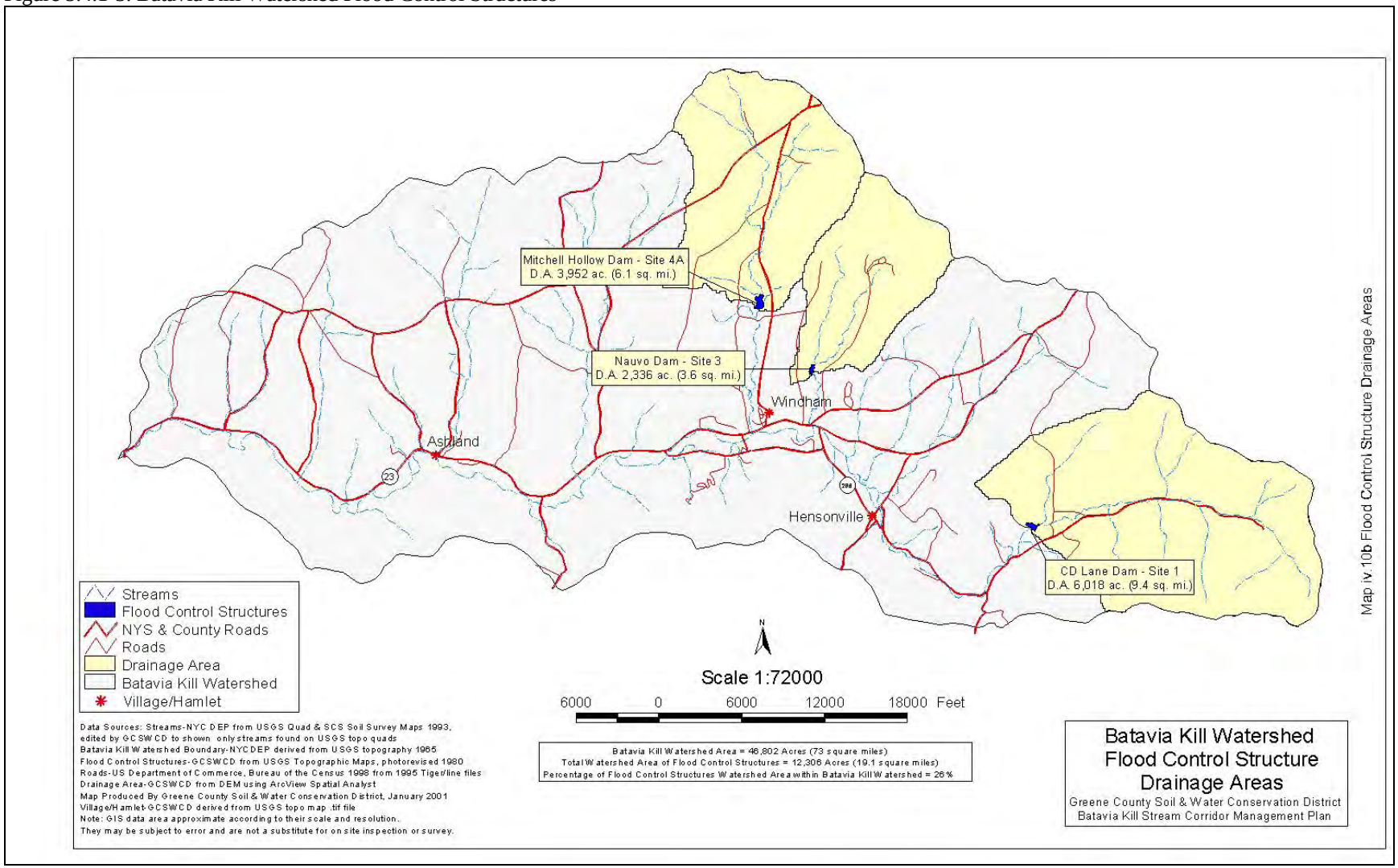
At 14-feet (roughly 26,000 cfs), the Creek begins to overflow onto Main Street (Rte. 23) in Prattsville, and by 18 feet (over 45,500 cfs) is considered severe flooding. Between 1904 and 2006, the Schoharie Creek at Prattsville has exceeded flood stage nearly 34 times (Figure 5.4.1-2), or about once in every 3 years. GCSWCD indicated that the flood of record (highest flood ever documented at the Prattsville gage since 1904) occurred in January 1996. This flood pushed the Schoharie Creek to its highest stage at 19.4 feet (peak flow of 52,800 cfs) reaching its 100-year flood stage (GCSWCD, 2007). However, the NWS

Advanced Hydrologic Prediction Service (AHPS) indicates that Prattsville experienced two historical events in January 1978 and March 1979 that exceeded a 19.4 foot flood stage (AHPS, 2007). These flood events, along with many other events at this station, are further discussed in the "Previous Occurrences" section of this hazard profile.

The Batavia Kill watershed is also located within the Mohawk River Basin and lies entirely within the boundaries of Greene County, particularly in Windham, Ashland and Prattsville. This watershed is typical of most areas in the Catskills, in having extensive areas of federally designated floodplains associated with most of the stream system. The nature of the watershed and the water regime of the area indicate that floods have been a common occurrence on the Batavia Kill, since the first settlers moved to the area. Documentation of past flood events, as well as recent experiences, show that short, intensive flood events have and continue to produce damage to transportation infrastructure, erosion of streambanks, and nuisance basement flooding. Rain and/or snow related events substantially increase the expected damages on both the smaller, uncontrolled tributaries as well as the Batavia Kill itself (GCSWCD, 2003). According to the USGS Gage Data from the Prattsville Gage on Schoharie Creek, floods on record within the vicinity of the Batavia Kill occurred in the years 1869, 1874, 1885, 1893, 1926, 1933, 1938, 1950, 1955, 1960, 1980, 1996 and 1999. During these floods, two lives were lost and hundreds of thousands of dollars in damage was done to the Village of Windham and its surrounding area.

In response to two major flood events in August 1955 and September 1960, the Greene County Legislature adopted a local ordinance in 1961 creating the GCSWCD, in order to allow local municipalities' access to federal flood protection funds. In 1965, the U.S. Department of Agriculture (USDA) Soil Conservation Service (now known as the Natural Resources Conservation Service) completed a Watershed Work Plan for Watershed Protection, Flood Prevention and Water Management in the Batavia Kill Watershed. The work plan called for the development of four flood control structures in the headwaters and on several tributaries to the Batavia Kill. Each of these structures was designed to attenuate a 100-year flood event with a design life of 50 years. Currently, three structures have been built within the Batavia Kill watershed known as the Mitchell Hollow Dam, Nuavo Dam and C.D. Lane Dam, which are further identified in Figure 5.4.1-3. They are well maintained and operated by the Batavia Kill Watershed Protection District. It has been reported that these structures have greatly reduced the amount of damage from floods in the watershed (GCSWCD, Date Unknown).

Figure 5.4.1-3. Batavia Kill Watershed Flood Control Structures



Source: GCSWCD, Date Unknown

As early as 1992, the NYCDEP and GCSWCD identified the Batavia Kill as the leader in high turbidity conditions throughout New York City water supply sub-basins. Faced with the need to either improve water quality or build an $8 billion filtration plant, these government agencies created a watershed protection program. They entered into cooperative discussions regarding the various problems and flood behaviors in the stream system, the multiple benefits which could be realized with a program to address stream instability as a result of flooding and erosion, various methods to assess stream conditions, and design of restoration projects. To achieve improved fisheries and water quality, at the same time as protecting property and infrastructure, the NYCDEP's Stream Management Program and GCSWCD initiated the development of the Batavia Kill Stream Corridor Pilot Project in 1996. The project included developing a stream management plan for managing and improving the overall health of the Batavia Kill (which was later completed in 2003), evaluating the stream's erosion rates and flooding behaviors, and demonstrating the use of Natural Channel Design (NCD) methods through the design and construction of various stream restoration projects along the Batavia Kill. Between 1999 and 2002, the Batavia Kill Project Team completed three stream restoration projects, including the restoration of 1,600 feet of stream on Maier Farm (Ashland); 3,600 feet of stream behind the Brandywine Restaurant (Ashland); and the restoration of 5,600 feet of stream above C.D. Lane Park (Maplecrest/Windham), also recognized as the Big Hollow Stream Project (GCSWCD, Date Unknown; Catskill Streams, 2006).

Middle Hudson River Basin

Many water bodies within the Middle Hudson River Basin of the Lower Hudson River watershed have caused flooding within Greene County, including, but not limited to, Stony Clove Creek, Broad Street Hollow, Catskill Creek and Coxsackie Creek (Lower Hudson Coalition of Conservation Districts, 2001-2002). These streams/creeks in Greene County are summarized below:

- The Stony Clove Creek, located in the center of the Catskill region within Greene and Ulster Counties, is a tributary to the Esopus Creek in Ultser County, and further extends to the Ashokan Reservoir of the New York City water supply watershed. Surrounded by Sheridan, Little Rocky, Tremper, Carl, Olderbark, Plateau, Hunter and Westkill Mountains, the Stony Clove Creek is typical of mountain streams. In Greene County, this Creek flows through the Town of Hunter.

  The Stony Clove Creek often experiences problems with flooding, water quality, recreation and human activities. Steep slopes, poorly drained soils, glacial geology and rainfall patterns are only a few factors which influence the Stony Clove Creek (GCSWCD, Date Unknown). Approximately 80-percent of the Stony Clove Creek watershed falls in Greene County. Precipitation in the mountains that surround the Stony Clove Creek watershed range between 50 and 60 inches each year, which is high even for the Catskills, and often comes in dramatic summer downbursts or late winter rain-on-snow events. Average slope of the watershed is 36.4-percent, the highest of any sub-basin in the New York City water supply watershed. Given the average drainage density, combined with steep slopes and high precipitation, the stream system is relatively flashy. These conditions within the Stony Clove Creek watershed led to the preparation of an SMP in February 2004, which documents current and historical conditions in the stream and offers recommendations for improving the Stony Clove Creek's stability, fisheries, and water quality, as well as reducing flood damage (GCSWCD, 2004). One section of Stony Clove Creek in need of stabilization as a result of severe streambank erosion was identified in the Hamlet of Lanesville in the Town of Hunter. Over 1,700 linear feet of the Stony Clove Creek within Lanesville was repeatedly modified from its natural condition, in response to damaging flood events. As a result, water quality was threatened; sediment transport through the reach was in a state of disequilibrium; and reaches both upstream and down stream of the project reach have been impacted by the instabilities. These conditions led the development and initiation of

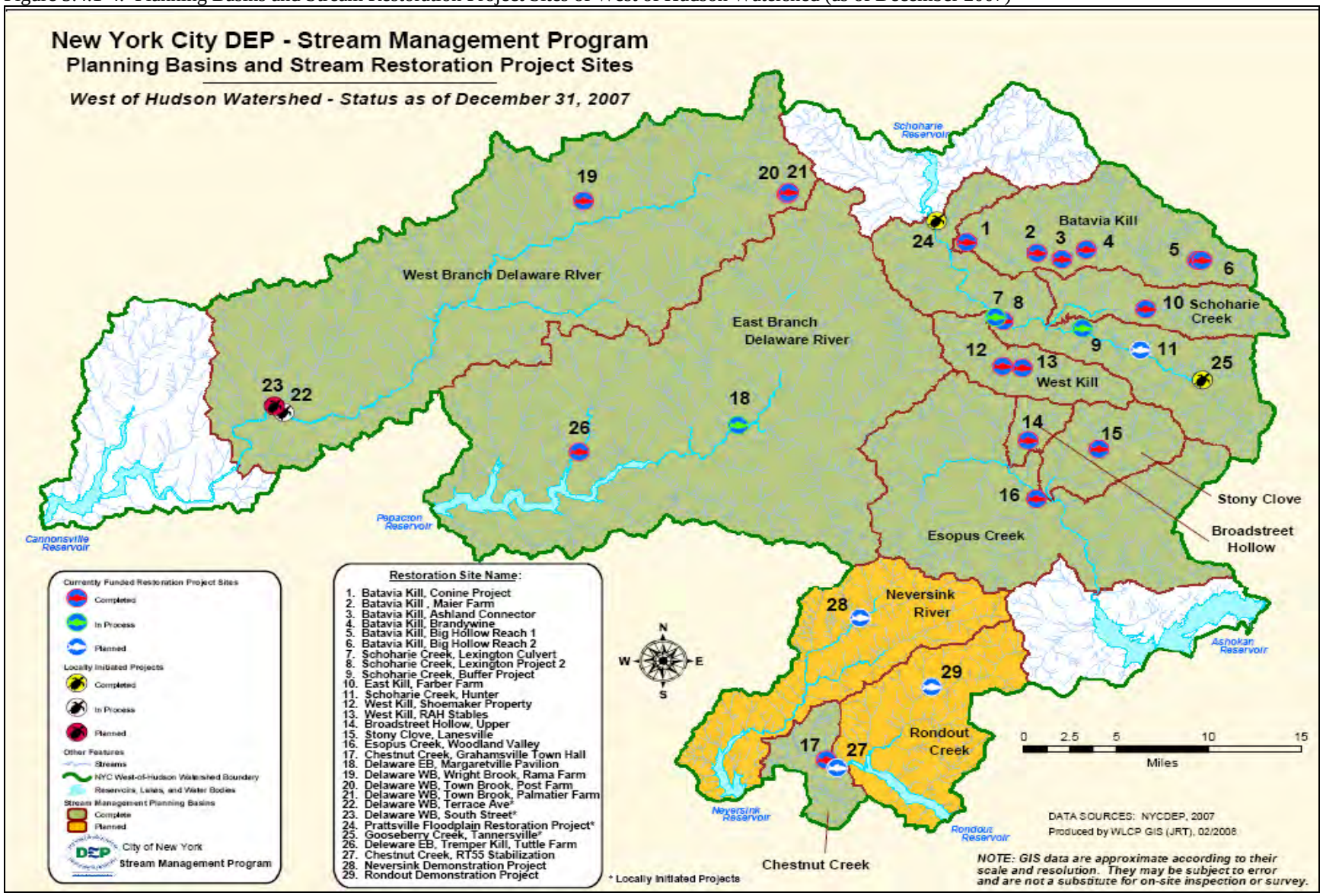
Lanesville Stream Stabilization Project in July 2003. As of December 2007, the NYSDEC indicates that this project has been completed (GCSWCD, 2003).

- The Broadstreet Hollow Stream is located in the Town of Lexington (Greene County) and is also a tributary to the Esopus Creek and a contributing sub-basin to the Ashokan Reservoir. Flooding within the Stream is primarily documented within a 1,100 foot section of the stream channel, adjacent to Broadstreet Hollow Road in the Town of Lexington. Broadstreet Hollow Road is located approximately two miles west of Phonecia (Ulster County) and a quarter mile east of the New York City portal exit of the Shandaken Tunnel. During a January 1996 flood event, an isolated area of the Broadstreet Hollow Stream experienced severe instability, resulting in over thirty feet of lateral erosion. The erosion caused structural damage to one home and threatened several other structures in the area. As a result, the Natural Resources Conservation Service (NRCS), in partnership with the Town of Lexington, provided assistance under the Emergency Watershed Protection Program (EWP). Under the EWP, the streambank was rebuilt to the pre-flood position using stream channel sediment and 475 feet of streambank was stabilized using heavy rock riprap at a cost of $47,597. In September 1999, flood conditions associated with Tropical Storm Floyd further degraded the stream channel and causing various other damaging conditions. Since that time, the GCSWCD and NYCDEP reviewed the condition of the reach and a restoration project was considered and developed in 2000, and initiated in October 2001 known as the Broad Street Hollow Stream Restoration Project (completed in 2002). One of the objectives of this project was "to provide long term channel stabilization, to reduce property and structural damage, while maintaining the integrity and benefit of a naturally functioning channel and floodplain (GCSWCD, 2003)."
- The Catskill Creek watershed falls within the Towns of Catskill (Palenville and Leeds) and Cairo of Greene County. Catskill Creek is characterized by broad, well-defined floodplains which create flooding issues throughout several areas of the watershed. Development in the floodplain has been limited, and problems are primarily associated with flooding of several structures located in the 100-year floodplain west of the hamlet of Leeds in Catskill. In the Leeds area, there is an area of repetitive flooding which affects two to three homes and one to two commercial properties. Other areas of concern include West Main Street and Snake Road in the Village of Catskill, which experience reoccurring flooding with only four inches of rain (GCSWCD, 2008). In Cairo, there is a reoccurring flood problem at the County Office complex located in the floodplain of the Shingle Kill Creek. In January 1996 and September 1999, the Shingle Kill flooded the buildings basement and heating system. In the Palenville hamlet within the Town of Catskill, the Kaaterskill Creek floodwaters repeatedly impacted roadways and structures. This led to the development and implementation of the Kaaterskill Creek Flood Mitigation Project (Lower Hudson Coalition of Conservation Districts, 2001-2002).
- The Coxsackie Creek watershed falls within the Towns of Coxsackie and New Baltimore of Greene County. This is a low-gradient stream with frequent flooding, primarily associated with stormwater runoff attributed to increasing imperviousness in the watershed. During extremely high tides, which occur when stream flow is also high, the Coxsackie Creek may flood over a small, low section of the roadway in the area near the confluence with the Hudson River. The steeper, western sections of the watershed have also experienced some flooding problems in the past. The stream crossing over the Climax Creek, just downstream from the point where it flows under the thruways, was damaged in the January 1996 flood event. On occasion, a short section of County Route 9 is frequently closed due to high flows, which cover the roadway (Lower Hudson Coalition of Conservation Districts, 2001-2002).

As of December 31, 2007, 17 stabilization and restoration projects in Greene County have been either planned, are in the process of or have been completed by the NYCDEP's Stream Management Program as a result of continued degradation from flood and severe storm events. As provided to the GCSWCD by

the NYCDEP, Figure 5.4.1-4 presents the location and status of these projects throughout the various sub-basins within the County. The scope of the map is the entire West of Hudson New York City drinking watershed. The projects on the map that were performed in and by Greene County are projects labeled 1 through 15, 24 and 25 (NYCDEP, 2007). Some of these projects have been briefly discussed previously within this hazard profile.

Figure 5.4.1-4. Planning Basins and Stream Restoration Project Sites of West of Hudson Watershed (as of December 2007)



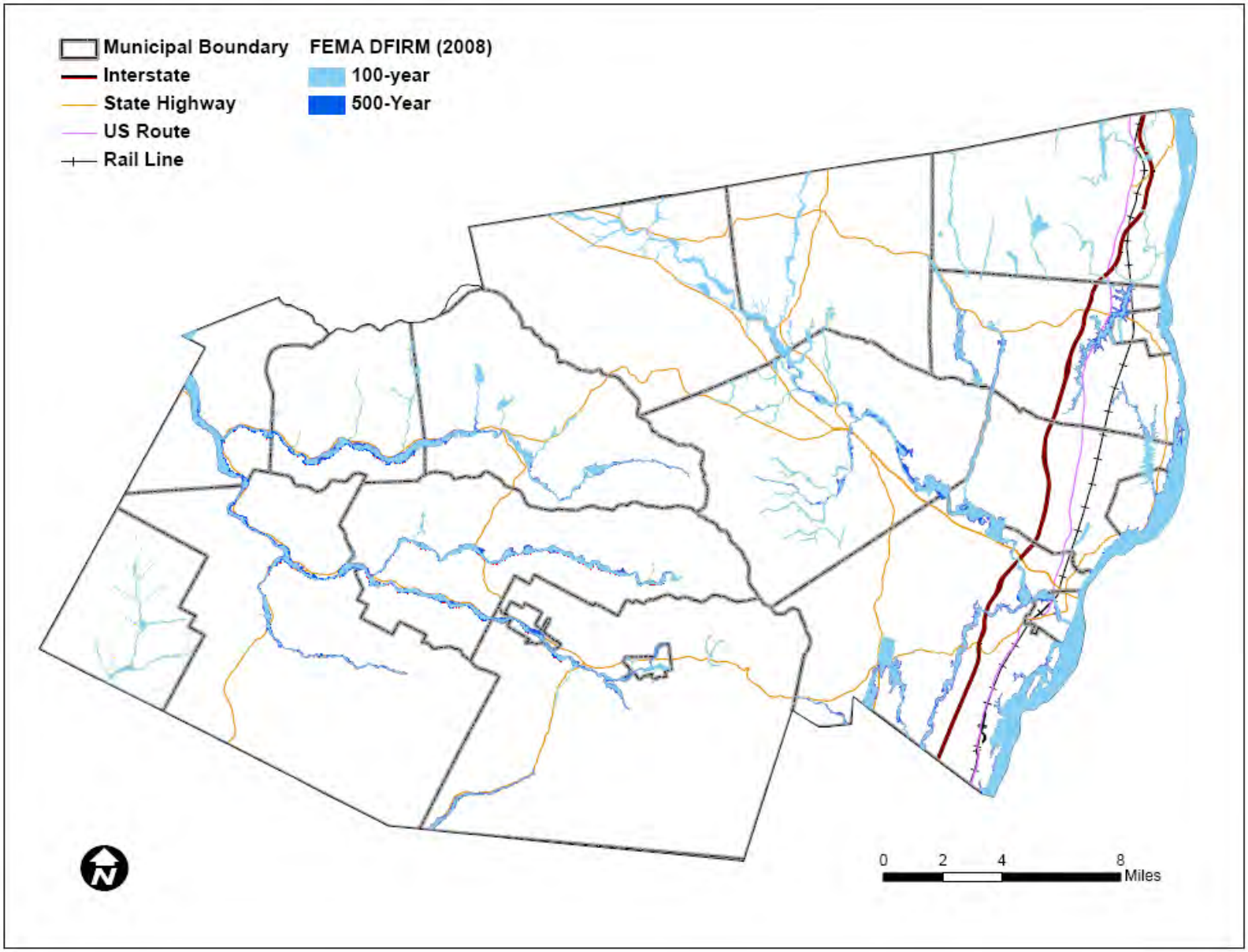
Source: NYCDEP, 2007

Federal Emergency Management Agency (FEMA) Flood Hazard Areas

According to FEMA, flood hazard areas are defined as areas that are shown to be inundated by a flood of a given magnitude on a map. These areas are determined using statistical analyses of records of riverflow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on FEMA's Flood Insurance Rate Maps (FIRM), which are official maps of a community on which the Federal Insurance and Mitigation Administration has delineated both the Special Flood Hazard Areas (SFHA) and the risk premium zones applicable to the community. These maps identify the SFHAs; the location of a specific property in relation to the SFHA; the base (100-year) flood elevation (BFE) at a specific site; the magnitude of flood a flood hazard in a specific area; the undeveloped coastal barriers where flood insurance is not available and locates regulatory floodways and floodplain boundaries (100-year and 500-year floodplain boundaries) (FEMA, 2003; FEMA, 2004; FEMA, 2006; FEMA, 2006).

The land area covered by the floodwaters of the base flood is the SFHA on a FIRM. It is the area where the National Flood Insurance Programs (NFIP) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. The SFHA includes Zones A, AO, AH, A1-30, AE, A99, AR, AR/A1-30, AR/AE, AR/AO, AR/AH, AR/A, VO, V1-30, VE, and V. (FEMA, 2007). This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities since many communities have maps showing the extent of the base flood and likely depths that will be experienced. The base flood is often referred to as the "100-year" flood designation. The BFE on a FIRM is the elevation of a base flood event, or a flood which has a 1-percent chance of occurring in any given year as defined by the NFIP. The BFE describes the exact elevation of the water that will result from a given discharge level, which is one of the most important factors used in estimating the potential damage to occur in a given area. A structure located within a 100-year floodplain has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage. The 100-year flood is a regulatory standard used by Federal agencies and most states, to administer floodplain management programs. The 100-year flood is used by the NFIP as the basis for insurance requirements nationwide. FIRMs also depicts 500-year flood designations, which is a boundary of the flood that has a 0.2-percent chance of being equaled or exceeded in any given year (FEMA, 2003; FEMA, 2006). FEMA partnered with the NYSDEC to update all FIRMs and Digitial FIRMS (DFIRMS) for Greene County as a part of a nationwide FEMA Map Modernization Program. These maps were completed and adopted on May 16, 2008 (FEMA, 2008; Goswami, 2008; Fidelity National Information Services, 2008). Figure 5.4.1-5 illustrates the regulatory FEMA 100-year and 500-year flood zones for the County.

Figure 5.4.1-5. FEMA DFIRM 100- and 500-Year Regulatory Floodplains within Greene County



Source: FEMA DFIRM, 2008

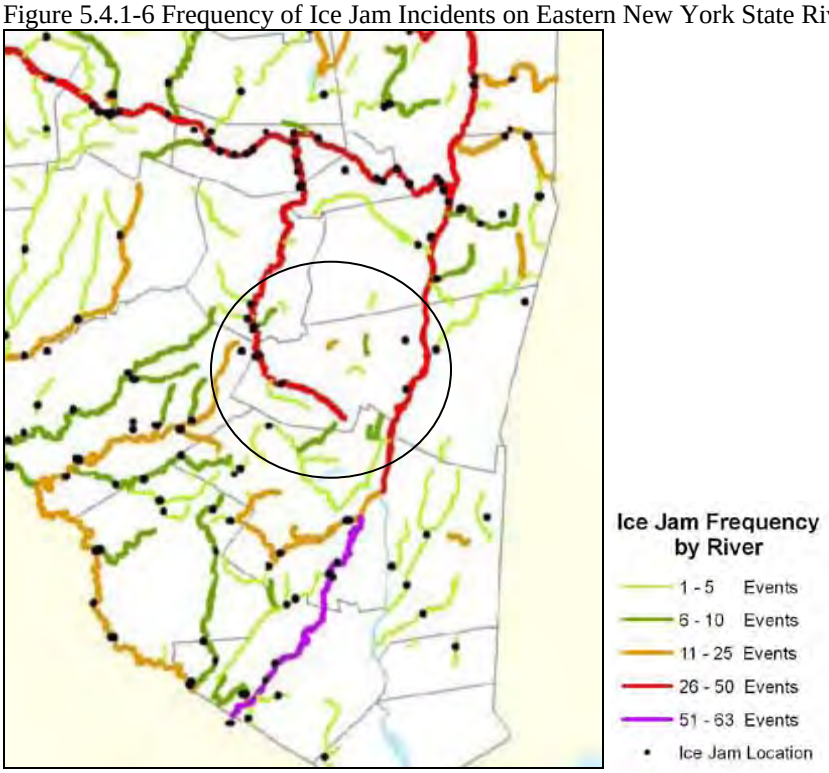
In addition to FIRM and DFIRMs, FEMA also provides Flood Insurance Studies (FISs) for entire counties and individual jurisdictions. These studies aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. They are narrative reports of countywide flood hazards, including descriptions of the flood areas studied and the engineered methods used, principal flood problems, flood protection measures and graphic profiles of the flood sources (FEMA, Date Unknown). The countywide FIS for Greene County were originally completed between the 1970s and 1980s; however, the FIS for the County was updated and became effective on May 16, 2008, in conjunction with the FIRMs, as a part of FEMA's Flood Map Modernization program. Currently, single jurisdictional FISs have not been completed for the County.

According to the 2008 County FIS, flooding can occur in any month of the year throughout Greene County. However, the majority of the larger floods have occurred in late winter and early spring, when snowmelt adds to heavy spring rains to produce increased runoff. Summer and fall floods also occur due to hurricane activity. As previously stated, the Schoharie Creek and Esopus Creek Watersheds are located within the County. Major flooding has historically occurred within the floodplains of these watersheds, particularly between 1938 and 2008. The effective FISs for the towns and villages within Greene County along Schoharie Creek all indicated major flooding events within the Schoharie Creek watershed in September 1938, October 1955, September 1960 (Hurricane Donna), June 1972 (Hurricane Agnes), March 1980, April 1987, January 1996 and September 1999 (Tropical Storm Floyd) (FEMA, 2008). Specific flood prone areas throughout the Towns and Villages of the County were not made available through the review of this FIS.

Ice Jam Hazard Areas

Ice jams are common in the Northeast U.S. and New York State is not an exception. In fact, according to the USACE, New York State ranks second in the country for total number of ice jam events, with over 1,435 incidents documented between February 1, 1867 and March 16, 2007. Areas of New York State that include characteristics lending to ice jam flooding include the northern counties of the Finger Lakes region and far western New York State, the Mohawk Valley of Central and eastern New York State and the North Country. Of the many streams, creeks and rivers that extend through the State, the Schoharie Creek and Hudson River (which travel through and along the eastern border of Greene County) are two of the top ten rivers within the State experiencing the most amounts of ice jams between 1875 and 2007. Figure 5.4.1-6 presents the frequency of ice jam incidences within the vicinity of Schoharie Creek and Hudson River. The Schoharie Creek has experienced over 47 ice jams and the Hudson River has experienced over 36 ice jams. Other leading rivers within the State include the Cazenovia Creek (63 incidences), Genessee River (55 incidences), Great Chazy River (54 incidences), Wallkill River (52 incidences) and the Mohawk River (48 incidences) (NYSDPC, 2008).

Figure 5.4.1-6 Frequency of Ice Jam Incidents on Eastern New York State Rivers (1875 – 2007)



Source: NYSDPC, 2008
Note (1): Circle indicates location of Greene County
Note (2): This map displays the number of instances a river was referenced as being the location for an ice jam in the USACE Cold Regions Research and Engineering Laboratory (CRREL) database.
Note (3): Multiple instances of ice jams can be associated to a single point location.

The Ice Jam Database, maintained by the Ice Engineering Group at the USACE Cold Regions Research and Engineering Laboratory (CRREL), currently consists of approximately 15,000 records from across the U.S. According to the USACE-CRREL and the NYS HMP, Greene County experienced approximately 31 historic ice jam events, mostly along the Schoharie Creek within the vicinity of Prattsville, between 1936 and 2007 (Ice Engineering Research Group, Date Unknown; NYSDPC, 2008). Historical events and their locations are further discussed in the "Previous Occurrences" section of this hazard profile.

Dam Break Hazard Areas

According to the NYSDEC Division of Water Bureau of Flood Protection and Dam Safety, the hazard classification of a dam is assigned according to the potential impacts of a dam failure pursuant to 6 NYCRR Part 673.3. Dams are classified in terms of potential for downstream damage if the dam were to fail. These hazard classifications are identified and defined below:

- *Low Hazard (Class A)* is a dam located in an area where failure will damage nothing more than isolated buildings, undeveloped lands, or township or county roads and/or will cause no significant economic loss or serious environmental damage. Failure or misoperation would result in no probable loss of human life. Losses are principally limited to the owner's property
- *Intermediate Hazard (Class B)* is a dam located in an area where failure may damage isolated homes, main highways, minor railroads, interrupt the use of relatively important public utilities, and/or will cause significant economic loss or serious environmental damage. Failure or

misoperation would result in no probable loss of human life, but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

- *High Hazard (Class C)* is a dam located in an area where failure may cause loss of human life, serious damage to homes, industrial or commercial buildings, important public utilities, main highways or railroads and/or will cause extensive economic loss. This is a downstream hazard classification for dams in which more than 6 lives would be in jeopardy and excessive economic loss (urban area including extensive community, industry, agriculture, or outstanding natural resources) would occur as a direct result of dam failure (NYSDEC, 2006).

According to information provided by the NYSDEC, GCSWCD and the Dam Incident Notification (DIN) system maintained by the National Performance of Dam Program (NPDP) there are 89 dams throughout Greene County. However, only eight dams within the County are labeled as Class C (high hazard) dams and 11 are classified as Class B (intermediate hazard). All other dams within the County are either a low hazard or have not been officially constructed (Albert, 2008; NYSDPC, 2008; USACE, Date Unknown; Department of Civil and Environmental Engineering [DCEE], Date Unknown). Refer to Table 4-X and Figure 4-X in the County Profile (Section 4.0) for dams located in Greene County.

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with flooding throughout New York State and Greene County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

Between 1953 and 2008, FEMA declared that New York State experienced over 36 flood-related disasters classified as one or a combination of the following disaster types: flooding, heavy rains, severe storms, coastal storms or high tides (FEMA, 2008). Of those events, the NYS HMP and FEMA indicates that Greene County has been declared as a disaster area as a result of 10 flood events between 1953 and August 2007, four of which took place between 2004 and 2007 (FEMA, 2008; NYSDPC, 2008).

Table 5.4.1-3 summarizes the FEMA Presidential Disaster (DR) or Emergency (EM) Declarations for flood events in Greene County. Many of these federal disasters were associated with a severe storm or tropical or extra tropical disturbance (hurricanes, tropical storms, Nor'Easters) either passing over or located within proximity to the State. These disasters resulted in flooding in the County, hence the reason for the occasional categorization by FEMA as "severe storms and flooding" event. Because flooding was the primary impact of many of these types of hazard events, only the severe flooding impact of major events are discussed in this Hazard Profile and are also mentioned in their designated sections of this HMP: Section 5.4.2 (Severe Storm) and Section 5.4.3 (Severe Winter Storm).

Table 5.4.1-3. Presidential Disaster Declarations for Flooding Events in Greene County (9 Declarations)

Type of Event*	Date**	Declaration Number	Cost of Losses (approximate)
Hurricane / Floods	August 1955	DR-45	New York State experienced property damage, road closures, 4 deaths, and damages in the millions (NYSDPC). The Schoharie Creek at Prattsville had a water discharge of 25,100 cfs. This event was also considered a major flood event in the Batavia Kill watershed. Losses in Greene County are unknown.

Type of Event*	Date**	Declaration Number	Cost of Losses (approximate)
Flood	October 1955	DR-52	New York State experienced approximately $11 M in damages (NYSDPC) as a result of flooding. The Schoharie Creek at Prattsville had a water discharge of 51,600 cfs and crested to 19.14 feet (7.14 feet above 12-foot flood stage). This event was also considered a major flood event in the Batavia Kill watershed and East Kill watershed. This event was a recorded peak event for the East Kill near Jewett Center, cresting 15.6 feet. Losses in Greene County are unknown.
Flooding	April 1987	DR-792	New York State experienced approximately $65 M in damages (USGS). The Schoharie Creek at Prattsville had a water discharge of 47,600 cfs and crested to 18.37 feet (6.37 feet above 12-foot flood stage). This event was a recorded peak event for the East Kill near Jewett Center, cresting 15.68 feet. This event also caused significant damages in the Batavia Kill watershed. The West Kill watershed in Greene, suffered nearly $2 M in damages to public infrastructure. Melodywood Condominiums in the Village of Hunter suffered extensive damage along its streambank from this event.
Severe Storms and Flooding	January 1996	DR-1095	New York State experienced between $100 and $160 M in eligible damages, road closures, closed businesses, and 10 deaths (NYSDPC and GCSWCD). New York State received $16.7 M in individual assistance and $103.7 M in public assistance. In Greene County, this event was the most widespread and devastating flooding since October 1955. NOAA-NCDC and SHELDUS indicate that Greene County experienced approximately $10 M in flood damages. USGS indicated, through information provided by FEMA, that Greene County received approximately $916 K in individual disaster aid and $4.4 M in public assistance (1997 USD). This event was the flood on record along the Schoharie Creek in Prattsville (the highest flood ever documented since 1904). Schoharie Creek reached its highest stage at 19.4 feet (7.4 feet above 12-foot flood stage) with peak flows of 52,800 cfs, reaching its 100-year flood stage and causing “disastrous” flooding (GCSWCD, 2007). Also, this event was a recorded peak event for the East Kill near Jewett Center, cresting 17.00 feet. In Greene County, the flooding from this event washed out multiple roads; caused significant damage to residential and commercial properties, sewer treatment plants, water systems, marinas and parks; and created the need for many evacuations (NCDC). Melodywood Condominiums, along the Schoharie Creek in the Village of Hunter, suffered extreme streambank failure from this event, with the immediate safety of the structure and additional adjoining properties threatened. As indicated by the GCSWCD, this flood event led to a preparation and initiation of a series of flood hazard mitigation and stream restoration projects throughout Greene County, particularly along Schoharie Creek, West Kill, Batavia Kill, East Kill and Stony Clove Creek (see further detail below).
Hurricane / Tropical Storm Floyd	September 1999	DR-1296	New York State experienced approximately $62.2 M in eligible damages as a result of property damage and debris accumulation (NYSDPC). NOAA-NCDC and SHELDUS indicate that Greene County experienced approximately $3 M in flood damages. As of December 6, 1999, FEMA indicated that Greene County was approved for over $121 K in public assistance. In Cairo, 12.21 inches of rainfall was recorded (the most associated with the storm). The Schoharie Creek at Prattsville had a water discharge of 42,800 cfs and crested to 17.64 feet (5.64 feet above 12-foot flood stage). This event created unstable conditions along many rivers and streams throughout the County and exacerbated the instability and degradation that was initially created during the January 1996 flood.

Type of Event*	Date**	Declaration Number	Cost of Losses (approximate)
Severe Storms	May - September 2000	DR-1335	New York State experienced approximately $34.6 M in eligible damages (NYSDPC). NOAA-NCDC and SHELDUS indicate that Greene County experienced nearly $115 K in flood damages from all storms that occurred during this time period (particularly from a Nor'Easter on June 6, 2000).
Severe Storms, Tornadoes and Flooding	July-August 2003	DR-1486	New York State experienced approximately $23 M in eligible damages as a result of property damages and road closures (NYSDPC). More than $5.3 M in disaster aid was approved for the State. NOAA-NCDC and SHELDUS indicated that Greene County experienced nearly $75 K in flood damages, particularly in Catskill and Athens.
Severe Storms and Flooding	April 2005	DR-1589	New York State experienced approximately $66.2 M in eligible damages (NYSDPC). NOAA-NCDC and SHELDUS indicated that Greene County experienced approximately $1.3 M in flood damages. The floodwaters overflowed creeks and tributaries, uprooted trees, destroyed roadways and many private properties and created the need for a few evacuations in Leeds. Over 40 roads throughout the County were closed. Many homes and businesses suffered significant damage, particularly in and around Tannersville and Jewett. As of September 14, 2005, more than $34.9 M in disaster aid has been approved for the State. The Greene County Department of Emergency Services indicated that as of June 1, 2005, FEMA approved over $2.2 M in public assistance reimbursements for various restoration and mitigation project costs generated as a result of flood damages during this event; particularly in the Towns of Hunter, Jewett and Tannersville. However, the September 14, 2005 press release indicated that FEMA only approved $1.1M in public assistance reimbursements to the County, for the Towns of Cairo, Coxsackie, Durham, Greenville, Halcott, Hunter, Jewett, Lexington, New Baltimore, Prattsville and Windham; the Villages of Catskill, Hunter and Tannersville; and the East Durham, Lexington and Palenville fire departments.
Severe Storms and Flooding	June / July 2006	DR-1650	This event was the largest and most costly natural disaster that New York State encountered since Hurricane Agnes in 1972. Resulted in a Disaster Declaration for 19 New York State counties (DR-1650). New York State experienced approximately $246.3 M in eligible damages (NYSDPC). As of December 29, 2006, more than $227 M in disaster aid was approved for the State. The Greene County Department of Emergency Services indicated that as of August 25, 2006, FEMA approved over $609 K in public assistance reimbursements for various restoration and mitigation project costs generated as a result of flood damages during this event; particularly in the Towns of Catskill and Greenville. Greene County received between 3 and 8 inches of rain from this event. Law enforcement personnel reported that several roads in Greene County were closed in and near the Towns of Catskill, Cairo and Haines Falls due to flooding. Part of Route 23-A remained closed between Palenville and Haines Falls, where a retaining wall gave way.

Type of Event*	Date**	Declaration Number	Cost of Losses (approximate)
Severe Storms and Inland and Coastal Flooding (also identified as a Nor'Easter)	April 2007	DR-1692	New York State experienced between $12.8 and $60 M in eligible damages (NYSDPC; Alarcon-The Daily Mail). The Greene County Department of Emergency Services indicated that preliminary storm damage totals eligible for federal public assistance for the County totaled approximately $472 K, with the Town of Cairo and Village of Catskill experiencing the most losses. Preliminary storm damage totals for individual assistance in the County totaled $111 M, with the Town/Village of Catskill experienced the most losses, totaling $110 M (These figures may be inaccurate). Individual assistance losses to the County were denied by FEMA. Other sources indicate that final losses eligible for public assistance were estimated at $1.3 M as a result of damage, response and debris removal costs throughout the County. Final losses to homeowners were tallied at $547 K (Alarcon – The Daily Mail). At the current time, it is unclear which loss estimated is correct. More than $61 M in Federal disaster aid has been approved for the State. As of July 11, 2007, public assistance to Greene County totaled $58 K. The latest public assistance details were not made available through the materials reviewed for this plan. The Schoharie Creek at Prattsville crested to 12.98 feet (.98 feet above 12-foot flood stage). The Catskill Creek in the Town of Catskill experienced continued stream bank erosion and migration from this event, which would cost an estimated $1 M to $1.5 M to restore if funding was available. Additionally, a landslide occurred along Warren Stein Road in Cairo.

Source(s): FEMA, 2008; NYSDPC, 2008; Hazards & Vulnerability Research Institute (SHELDUS), 2008; NCDC, 2008; NYSEMO, 2006; Greene County Department of Emergency Services

* The 'Type of Event' is the disaster classification that was assigned to the event by FEMA.

** Represents the date of the event

Note (1): Flood stage for the Schoharie Creek at Prattsville is considered by the NWS to be at 12 feet on the gage, which corresponds to approximately 18,000 cubic feet per second (cfs). At 14 feet (roughly 26,000 cfs), the creek begins to overflow onto Main Street (Rte. 23), and 18 feet (over 45,500 cfs) is considered severe flooding.

Note (2): Dollars rounded to nearest thousand. Recorded losses indicate the dollar value of covered losses paid, as available through the public records reviewed. Some of these events overlap with events shown under the Severe Storm and Severe Winter Storm hazard profiles of this Plan.

K = Thousand

M = Million

USD = U.S. Dollars

As part of the USGS's program for disseminating water data within USGS, to USGS cooperators, and to the general public, the USGS maintains a distributed network of computers and fileservers for the acquisition, processing, review, and long-term storage of water data. This network of computers is called the National Water Information System (NWIS) and the data is continuously collected at over 1.5 million sites, also known as stream flow stations or gages, around the country and at some border and territorial sites. Many types of data are stored in NWIS, including comprehensive information for site characteristics, well-construction details, time-series data for gage height, streamflow, ground-water level, precipitation, and physical and chemical properties of water. Additionally, peak stream flows, chemical analyses for discrete samples of water, sediment, and biological media are accessible within NWIS (USGS, 2008).

The Greene County network consists of 17 stream flow stations; with each station having different periods of record up to 2006 (USGS, 2008). One of the oldest stations in the County, located on the Schoharie Creek at Prattsville, has recorded 96 years of stream flow data, and is frequently used to study stream hydrology in the contributing sub-basins (GCSWCD, 2003). For the purpose of this HMP, the peak stream flows of each of these stations during their period of record were reviewed to identify the record peak events at those stations. Peak flow data identifies the *annual flood* or largest flood with the highest maximum instantaneous peak streamflow (or discharge) and gage height for a given station of

each water year. These records indicate that the most prominent events that have impacted the stations of the County appear to have occurred in September 1960, April 1987, January 1996, and September 1999 and April 2005. Table 5.4.1-4 below lists the peak stream flows for Greene County.

Table 5.4.1-4. USGS Peak Stream Flows for Greene County

USGS Station ID	USGS Station Name	Period of Record				Record Peak(s)	
		Begin Date	End Date	Daily Average Discharge (Cubic Feet / Second) (approx. range) [1]	Total Peak Events	Event Date	Peak Discharge (Cubic Feet / Second)
1349541	Sugarloaf Brook south of Tannersville	9/16/1999	6/26/2006	1 - 18	8	6/26/2006	761
1349700	East Kill near Jewett Center	3/31/1951	11/30/2005	10 - 300	22	1/19/1996	13,500
1349705	Schoharie Creek near Lexington	9/16/1999	11/30/2005	90 - 1,000	8	9/16/1999	23,000
1349711	West Kill Below Hunter Brook near Spruceton	6/14/1998	11/30/2005	3 - 60	9	9/16/1999	2,080
1349810	West Kill near West Kill	1/19/1996	6/28/2006	10 - 200	10	1/19/1996	6,500
1349840	Batavia Kill near Maplecrest	6/14/1998	6/26/2006	1 - 20	9	9/16/1999	800
1349850	Batavia Kill near Hensonville	8/13/1955	11/30/2005	NA	30	8/13/1955 and 9/12/1960	5,000
1349900	Batavia Kill near Ashland	4/4/1987	6/28/2006	4 - 500	16	9/16/1999	15,000
1349920	Batavia Kill at Ashland	10/16/1955	12/21/1973	NA	8	9/12/1960	24,000
1349950	Batavia Kill at Red Falls near Prattsville	1/19/1996	6/28/2006	10 - 500	10	9/17/1999	16,400
1350000	Schoharie Creek in Prattsville	10/9/1903	11/30/2005	200 - 1,000	98	1/19/1996	52,800
1359924	Hannacroix Creek near New Baltimore	5/30/1968	9/16/1999	1 - 400	12	6/9/1996	3,700
1361500	Catskill Creek near Oak Hill	6/13/1911	6/26/2006	5 - 550	88	4/4/1987	15,400
1361570	Tenmile Creek at Oak Hill	9/12/1960	4/4/1987	1 - 300	13	3/21/1980	3,800
1361900	Shingle Kill at Cairo	12/11/1952	9/16/1999	NA	26	3/21/1980	3,600
1362000	Catskill Creek near South Cairo	9/29/1902	3/27/1906	20 – 3,000	5	10/9/1903	25,000
1362342	Hollow Tree Brook at Lanesville	6/14/1998	11/30/2005	1 - 30	9	4/2/2005	306

Source: USGS, 2008

Note (1): Daily average discharge is the daily mean discharge amount for the period of record based on surface-water daily statistics provided by the USGS data for each station. A constant discharge amount is not assigned to an individual station since stream flow is always changing.

Based on all sources researched, many flood events have impacted Greene County, as summarized in Table 5.4.1-5. With flood documentation for the State being so extensive, not all sources may have been identified or researched. Hence, Table 5.4.1-5 may not include all events that have occurred throughout the region. Only one potential dam failure or scare was documented for the County; therefore, this one incident is included in this table. This summary table does not include ice jam events which are listed separately in Table 5.4.1-6.

Table 5.4.1-5. Flooding Events between 1839 and 2007

Event Date / Name	Location	Losses / Impacts	Source(s)
Flood January 31, 1839	Multi-County	A tannery, saw mill and dam in Plattsville were lost. Also, a bridge was swept away, and a grist mill was carried off.	Zimmer
Flood 1869	Batavia Kill Watershed (Windham)	Flooding reported in the Town of Windham.	GCSWCD
Flood June 14, 1874	Prattsville, Windham	A damaging flooding in Prattsville carried away houses and destroyed many other properties. One woman drowned from the floodwaters. This was also a flood on record for the Town of Windham.	NY Times, GCSWCD
Flood 1885	Batavia Kill Watershed (Windham)	Flooding reported in the Town of Windham.	GCSWCD
Flood 1893	Batavia Kill Watershed (Windham)	A crowd of people gathered on the Church St. bridge in Windham to watch the waters of the Batavia Kill rise. The bridge was swept away when a tree struck it, along with the people on it. Most of the people made it safely to shore, but one woman drowned.	GCSWCD
Flood / Ice Jam March 1-2, 1896	Hudson River (Coxsackie, Athens, New Baltimore)	Heavy ice flowing down Hudson River crushed in many buildings within New Baltimore. The loss was reported to be great. Ice harvesting companies were significantly impacted by the floods and ice of this event.	NY Times
Flood October 8-9, 1903	Countywide	Reportedly reached a higher crest stage than the 1936 or 1938 floods. Schoharie Creek at Prattsville had a water discharge of 28,000 cfs from this flood event.	USGS
Flood* September 30, 1924	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville had a water discharge of 29,000 cfs from this flood event.	GCSWCD
Flood* November 16, 1926	Schoharie Creek (Prattsville), Batavia Kill (Windham)	Schoharie Creek at Prattsville had a water discharge of 42,300 cfs from this flood event. Flooding reported in the Town of Windham.	GCSWCD
Flood* August 24, 1933	Schoharie Creek (Prattsville), Batavia Kill (Windham)	Schoharie Creek at Prattsville had a water discharge of 39,000 cfs and crested 18.33 feet (6.33 feet above 12-foot flood stage) from this flood event. Flooding reported in the Town of Windham in the Batavia Kill Watershed.	GCSWCD, AHPS
Flood* March 3, 1934	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville had a water discharge of 50,002 cfs from this flood event.	GCSWCD
Flood*	Multi-State	Schoharie Creek at Prattsville had a water discharge of 27,400 cfs from this flood	NWS, GCSWCD

Event Date / Name	Location	Losses / Impacts	Source(s)
July 6-10, 1935		event.	
Flood* March 18-20, 1936	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville had a water discharge of 38,500 cfs and crested 17.44 feet (5.44 feet above 12-foot flood stage) from this flood event.	AHPS, USGS, GSCWCD, NYSDPC
Flood* February 22, 1937	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville had a water discharge of 29,800 cfs from this flood event.	GCSWCD
Flood* September 21-22, 1938 (Remnants of Tropical Storm)	Multi-State	Schoharie Creek at Prattsville had a water discharge of 45,000 cfs and crested 15.6 feet (3.6 feet above 12-foot flood stage) from this flood event. Flooding reported in the Town of Windham in the Batavia Kill Watershed.	USGS, FEMA, GCSWCD
Flood* November 25, 1950	Multi-County	This was a major flooding event recorded in the Batavia Kill and Schoharie Creek Watersheds. Schoharie Creek at Prattsville had a water discharge of 49,500 cfs and crested 15.5 feet (3.5 feet above 12-foot flood stage) from this flood event. Flooding reported in the Town of Windham in the Batavia Kill Watershed.	GCSWCD, SCS
Flood March 31, 1951	Multi-County (East Kill near Jewett)	East Kill near Jewett had a water discharge of 6,450 cfs and had a gage height of 8.92 feet.	USGS
Flood* December 11, 1952	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville had a water discharge of 28,200 cfs and crested 12.5 feet (.5 feet above 12-foot flood stage) from this flood event.	GCSWCD
Hurricane / Floods* August 12-19, 1955 (Remnants of Hurricane Diane) (FEMA DR-45)	Southeastern New York	See FEMA Disaster Declarations (Table 5.4.1-3)	NYSDPC, FEMA, USGS
Flood* October 16-17, 1955 (Remnants of Hurricane Katie) (FEMA DR-52)	Multi-County (Eastern Catskill and Lower Hudson Tributaries)	See FEMA Disaster Declarations (Table 5.4.1-3)	USGS, AHPS, FEMA FIS (1982 through 2002), NYSDPC
Flood* December 21, 1957	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville had a water discharge of 31,000 cfs and crested 15.37 feet (3.37 feet above 12-foot flood stage) from this flood event.	GCSWCD, USGS Real-Time Water Data
Flood* August 29, - September 14, 1960 (Remnants of Hurricane Donna)	Multi-State	In the Batavia Kill watershed this event was considered to be the most damaging on record, causing over $750 K in damages (1960 dollars) (GCSWCD). The storm resulted in damage to over 75 residences ($100 K), 27 businesses ($130 K) and state, county, and town roads ($425 K). In addition, damages occurred to the Windham Country Club, two churches, Windham Ashland School and utilities. During the event, seven bridges were lost in the Batavia Kill Watershed. The flood also contaminated the Windham water system resulting in a period of boil water advisory. In Ashland, Fire Chief Paul Alle was swept away by the rushing waters of the Batavia Kill. Also, the Schoharie Creek at Prattsville had a water discharge of 49,900 cfs and crested 18.35 feet (6.35 feet above 12-foot flood stage) from this flood event.	NYSDPC, GCSWCD, AHPS, USGS, FEMA

Event Date / Name	Location	Losses / Impacts	Source(s)
Flood February 2, 1970	Prattsville	Minor flooding resulting in $2 K in property damages.	NYSDPC, Hazards & Vulnerability Research Institute (SHELDUS)
Flood March 1972	Prattsville	No additional information made available for Greene County.	NYSDPC
Flood* June 20-22, 1972 (Remnants of Tropical Storm Agnes)	Multi-State	Resulted in a Disaster Declaration for 26 New York State counties (DR-338), however, it did not include Greene County. Greene County experienced approximately $806 K in property damages and crop damages. Schoharie Creek at Prattsville had a water discharge of 27,400 cfs and crested 13.95 feet (1.95 feet above 12-foot flood stage) from this flood event. This event was a recorded peak event for the East Kill near Jewett Center, cresting 15.27feet.	FEMA, Hazards & Vulnerability Research Institute (SHELDUS), NYSEMO History of Declarations, GCSWCD, USGS
Flood June 28, 1973	Countywide	Greene County experienced approximately $38 M in property damages from this event. However, no other sources indicate that Greene County was greatly impacted from this flood. Therefore, this monetary figure may be an error or inaccurate.	Hazards & Vulnerability Research Institute (SHELDUS)
Flood* December 21, 1973	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville had a water discharge of 24,900 cfs and crested 13.34 feet (1.34 feet above 12-foot flood stage) from this flood event. This event was a recorded peak event for the East Kill near Jewett Center, cresting 14.38 feet.	NYSDPC, GCSWCD, USGS
Flood* December 8, 1974	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville had a water discharge of 24,800 cfs from this flood event.	NYSDPC, GCSWCD
Flood July 1975	Multi-County	No additional information made available for Greene County.	NYSDPC
Flood February 1976	Multi-County	No additional information made available for Greene County.	NYSDPC
Flood* January 9, 1978	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville had a water discharge of 30,600 cfs and crested 14.71 feet (2.71 feet above 12-foot flood stage) from this flood event. USGS indicates that this flood was a result of an ice jam.	GCSWCD, USGS
Flood January 26, 1978	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville crested 19.50 feet	AHPS
Flood March 5, 1979	Schoharie Creek (Prattsville)	Schoharie Creek at Prattsville crested 19.57 feet USGS indicates that this flood was a result of an ice jam.	AHPS, USGS
Flood* March 21-22, 1980	Schoharie Creek (Prattsville), Batavia Kill (Windham)	Schoharie Creek at Prattsville had a water discharge of 39,600 cfs and crested 16.72 feet (4.72 feet above 12-foot flood stage) from this flood event. Flood on record for the Town of Windham in the Batavia Kill Watershed	AHPS, USGS, GCSWCD, FEMA
Flood December 12, 1983	Countywide	Greene County experienced approximately $227 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS)
Coastal Storms and Flood April 5-7, 1984	Multi-State	Resulted in a Disaster Declaration for 12 New York State counties (DR-702), however, it did not include Greene County. Schoharie Creek at Prattsville had a water discharge of 29,500 cfs from this flood event.	FEMA, NYSEMO, GCSWCD

Event Date / Name	Location	Losses / Impacts	Source(s)
Flood May 28, 1984	Countywide	Greene County experienced approximately $2.4 M in property damages and $2 K in crop damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS)
Flood March 14, 1986	Countywide	Greene County experienced approximately $238 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS)
Flood April 3-6, 1987 (FEMA DR-792)	Multi-County	See FEMA Disaster Declarations (Table 5.4.1-3)	FEMA, Lumia (USGS WRIR 97-4252), Zembrzuski and Evans (USGS WRIR 89-4084), NYSEMO, AHPS, Hazards & Vulnerability Research Institute (SHELDUS), USGS, New York State Floodplain and Stormwater Managers Association, GCSWCD
Flood March 29, 1993	Countywide	Greene County experienced between $50 K and 500 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Flood April 16, 1993	Countywide	Greene County experienced approximately $50 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Flood October 21, 1995	Countywide	Greene County experienced approximately $3 M in property damages from this event. Melodywood Condominiums in the Village of Hunter experienced severe damage from runoff generated from this event, making the structure extremely vulnerable to future floods.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC, GCSWCD
Wind/Heavy Rain/Flooding November 11-12, 1995	Countywide	Heavy rains of four to five inches resulted in flooding in parts of Greene County. Twenty to thirty county roads were closed. In Platte Cove along route 16 a bridge was washed out. Greene County experienced approximately $50 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Severe Storms and Flood January 18-20, 1996 (FEMA DR-1095) “Deluge of 1996”	Northeastern U.S.	See FEMA Disaster Declarations (Table 5.4.1-3)	FEMA, NOAA-NCDC, NYS HMP, NWS, Lumia (USGS WRIR 97-4252), Hazards & Vulnerability Research Institute (SHELDUS), NYSEMO, NYSDPC, GCSWCD, USGS New York State Floodplain and Stormwater Managers Association
Flood January 27, 1996	Countywide	Up to three inches of rain fell across parts of the Catskills. This amount of rainfall on already saturated soil brought many small streams out of their banks across Greene County which washed out several roads. The Schoharie Creek also flooded. Some of the damaged roads included route 296 from Hunter to	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC

Event Date / Name	Location	Losses / Impacts	Source(s)
		Tannersville, county route 2 in Lexington, route 32A and Pennsylvania Avenue in Palenville, route 23B in Cairo and route 385 in the village of Coxsackie. Greene County experienced approximately $300 K in property damages from this event.	
Flood June 9, 1996	New Baltimore (Hannacroix Creek)	Record flood/discharge event for Hannacroix Creek USGS station near New Baltmore.	USGS Real-Time Water Data
Flood July 13, 1996	New Baltimore / Windham	Greene County experienced approximately $30 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Flood October 20, 1996	Windham / West Kill	Rainfall totals in the Catskills averaged several inches, with 5.60 inches at East Jewitt in Greene County. The heavy rain produced flooding across parts of Greene and Ulster Counties and along the Schoharie Creek. In Greene County, several roads were flooded and closed. County route 21 in Windham and county route 26 in Greenville were closed. Local street flooding occurred in Windham, Oak Hill, Durham and Maplecrest. Three temporary bridges were damaged or destroyed. Two were located in West Kill, off county route 6 and the other was in Lanesville off state highway 214. Minor flooding also occurred along the Schoharie Creek in Greene County. Greene County experienced approximately $40 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Flood January 8-11, 1998	Countywide	Greene County experienced between $186 and $745 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Flood May 6, 1998	New Baltimore / Coxsackie	At the Hamlet of New Baltimore, Church Street was washed out and State Highway 144 was closed. Underpasses were flooded in Coxsackie along with many basements. Greene County experienced approximately $40 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Flood June 14-15, 1998	Countywide	In Greene County, flooding occurred in the Towns of Catskill and Greenville. In the Town of Catskill, the Kaaterskill Creek flooded several roads. In the Town of Greenville, county routes 37 and 35 were flooded by small streams. Across the western portion of the County the Schoharie Creek caused minor flooding. Greene County experienced approximately $25 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Flood March 22, 1999	Countywide	4 inches of precipitation fell across Ulster and Greene counties in less than a 12 hour interval. In Greene County the Catskill Creek overflowed and forced some people to be evacuated from their homes. Greene County experienced approximately $10 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Flood July 4, 1999	Halcott Center	Heavy rains from a thunderstorm cell measuring up to 4 inches washed out six town roads and a county road in the vicinity of Halcott, Greene county. Greene County experienced approximately $40 K in property damages from this event.	Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Flood (Remnants of Hurricane/Tropical Storm Floyd)	Multi-State	See FEMA Disaster Declarations (Table 5.4.1-3)	NYSDPC, GSCWCD, AHPS, USGS, Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC, New York State

Event Date / Name	Location	Losses / Impacts	Source(s)
September 19, 1999 (FEMA DR-1296)			Floodplain and Stormwater Managers Association
Severe Storms May 3, – September, 14, 2000 (FEMA DR-1335)	Statewide	See FEMA Disaster Declarations (Table 5.4.1-3)	Governor Pataki Press Release, FEMA, NYSDPC, NOAA-NCDC, Hazards & Vulnerability Research Institute (SHELDUS), NYSEMO
Flood December 16-17, 2000	Multi-County (Catskills)	Causing minor overflow of rivers and streams throughout Greene County. During this storm event, several of the cross vanes structures of the Broad Street Hollow Project were substantially damaged due to flooding and excessive plunge pool scour. Flooding was noted on roads in New Baltimore. The Catskill Creek overflowed its banks onto Route 32, in the Town of Greenville. Greene County experienced approximately $63 K in property damages from this event.	GCSWCD, USGS, Hazards & Vulnerability Research Institute (SHELDUS), NOAA-NCDC
Severe Storms, Tornadoes and Flood July-August 2003 (FEMA DR-1486)	Multi-County	See FEMA Disaster Declarations (Table 5.4.1-3)	FEMA, NOAA-NCDC, NWS, Hazards & Vulnerability Research Institute (SHELDUS), NYSEMO, USGS
Dam Scare September 15, 2004	Durham, Oak Hill	An unstable dam near Cochrane Farms south of Durham and Oak Hill caused a major evacuation of residents of two dozen homes, approximately 100 people. Erosion opened a drainage route around the dam's flow pipes, and water began surging out of the impoundment. Cochrane Road was temporarily flooded and homes along the potential floodwaters path and the downstream Catskills area were evacuated.	Planck - The Daily Mail
Flood (Remnants of Hurricane Ivan) September 18, 2004	Multi-County	Greene County suffered many road closures in Windham, Climax, Jewett, Catskill, Coxsackie, Leeds, Lexington, Prattsville, and Kiskatom. In Catskill, the Catskill Creek flooded Cauterskill Road, trapping a person in their car. Schoharie Creek at Prattsville had a water discharge of 26,500 cfs and crested 14.11 feet (2.11 feet above 12-foot flood stage) from this flood event. On the West Kill at the West Kill gage, storm flow responded to precipitation very rapidly, with streamflow increasing from about 150 cfs to nearly 3,000 cfs within 24 hours. The Batavia Kill exceeded its flood stage of 5.0 feet, cresting at 7.47 feet at the Red Falls gage. The Bear Kill exceeded its flood stage of 5.0 feet, cresting at 7.82 feet at the Prattsville gage. This storm was the highest recorded peak for this water year and one of the highest for the entire period of record at this location.	NOAA-NCDC, GCSWCD, USGS
Flood March 28, 2005	Countywide	In Cairo, 15 County Roads closed due to flooding. Eighteen Fire companies pumped out basements throughout county. Greene County experienced approximately $100 K in property damages.	NYSDPC, NCDC
Severe Storms and Flood April 2-4, 2005 (FEMA DR-1589)	Multi-State	See FEMA Disaster Declarations (Table 5.4.1-3)	NCDC, NWS, FEMA, NYSDPC, NOAA-NCDC, Hazards & Vulnerability Research Institute (SHELDUS), NYSEMO, GCSWCD, USGS,

Event Date / Name	Location	Losses / Impacts	Source(s)
			Greene County Department of Emergency Services, Travers (The Daily Mail), Earley (Daily Freeman)
Flood July 18, 2005	Catskill	Interstate 87 north and south bound lanes closed between mile marker 106 and 107 due to flooding. Washout at Embought and Route 9W. Pavement washed out and poles and wires down on Old Kings Road, south of Route 23A to the Ulster County line.	NOAA-NCDC
Flood (Remnants of Tropical Cyclone Tammy) October 7-9, 2005	Multi-County	Rainfall amounts in Greene County include: 7.63 inches in Catskill, 6.64 inches in East Jewett and 4.87 inches in Cairo.	NWS
Flood November 30, 2005	Multi-County (Schoharie Creek)	Schoharie Creek at Lexington had a water discharge of 13,900 cfs and a gage height of 11.9 feet from this flood event.	USGS
Flood January 18, 2006	Countywide	Flooding on the Schoharie Creek at Prattsville and Batavia Kill at Red Falls slightly exceeding their flood stage.	NOAA-NCDC
Severe Storms and Flood June 25 - July 10, 2006 (FEMA DR-1650)	Multi-State	See FEMA Disaster Declarations (Table 5.4.1-3)	FEMA, NOAA-NCDC, NWS, NYSEMO, NYSDPC, Eyewitness News, USGS, NEWS10, NOAA, Greene County Department of Emergency Services, Alarcon (The Daily Mail)
Severe Storms / Inland and Coastal Flood April 14-17, 2007** (also identified as a Nor'Easter) (FEMA DR-1692)	Multi-State	See FEMA Disaster Declarations (Table 5.4.1-3)	FEMA, USGS, Greene County Department of Emergency Services, Macko (The Daily Mail), Alarcon (The Daily Mail)
Flood June 19-20, 2007	Multi-County	A flash flood occurred the night of June 19-20 after 8 New York counties received up to 8 inches of rain in a matter of hours. Counties affected included Broome, Chenango, Delaware, Greene, Otsego, Schoharie, Sullivan and Ulster. The ensuing water washed out one bridge, damaged several other bridges and roads, incapacitated all landline and cellular communications and ripped homes from their foundations. The federal Small Business Administration (SBA) issued a physical disaster and economic injury declaration for homeowners, residents and businesses.	Spitzer

Note (1): This table does not represent all events that may have occurred throughout the County. NOAA/NCDC storm query indicated that Greene County has experienced 58 flood events between January 1, 1950 and January 31, 2008 (including flash floods). However, not all of these events were identified in this table due to a lack of detail and /or their minor impact upon the County.

Note (2): Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of inflation.

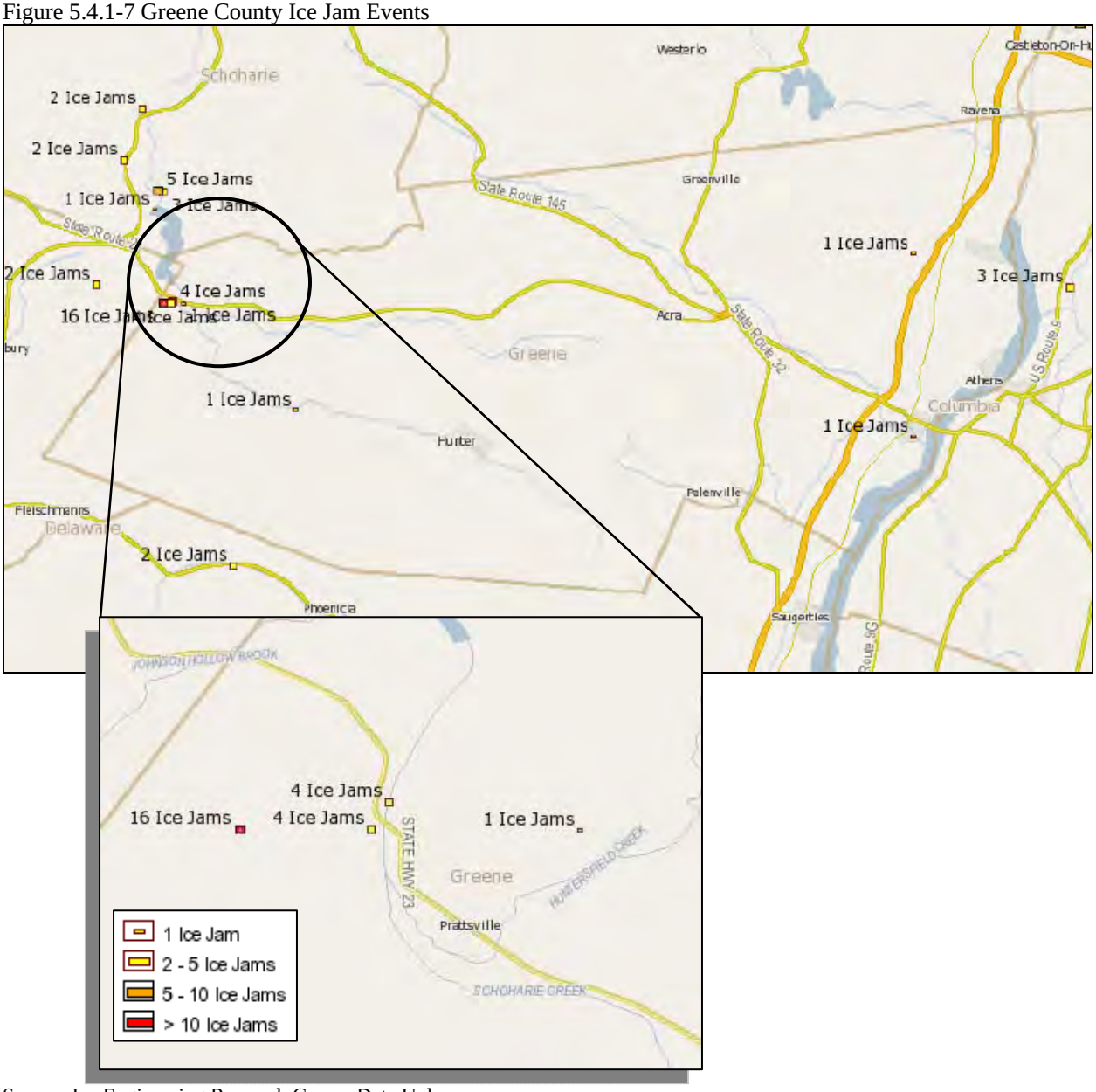
* Flood frequency statistics based on recorded peak flows through 1997. These events do not represent all flood events for this area. They are flood events recorded at the Schoharie Creek gage #01350000 that exceed a 5-year recurrence interval or return period, which is a flood with 20-percent chance of occurring or being exceeded in any single year, commonly referred to as a 5-year flood. Flood stage for the Schoharie Creek at Prattsville is considered by the NWS to be at 12 feet on the gage, which corresponds to approximately 18,000 cubic feet per second (cfs). At 14 feet (roughly 26,000 cfs), the creek begins to overflow onto Main Street (Rte. 23), and by 18 feet (over 45,500 cfs) is considered severe flooding. USGS indicates that this gage has experienced a total of 98 peak stream flows between 1903 and 2006 (USGS, 2008).

** According to many sources, these events were known as Nor'Easters; therefore, only the flood impacts of these events (if applicable) are briefly discussed in this hazard profile and are further mentioned in Section 5.4.3 (Severe Winter Storm).

AHPS	Advanced Hydrologic Prediction Service
DR	Federal Disaster Declaration
EM	Federal Emergency Declaration
FEMA	Federal Emergency Management Agency
HMP	Hazard Mitigation Plan
K	Thousand ($)
M	Million ($)
NA	Not Available
NCDC	National Climate Data Center
NOAA	National Oceanic Atmospheric Administration
NPDP	National Performance of Dams Program
NRCC	Northeast Regional Climate Center
NSIDC	National Snow and Ice Data Center
NTSB	National Transportation Safety Board
NWS	National Weather Service
NYS	New York State
NYSDPC	New York State Disaster Preparedness Commission
NYSEMO	New York State Emergency Management Office
SCS	Soil Conservation Service
SHELDUS	Spatial Hazard Events and Losses Database for the U.S.
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WRIR	Water Resources Investigation Report

According to the CRREL database, ice jams in Greene County have most commonly formed along the Schoharie Creek in Prattsville and the Hudson River (Ice Engineering Research Group, Date Unknown). Figure 5.4.1-7 identifies the approximate location of where all ice jams have formed throughout the County between 1936 and 2007.

Figure 5.4.1-7 Greene County Ice Jam Events



Source: Ice Engineering Research Group, Date Unknown.
Note: Ice jams within Greene County have most commonly occurred along the Schoharie Creek and Hudson River. Prattsville experienced the most ice jams (25 incidences) within the County along the Schoharie Creek.

Based on review of all available sources, Table 5.4.1-5 lists 31 ice jam events that have occurred in Greene County between 1936 and 2007. Information regarding losses associated with these reported ice jams was limited.

Table 5.4.1-6. Ice Jam Events in Greene County between 1936 and 2007

Event Date	River / Stream	Location	Description	Source(s)
March 19, 1936	Hudson River	Coxsackie	Numerous boats were smashed or torn loose from their mooring along the Hudson River as winter ice broke up and was hurled downstream by flood waters. Anchored in the path of the ice, the Storm King, salvage boat, was torn loose and tossed ashore near Coxsackie.	CRREL
February 17, 1939	Schoharie Creek	Prattsville	Maximum annual gage height of 10.09 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville.	CRREL
February 8, 1941	Schoharie Creek	Prattsville	Maximum annual gage height of 6.76 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville.	CRREL
March 9, 1942	Schoharie Creek	Prattsville	Gage height of 8.80 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville (discharge 12,200 cfs).	CRREL
December 30, 1942	Schoharie Creek	Prattsville	Gage height of 8.32 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville, on December 30, 1942 (discharge 10,400 cfs). Additional ice affected gage height of 10.80 feet (maximum for year) reported on February 23, 1943. Also ice-affected gage height of 10.75 feet, reported on March 12, 1943 (discharge 6,000 cfs).	CRREL
January 1, 1945	Schoharie Creek	Prattsville	Gage height of 6.12 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville.	CRREL
January 6, 1946	Schoharie Creek	Prattsville	Maximum annual gage height of 14.66 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville (discharge 5,740 cfs).	CRREL
March 14, 1947	Schoharie Creek	Prattsville	Gage height of 6.94 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville (discharge 5,000 cfs).	CRREL
February 14, 1948	Schoharie Creek	Prattsville	Maximum annual gage height of 9.49 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville	CRREL
February 1, 1951	Schoharie Creek	Prattsville	Gage height of 12.28 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville.	CRREL
December 21, 1951	Schoharie Creek	Prattsville	Maximum annual gage height of 14.92 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville.	CRREL
January 23, 1957	Schoharie Creek	Prattsville	Maximum annual gage height of 8.52 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville.	CRREL
February 11, 1960	Schoharie Creek	Prattsville	Gage height of 11.75 feet, affected by backwater from ice, reported at USGS gage Schoharie Creek at Prattsville (discharge 12,800 cfs).	CRREL
January 25, 1964	Schoharie Creek	Prattsville	Maximum gage height of 10.25 feet, caused by an ice jam, reported at USGS gage Schoharie Creek at Prattsville (discharge for day was 4,100 cfs).	CRREL
December 10, 1977	Schoharie Creek	Prattsville	The USGS reported an ice jam on the Schoharie Creek at Prattsville. The water discharge was 720 cfs, gage height was 7.24 feet.	CRREL
December 14, 1977	Schoharie Creek	Prattsville	The USGS reported an ice jam on the Schoharie Creek at Prattsville. The water discharge 1,500 cfs, gage height 9.54 feet.	CRREL
January 9, 1978	Schoharie Creek	Prattsville	Ice jam in Prattsville with a gage height of 19.50 feet (7.5 feet above 12-foot flood stage).	USGS

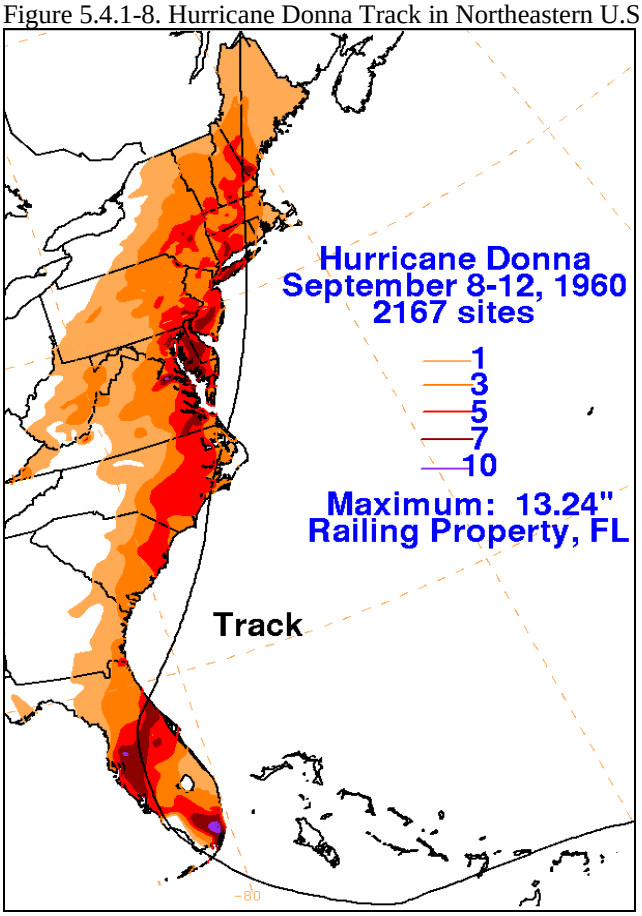
Event Date	River / Stream	Location	Description	Source(s)
January 26, 1978	Schoharie Creek	Prattsville	A severe ice jam in Prattsville occurred effectively blocking the streamflow. It caused widespread flooding in the region. An entire herd of dairy cattle drowned in their barn.	CRREL
January 1, 1979	Schoharie Creek	Prattsville	The USGS reported an ice jam on the Schoharie Creek at Prattsville. The water discharge was 1,300 cfs. The gage height was 8.75 feet.	CRREL
January 21, 1979	Schoharie Creek	Prattsville	The USGS reported an ice jam on the Schoharie Creek at Prattsville. The water discharge was 860 cfs. The gage height was 14.53 feet.	CRREL
January 25, 1979	Schoharie Creek	Prattsville	The USGS reported an ice jam on the Schoharie Creek at Prattsville. The water discharge was 2,400 cfs. The gage height was 11.34 feet.	CRREL
March 5, 1979	Schoharie Creek	Prattsville	The USGS reported an ice jam on the Schoharie Creek at Prattsville. The water discharge was 8,600 cfs. The gage height was 19.57 feet (7.57 feet above 12-foot flood stage). The maximum annual gage height on this date also resulted in the maximum gage height for the period of record between 1902 - 1980.	CRREL, USGS
February 11, 1981	Schoharie Creek	Prattsville	An ice jam was reported on Schoharie Creek at Prattsville. The water discharge was 5,000 cfs. The gage height was 10.76 feet.	CRREL
February 3, 1982	Schoharie Creek	Prattsville	An ice jam was reported on Schoharie Creek at Prattsville. The water discharge was 1,500 cfs. The gage height was 12.73 feet.	CRREL
January 16, 1996	Schoharie Creek	Prattsville	According to NWS Flood Statements, about a mile below Prattsville an ice jam formed on Schoharie Creek. The water level rose above 10-foot flood stage.	CRREL
January 21, 1996	Hudson River	Catskill	The NWS reported that a large ice jam formed on the Hudson River in Catskill, between the Rip Van Winkle Bridge and the confluence with the Catskill Creek.	CRREL
February 26, 2000	Schoharie Creek	Prattsville	The NWS reported an ice jam on the Schoharie Creek at Prattsville. The gage height was 10.56 feet.	CRREL
January 20, 2003	Schoharie Creek	Prattsville	The NWS reported that an ice jam formed on the Schoharie Creek at Prattsville. No other information available.	CRREL
January 22, 2004	Schoharie Creek	Prattsville	The NWS reported a freeze-up jam on the Schoharie Creek near Prattsville. No other information available. This jam froze in place, and caused a second ice jam when the river ice broke up due to rain on snow event of 5 March (See that entry for details).	CRREL, NYS HMP (2008)
March 5-6, 2004	Schoharie Creek	Prattsville	A freezeup ice jam that formed on January 22, 2004 froze in place (see earlier entry). This jam blocked the transport of river ice during ice cover breakup on March 5-6, 2004 that occurred as a result of a rain and snow event. The resulting breakup jam stage was 11.5 feet on March 6th (flood stage is 12 feet, flooding of low-lying areas occurs at 11 feet).	CRREL, NYS HMP (2008)
March 6, 2004	Schoharie Creek	Lexington	The NWS reported an ice jam on the Schoharie Creek at Lexington. The gage records shows a sudden rise to about 5.8 feet just before midnight on March 5, following a rain on snow event that day in which 0.5 to .75 inches of rain fell and temperatures were in the 50's.	CRREL, NYS HMP (2008)

Further descriptions of select flood events that have impacted Greene County are provided below for selected events where details regarding their impact (where available). These descriptions are provided to give the reader a context of the flood events that have affected the County and to assist local officials in locating event-specific data for their municipalities based on the time and proximity of these events. Flood impacts associated with hurricanes, tropical storms or Nor'Easters, are discussed in this profile and are also mentioned in their designated hazard profiles (Section 5.4.2 Severe Storm and Section 5.4.3 Severe Winter Storm).

Monetary figures within the event descriptions were U.S. Dollar (USD) figures calculated during or within the approximate time of the event (unless present day recalculations were made by the sources reviewed). If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of inflation.

August 29 - September 14, 1960 (Hurricane Donna): This event holds the record for retaining "major hurricane" status (Category 3 or greater on the Saffir-Simpson Hurricane Scale) in the Atlantic Basin for the longest period of time on record (a total of 17 days). The storm affected every state along the East Coast; producing hurricane-force winds (up to 115 mph) from South Carolina to Maine (Barnes and Lyons, 2007). Fifty people were reported dead in the U.S., with damages totaling approximately $3 billion (2004 USD) (Blake et al., 2005). Figure 5.4.1-8 displays the storm track and rainfall totals for September 8-12, 1960. This figure indicates that Greene County experienced between 5 and 7 inches of rain.

Figure 5.4.1-8. Hurricane Donna Track in Northeastern U.S. - Rainfall Totals



Source: HPC, 2007 (Supplied by HPC by the National Climatic Data) Center in Asheville, North Carolina and the South Florida Water Management District).

In Greene County, the impacts of this event fell primarily within the Batavia Kill watershed. The Soil Conservation Service indicated that the storm devastated the Town of Windham, producing more than $750,000 in damages (1960 USD) to over 75 residences, 27 businesses, utilities, seven bridges, and multiple state, county, and town roads. The Windham Country Club, two churches, and the Windham Ashland School all experienced damage. The flooding from this event caused water contamination in the Town of Windham, causing a boil water advisory for a period of time (GCSWCD, 2003). Information regarding other areas throughout the County impacted from this event is limited or has not been disclosed in the materials reviewed to develop this plan.

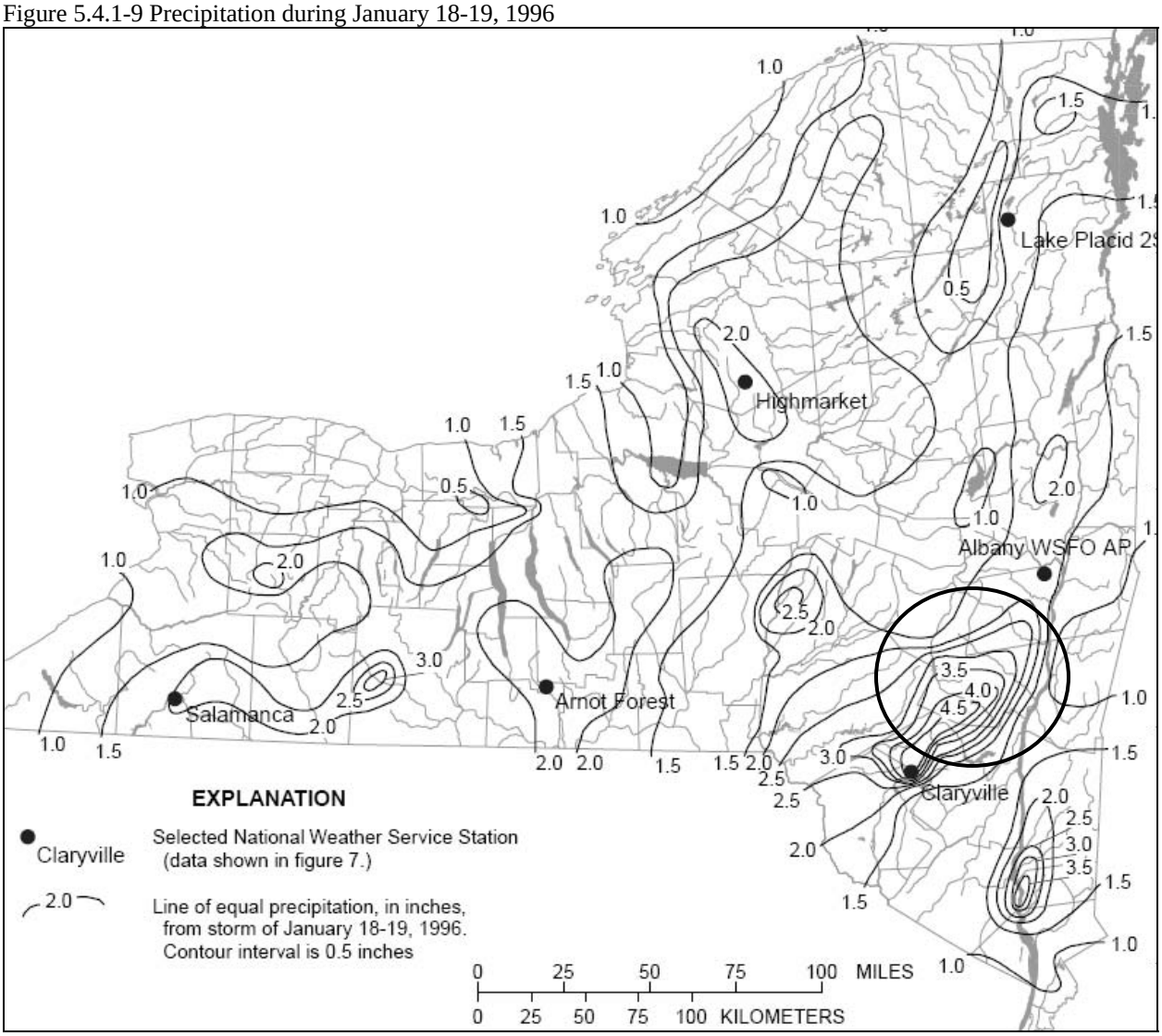
April 3-6, 1987 (FEMA DR-792): Heavy rains from this event caused widespread flooding in southeastern New York State. As much as nine inches of rain fell throughout the Catskill Mountains. Flooding along the Schoharie Creek was the third largest since records began in the early 1900s and was exceeded only by the October 1955 and March 1980 floods. In 1987, NYSEMO estimated that flood damage to homes, businesses, farms, crops, roadways and bridges in New York State exceeded $65 million (Zembrzuski and Evans, 1989; Perry et al., 2005).

In Greene County, the Schoharie Creek at Prattsville had a water discharge of 47,600 cfs and crested to 18.37 feet (6.37 feet above 12-foot flood stage) during this event (USGS, 2008). It was a recorded peak event for the East Kill near Jewett Center, cresting 15.68 feet (USGS, Date Unknown). It also caused significant damages in the Batavia Kill watershed and resulted in approximately $2 million in property damage to public infrastructure in the West Kill watershed (New York State Floodplain and Stormwater Managers Association, 2002).

This storm resulted in a FEMA Disaster Declaration (FEMA DR-792) on May 15, 1987. Through this declaration, the following five counties were declared eligible for Federal and State disaster funds: Delaware, Greene, Montgomery, Schoharie, and Ulster (NYSDPC, 2008; NYSEMO, 2006; FEMA, 2008). Disaster aid for Greene County was not available in the materials reviewed to develop this plan.

January 18-20, 1996 (FEMA DR-1095): Precipitation from a strong storm during January 18-20, 1996, combined with unseasonably warm temperatures that caused rapid snowmelt, resulted in extensive flooding throughout New York State. The storm and flooding claimed ten lives, stranded hundreds of people, destroyed or damaged thousands of homes and businesses, and closed hundreds of roads. The areas within and surrounding the Catskill Mountains were severely affected by this event. More than 4.5 inches of rain fell on at least 45 inches of melting snow in the Catskill Mountain region and caused major flooding throughout the southeastern section of the State (Figure 5.4.1-9). The most destructive flooding was along Schoharie Creek and the East and West Branches of the Delaware River. The State experienced between $100 and $160 million in property damages from this event (Lumia, 1998; NYSDPC, 2008)

Figure 5.4.1-9 Precipitation during January 18-19, 1996



Source: Lumia, 1998 (Data from NOAA, 1996).
Note: The black circle within New York State indicates the approximate location of Greene County

As indicated in Figure 5.4.1-9, Greene County received between 1.5 and 4.5 inches of rain during this event, resulting in widespread flooding along the major rivers and small streams of the County. The Schoharie Creek at Prattville experienced its highest flood stage ever documented since the beginning of record floods at the gage in 1904. Floodwaters at the station crested at 19.4 feet (7.4 feet above 12-foot flood stage) with peak flows of 52,800 cfs, reaching its 100-year flood stage and representing "disastrous" flooding (GCSWCD, 2007; USGS, 2008). Many residential and commercial properties, infrastructure, roadways, bridges, and transportation systems experienced significant damage throughout the County. In Athens, Coxsackie and New Baltimore flooding of the Hudson River resulted in multiple evacuations and damage to sewer treatment plants. The Prattsville Water System experienced severe damage. Flooding along the Hudson River damaged several marinas and parks including Riverside Park in Coxsackie, Athens Riverfront Park and the marina section of New Baltimore. Some of the most severe flooding occurred in Palenville, Athens, Windham and Lexington. Residents in Palenville were evacuated due to the flooding of Kaaterskill Creek. Road washouts were primarily reported in the mountainous terrain of the County. Eighty-percent of the roads in the Town of Durham suffered damage with six roads washed out. Severely damaged State routes within the County included Routes 42, 214, 296, 32 and 81 (NCDC,

2008). Melodywood Condominiums, along the Schoharie Creek in the Village of Hunter, suffered extreme streambank failure from this event, with the immediate safety of the structure and additional adjoining properties threatened (Figure 5.4.1-10) (GCSWCD, Date Unknown).

Figure 5.4.1-10 Streambank Failure near Melodywood Condominiums

Source: GCSWCD, Date Unknown

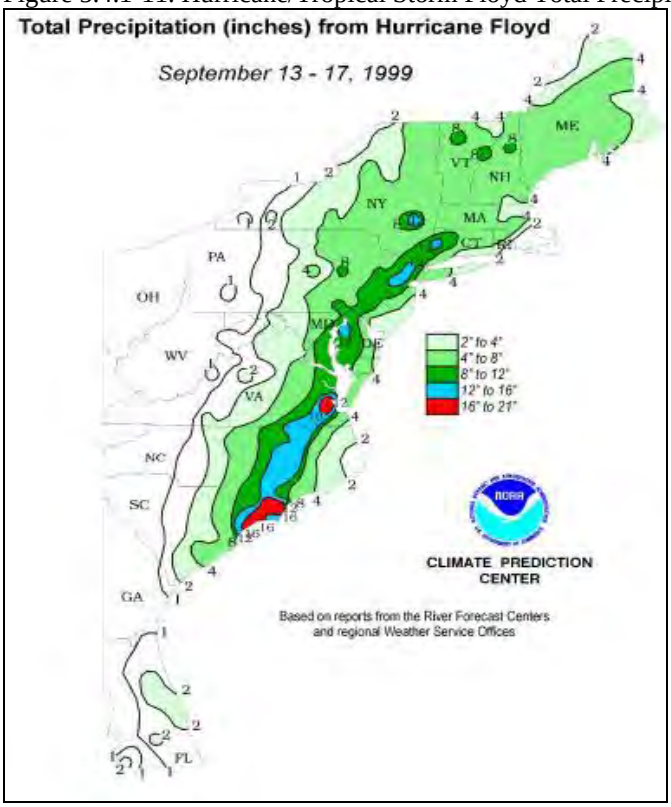
This event resulted in nearly $2 million in property damage to public infrastructures in the West Kill watershed (New York State Floodplain and Stormwater Managers Association, 2002). NOAA-NCDC and SHELDUS indicated that Greene County experienced approximately $10 million in total property damages from this event (NCDC, 2008; Hazards & Vulnerability Research Institute, 2007). With the extent of damage created throughout the County during this event, County and State officials began the preparation and initiation of a series of flood hazard mitigation and stream restoration projects throughout Greene County, particularly along Schoharie Creek, West Kill, Batavia Kill, East Kill and Stony Clove Creek.

This storm resulted in a FEMA Disaster Declaration (FEMA DR-1095) on January 24, 1996. Through this declaration, the following 41 counties were declared eligible for Federal and State disaster funds: Albany, Allegany, Broome, Cattaraugus, Cayuga, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Essex, Franklin, Greene, Herkimer, Jefferson, Lewis, Livingston, Madison, Montgomery, Onondaga, Ontario, Orange, Otsego, Putnam, Rensselaer, St. Lawrence, Saratoga, Schenectady, Schoharie, Schuyler, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wyoming and Yates (NYSEMO, 2006; FEMA, 2008; NYSDPC, 2008). Disaster assistance for all counties affected in the State totaled approximately $16.7 million in individual assistance and $103.7 million in public assistance (1997 USD). Greene County received $916,839 in individual assistance and $4.4 million in public assistance (1997 USD) (Lumia, 1998).

September 16, 1999 (Hurricane/Tropical Storm Floyd) (FEMA DR-1296): According to the NOAA NHC, this event was a large and intense storm that pounded the central and northern Bahama islands, seriously threatened Florida, struck near the coast of North Carolina and moved up the east coast of the U.S. into New England as a tropical storm. It neared the threshold of a Category 5 on the Saffir/Simpson Hurricane Scale as it approached the Bahamas, and caused a flood disaster of immense proportions in the eastern U.S., particularly from the eastern coast of North Carolina through New Jersey (Pasch et al., 1999). Much of Floyd's impact was due to heavy rainfall, creating major losses from floodwaters throughout the eastern U.S. Common rainfall totals ranged between 4 and 12 inches (Figure 5.4.1-11)

(NWS, 1999). Ten states were declared major disaster areas, which included Connecticut, Delaware, Florida, Maryland, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, and Virginia (NCDC, 2000).

Figure 5.4.1-11. Hurricane/Tropical Storm Floyd Total Precipitation



Source: NWS, 1999

New York State experienced approximately $62.2 million in property damages from this event (NYSDPC, 2008). In Greene County, rainfall totals ranged between 6.9 inches (Prattsville) and 12.21 inches (Cairo) (NWS, 1999). NOAA-NCDC and SHELDUS indicated that Greene County experienced approximately $3 million in flood damages. Over twelve inches of rain was recorded in Cairo, the most recorded amount of rainfall associated with the storm in the State (NCDC, 2008). The Schoharie Creek at Prattsville had a water discharge of 42,800 cfs and crested to 17.64 feet (5.64 feet above 12-foot flood stage). This event created unstable conditions throughout many rivers and streams of the County and exacerbated the degradation and streambank erosion that was initially created during the January 1996 flood.

This storm resulted in a FEMA Disaster Declaration (FEMA DR-1296) on September 19, 1999. Through this declaration, the following 15 counties were declared eligible for Federal and State disaster funds: Albany, Dutchess, Essex, Greene, Nassau, Orange, Putnam, Rensselaer, Rockland, Schenectady, Schoharie, Suffolk, Ulster, Warren and Westchester counties (NYSEMO, 2006; FEMA, 2008; NYSDPC, 2008). Disaster assistance for all counties affected in the State has not been clearly documented. However, as of December 6, 1999, FEMA and the State have approved 69 Disaster Housing grants throughout Greene County, totaling $121,485 (FEMA, 2003).

May through September 2000 (FEMA DR-1335): Between May and September 2000, multiple severe storm events occurred throughout New York State resulting in significant flooding and over $34.6 million in damage throughout various New York State counties.

In Greene County, NOAA-NCDC indicated that flooding during this time period particularly occurred on June 6-7, 2000, when heavy rain fell across the Catskills with as much as 5.77 inches falling in East Jewett in Greene County. A portion of State Route 385 was closed in Athens. In New Baltimore, two roads and culvert bridges were closed as a result of flooding. In Leeds, 23 people had to be evacuated from homes along State Highway 23B as the Catskill creek rose out of its banks. Greene County experienced over $115,000 in flood damages during this time period (NCDC, 2008; Hazards & Vulnerability Research Institute, 2007).

These storms resulted in a FEMA Declaration Disaster (FEMA DR-1335) on July 21, 2000. Through this declaration, the following 27 counties were declared eligible for Federal and State disaster funds: Albany, Allegany, Cattaraugus, Columbia, Dutchess, Erie, Essex, Greene, Herkimer, Lewis, Livingston, Madison, Montgomery, Niagara, Oneida, Onondaga, Orleans, Otsego, Rensselaer, Schenectady, Schoharie, Steuben, Sullivan, Tioga, Tompkins, Ulster and Yates (FEMA, 2003). According to the Schoharie Creek SMP, Greene County received approximately $176,596 in disaster aid from this event (GCSWCD, 2007).

July 21 through August 15, 2003 (FEMA DR-1486): A series of slow-moving thunderstorms, accompanied by torrential rainfall, caused flash flooding throughout much of New York State, including Greene County. Although $1 million in damages resulted from a tornado outbreak in July, Greene County suffered the most amount of flood damage in early August.

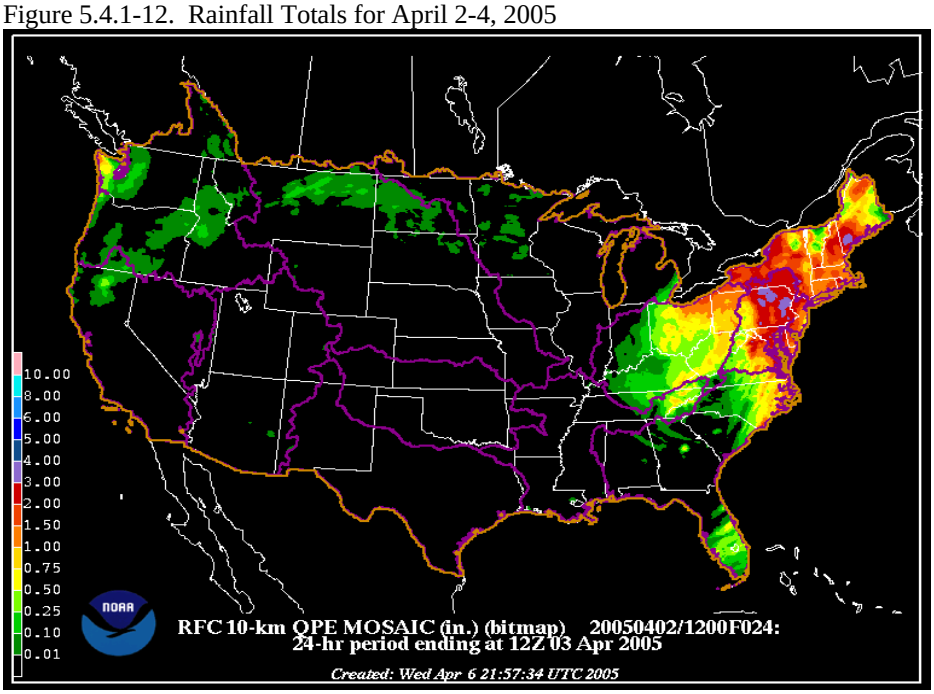
On August 2nd, the area experienced severe weather when isolated thunderstorms affected the Catskill region. Approximately four to five inches of rain fell in less than two hours throughout eastern Greene County. The heavy rainfall resulted in flooded roads in both Leeds and Catskill. In Catskill, the Catskill Creek overflowed onto State Highway 23B and a mudslide was reported on Sandy Plain Road. The Poltic Creek overflowed its banks and washed away a small bridge. Homes in the cities of Catskill and Athens took on significant water in their basements (NOAA-NCDC, 2008). According to NOAA-NCDC and SHELDUS, Greene County had approximately $60,000 in flood damage due to the storms (NCDC, 2008; Hazards & Vulnerability Research Institute, 2007).

Another slow-moving series of thunderstorms developed in the area on August 11th, producing torrential rainfall and flooding. In Greene County, portions of Route 296 in Hensonville were washed out and flooding was noted on Route 23 near Cairo. According to NOAA-NCDC and SHELDUS, Greene County had approximately $15,000 in flood damage due to the series of storms (NCDC, 2008; Hazards & Vulnerability Research Institute, 2007).

These storms resulted in a FEMA Disaster Declaration (DR-1486) on August 29, 2003. Through this declaration, the following 17 counties were declared eligible for Federal and State disaster funds: Allegany, Cattaraugus, Chemung, Columbia, Delaware, Fulton, Greene, Livingston, Madison, Montgomery, Ontario, Rensselaer, Schuyler, Steuben, Sullivan, Wyoming, and Yates. On October 30, 2003, FEMA approved $5.3 million to New York State residents that were affected by the severe storms, widespread flooding and multiple tornadoes that struck the state (FEMA, 2003). Disaster aid for Greene County was not available in the materials reviewed to develop this plan.

April 2-4, 2005 (FEMA DR-1589): A slow moving storm moved up through the Appalachians and into the northeast U.S. The heavy rainfall from this event produced flooding throughout New York, New Jersey and Pennsylvania (NCDC, 2005). Prior to this storm, the rivers and streams in the area had high flow-rates due to a previous rainstorm on March 28th and snowmelt. This substantially increased flooding and caused additional damage, along with the damage produced by this storm. Figure 5.4.1-12 shows rainfall totals from this event for the northeast U.S.

Figure 5.4.1-12. Rainfall Totals for April 2-4, 2005



Source: NCDC, 2005

The NWS reported the heaviest rain and the worst flooding occurred in Ulster and Greene Counties (NWS, 2005). The NYS HMP indicated that New York State experienced approximately $66.2 million in damages from this event (NYSDPC, 2008).

In Greene County, NOAA-NCDC indicated that many municipalities were impacted by floodwaters from this event. The Hamlet of East Jewett experienced the most rainfall, resulting in significant flooding (Figure 5.4.1-12) (NWS, 2005). Many of the County's roads were closed, including: Paul Saxe, Embought and Mountain Roads in the Town of Catskill; And County Routes 77, 23C, 14, and State Route 23A in the Town of Jewett. In Haines Falls, State Route 23A was washed out and Route 32 was under water in Greenville Center. In Leeds, Lexington Road and Route 23B were under water (NCDC, 2008). The Schoharie Creek at Prattsville crested to 17.41 feet (5.41 feet above 12-foot flood stage). The West Kill reached flood stage at 3.0 feet in Spruceton. Rainfall totals throughout the County ranged between 1.50 inches in New Baltimore and 5.54 in East Jewett (NWS, 2005). According to NOAA-NCDC and SHELDUS, Greene County experienced approximately $1.3 million in flood damages from this event (NCDC, 2008; Hazards & Vulnerability Research Institute, 2007).

Figures 5.4.1-13 through 5.4.1-20 show a collection of photographs collected during this flood event by the NWS and Greene County Department of Emergency Services.

Figure 5.4.1-13. Floodwaters in East Jewett

Source: NWS, 2005

Figure 5.4.1-14. Flooding in the Village of Catskill

Source: Greene County – John Farrell

Figure 5.4.1-15. Flooding near the Town of Jewett

Source: Greene County – John Farrell

Figure 5.4.1-16. Flooding in the Village of Catskill

Source: Greene County – John Farrell

Figure 5.4.1-17. Flooding in the Village of Athens

Source: Greene County – John Farrell

Figure 5.4.1-18. Flood Damage in Village of Tannersville

Source: Greene County – John Farrell

Figure 5.4.1-19. Water Street in the Village of Athens

Source: Greene County – John Farrell

Figure 5.4.1-20. West Main Street in the Village of Catskills

Source: Greene County – John Farrel

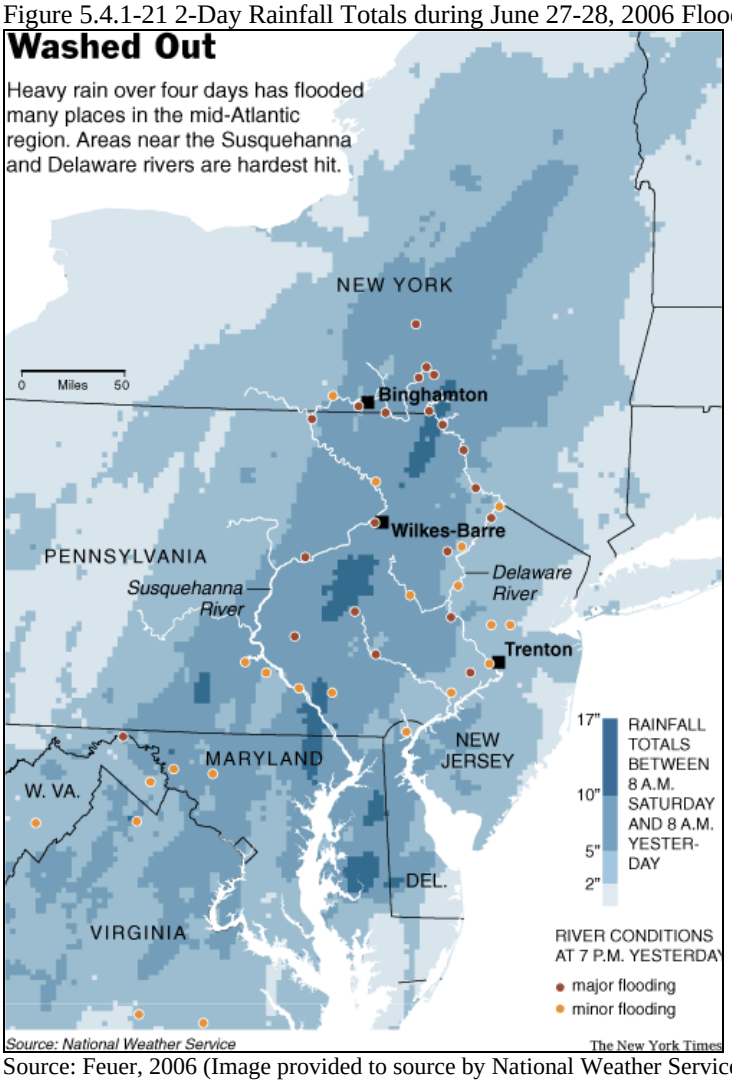
This storm resulted in a FEMA Disaster Declaration (DR-1589) on April 19, 2005. Through this declaration, the following 20 counties were declared eligible for Federal and State disaster funds: Broome, Cayuga, Chautauqua, Chenango, Columbia, Cortland, Delaware, Greene, Madison, Montgomery, Niagara, Orange, Otsego, Putnam, Rensselaer, Schoharie, Sullivan, Tioga, Ulster and Westchester (NYSDPC, 2008; FEMA, 2008).

In a September 14, 2005 Press Release, FEMA indicated that nearly $35 million in disaster aid was made available to all declared counties as result of this event. In this press release, FEMA approved $1.1 million in public assistance reimbursements for the Towns of Cairo, Coxsackie, Durham, Greenville, Halcott, Hunter, Jewett, Lexington, New Baltimore, Prattsville and Windham; the Villages of Catskill, Hunter and Tannersville; and the East Durham, Lexington and Palenville fire departments (FEMA, 2005). However, documentation provided by FEMA to Greene County Department of Emergency Services indicated that as of June 1, 2005, the County was approved for over $2.2 million in public assistance reimbursements. Aid was provided for various restoration and mitigation project costs generated as a result of flood damages during this event; particularly in the Towns of Hunter, Jewett and Tannersville (Greene County Department of Emergency Services, 2005).

June 25 – July 10, 2006 (FEMA DR-1650): This severe storm event resulted in a significant flooding that affected much of the Mid-Atlantic region. The flooding was widespread, affecting numerous rivers, lakes and communities from upstate New York to North Carolina. Rain totals throughout the eastern U.S.

ranged from 2 to 17 inches, particularly between June 27th and 29th, with the largest accumulations falling in Maryland, Pennsylvania and New York State (Figure 5.4.1-21). Overall, the storm resulted in over 16 deaths and millions of dollars in damages throughout the affected states (NOAA, 2006).

Figure 5.4.1-21 2-Day Rainfall Totals during June 27-28, 2006 Flood

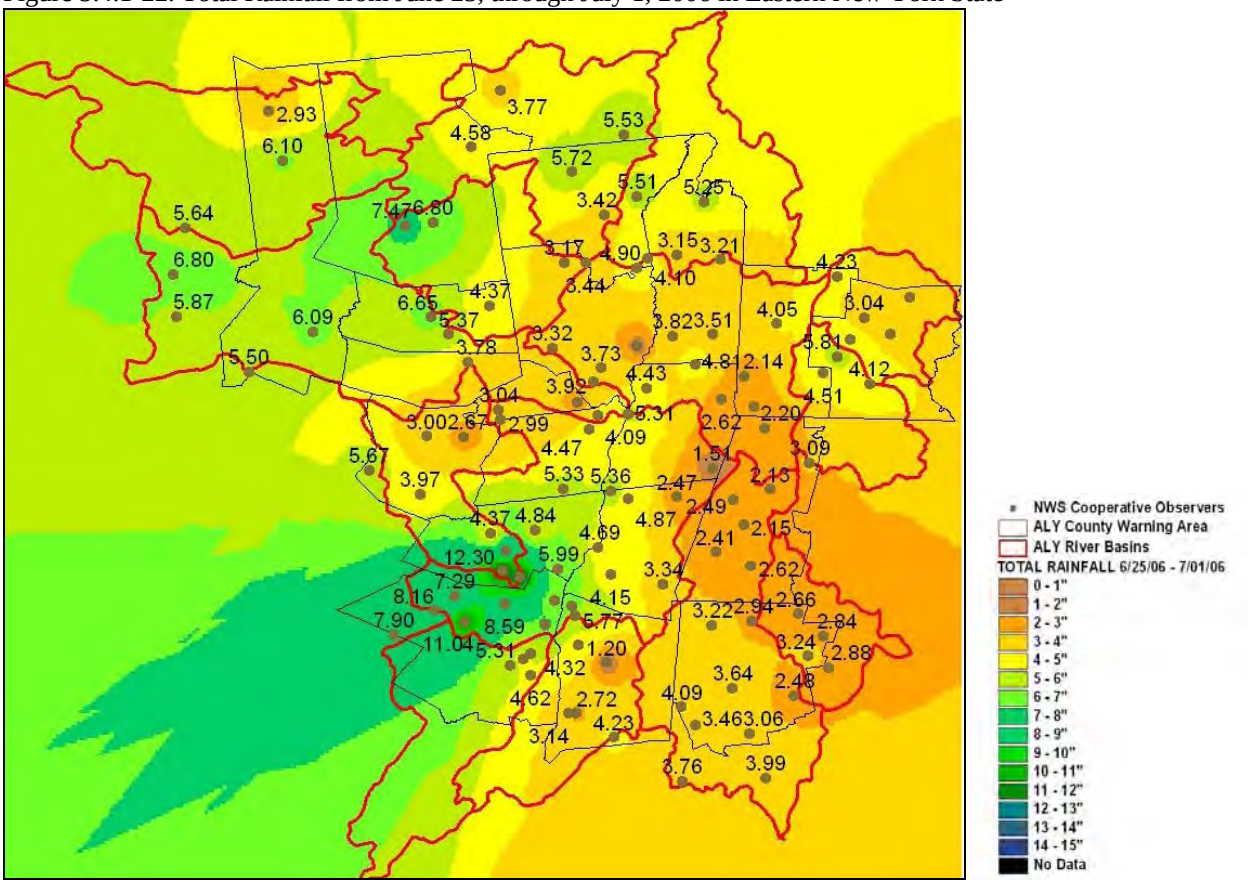


Source: Feuer, 2006 (Image provided to source by National Weather Service)

Some sources indicated that this flooding event was the largest and most costly natural disaster that New York State has encountered since Hurricane Agnes in 1972. The NYS HMP indicated that the counties affected throughout the State experienced approximately $246.3 million in damages during this flood (NYSDPC, 2008).

In Greene County, precipitation totals averaged between 3 and 12 inches of rain, with the largest accumulations generated in the south central portion of the County (Figure 5.4.1-22). Rain totals between June 26th and June 30th included: Tannersville (12.20 inches), East Jewett (8.3 inches), Catskill (4.43 inches) and Windham (3.14 inches) (NWS, 2006). Law enforcement personnel reported that several roads in Greene County were closed in and near the Towns of Catskill, Cairo and Haines Falls due to flooding. Part of Route 23-A remained closed between Palenville and Haines Falls, where a retaining wall gave way (NCDC, 2008). Cost estimates of property damage in Greene County were unavailable in the materials reviewed to develop this plan.

Figure 5.4.1-22. Total Rainfall from June 25, through July 1, 2006 in Eastern New York State



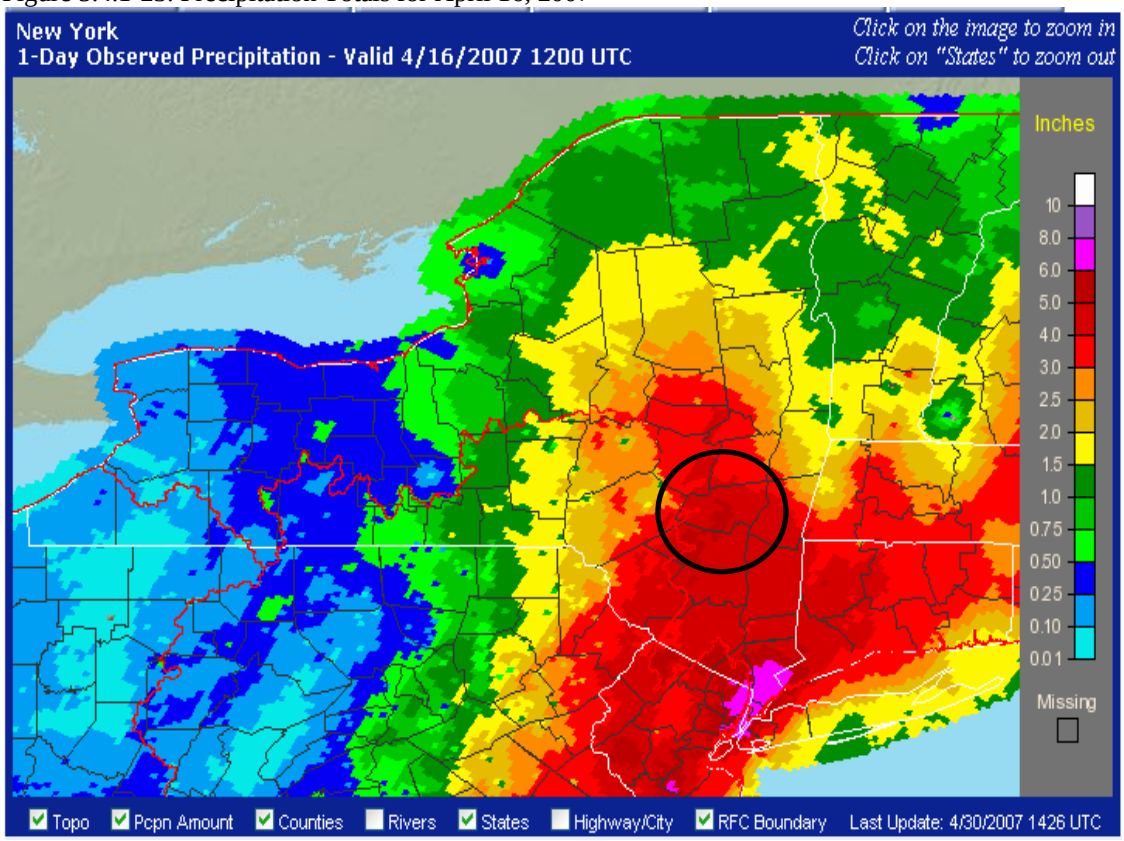
Source: NWS, 2006

This event resulted in a FEMA Emergency Declaration (FEMA EM-1650) on July 1, 2006. Through this declaration, the following 19 Counties were declared eligible for Federal and State disaster funds: Broome, Chenango, Cortland, Delaware, Fulton, Greene, Hamilton, Herkimer, Madison, Montgomery, Oneida, Otsego, Rensselaer, Schoharie, Schenectady, Sullivan, Tioga, Tompkins, and Ulster Counties (FEMA, 2008). As of December 29, 2006, FEMA indicated that nearly $227 million in disaster aid was made available to all declared counties as result of this event (FEMA, 2008). The Greene County Department of Emergency Services indicated that as of August 25, 2006, FEMA approved over $609,000 in public assistance reimbursements for various restoration and mitigation project costs generated as a result of flood damages during this event; particularly in the Towns of Catskill and Greenville (Greene County Department of Emergency Service, 2006).

April 14-18, 2007 (FEMA DR-1692): An intense and powerful Nor'Easter brought flooding rains and heavy wet snowfall to the northeast U.S. Rainfall totals of six to eight inches were reported across the eastern Catskill Mountains, mid-Hudson Valley and western New England, resulting in widespread flooding. Snowfall accumulations of one to one and a half feet were reported across the southern Adirondacks, eastern Catskills, Berkshires, and southern Green Mountains (NWS, Date Unknown). The combined effects of high winds and heavy rainfall during this event led to flooding, storm damages, power outages, evacuations, and disrupted traffic and commerce.

Various counties in the eastern Catskills and Mid-Hudson Region of New York State were impacted by several inches of rain during this event (NWS, 2007) (Figure 5.4.1-23). New York State experienced between $12.8 and $60 million in damages from this event (NYSDPC, 2008; Alarcon, 2007).

Figure 5.4.1-23. Precipitation Totals for April 16, 2007



Source: NOAA, 2007
Note: The black circle within New York State indicates the approximate location of Greene County.

In Greene County, NOAA-NCDC indicated that the heavy rain from this event led to widespread flooding of small streams and creeks. Figure 5.4.1-23 shows that precipitation totals for the County ranged between three and six inches, with the greatest accumulations centrally located in the Towns of Lexington, Jewett and Hunter (NOAA, 2007). Other sources indicate that specific rainfall totals in Greene County ranged from 3.97 inches in Cairo to 7.9 inches in Tannersville (NWS, 2007). Numerous roads were closed throughout Greene County, including County Route 61 in Coxsackie, and several roads near Catskill (NCDC, 2008). The Schoharie Creek at Prattsville crested to 12.98 feet (.98 feet above 12-foot flood stage) (USGS, 2008). The Catskill Creek in the Town of Catskill experienced continued stream bank erosion and migration from this event, which would cost an estimated $1 to $1.5 million to restore (Alarcon, 2007). A reported landslide occurred along Warren Stein Road in the Town of Cairo (Macko, 2007).

The Greene County Department of Emergency Services indicated that preliminary storm damage totals eligible for federal public assistance in Greene County totaled nearly $472,000; with the Town of Cairo and Village of Catskill experiencing the most losses. Storm damage totals for individual assistance in the County totaled $111 million, with the Town and Village of Catskill experiencing the most losses, totaling $110 million. Individual assistance losses to the County were denied by FEMA (Greene County Department of Emergency Service, 2007). Other sources indicate that final losses eligible for public assistance were estimated at $1.3 million as a result of flood damage, response and debris removal costs throughout the County. Additionally, final loss estimates to homeowners were tallied at $547,000 (Alarcon, 2007). These conflicting monetary figures indicate that a discrepancy exists regarding total damages to the County.

This Nor'Easter resulted in a FEMA Emergency Declaration (FEMA EM-1692) on April 24, 2007. Through this declaration, the following 13 Counties were declared eligible for Federal and State disaster funds: Albany, Columbia, Dutchess, Essex, Greene, Montgomery, Orange, Putnam, Rockland, Schoharie, Suffolk, Ulster and Westchester Counties (FEMA, 2007). As of August 13, 2007, FEMA indicated that nearly $61 million in disaster aid was made available to all declared counties as result of this event (FEMA, 2007). On July 11, 2007, FEMA approved $58,000 in public assistance reimbursements for Greene County (FEMA, 2007). Details regarding the latest public assistance reimbursements were not available in the materials reviewed for this plan.

National Flood Insurance Program

According to FEMA's 2002 *National Flood Insurance Program (NFIP): Program Description*, the U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968. The NFIP is a Federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. The NFIP collects and stores a vast quantity of information on insured structures, including the number and location of flood insurance polices number of claims per insured property, dollar value of each claim and aggregate value of claims, repetitive flood loss properties, etc. NFIP data presents a strong indication of the location of flood events among other indicators (NYSDPC, 2008).

Participation in the NFIP is based on an agreement between communities and the Federal Government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction and substantial improvements in floodplains, the Federal Government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods (Federal Insurance and Mitigation Administration-FEMA, 2002).

There are three components to NFIP: flood insurance, floodplain management and flood hazard mapping. Nearly 20,000 communities across the U.S. and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary. Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly $1 billion a year through communities implementing sound floodplain management requirements and property owners purchasing of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance (FEMA, 2007).

According to the most recent NFIP statistics for the State (which are updated regularly), there is an extensive history of flood claims with NFIP which indicates a total of more than 79,500 claims since the inception of the program in the late 1970s. New York State is ranked within the top 5 States of the U.S. with the highest number of claims and is also amongst the highest in repetitive flood claims (as defined by FEMA/NFIP). In Greene County, all Towns and Villages participate in the NFIP (FEMA, 2008, NYSDPC, 2008). According the most recent data provided by NFIP, Greene County has filed 306 flood-related claims between January 1978 and February 2008, resulting in approximately $4.2 million in flood related losses being paid to the County. The Town of Catskill filed 80 flood claims, the most claims out of any other community in the County, and has received the most payment during that time period totaling approximately $2.5 million (FEMA, 2008). All NFIP data for the County is presented further in Table 5.4.1-11 in the "Vulnerability Assessment" section of this hazard profile.

The NFIP program also tracks properties that file several claims of a certain value over a specific period of time, termed Repetitive Loss Properties (RLPs). These properties, as defined by FEMA, are NFIP-insured properties that, since 1978 and regardless of any changes in ownership during that period, have experienced any of the following:

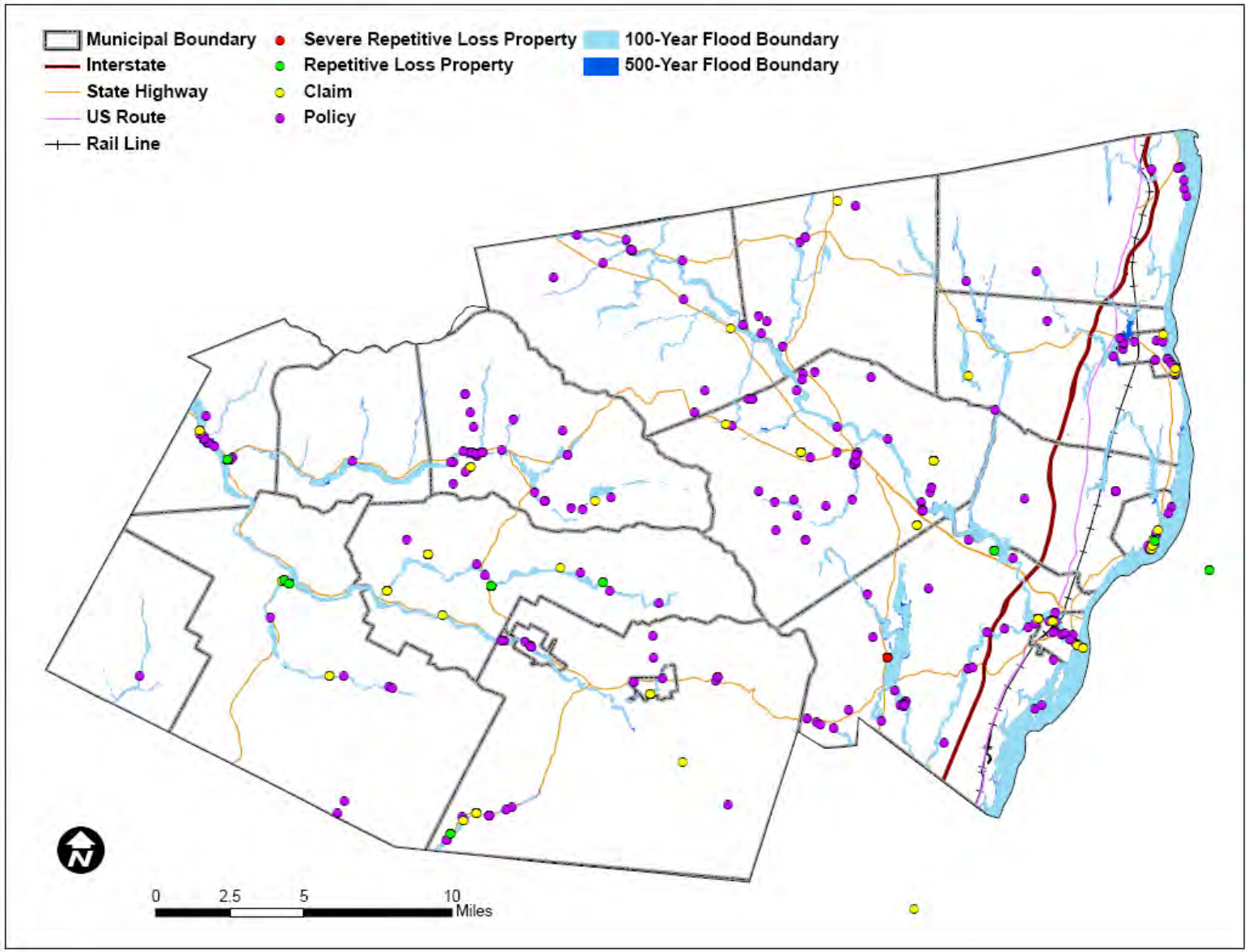
- Four or more paid losses in excess of $1,000
- Two paid losses in excess of $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property (FEMA, 2005; FEMA, 2006)

RLPs make up only one to two percent of the flood insurance policies currently in force nationally, yet they account for 40-percent of the country's flood insurance claim payments. The NFIP is concerned with RLPs because structures that flood frequently strain the National Flood Insurance Fund. In fact, the RLPs are the biggest draw on the Fund by not only increasing the NFIP's annual losses and the need for borrowing; but they drain funds needed to prepare for catastrophic events. Community leaders and residents are also concerned with the RLP problem because residents' lives are disrupted and may be threatened by the continual flooding (FEMA, 2005).

FEMA NFIP statistics indicate that over 8,000 RLPs exist in New York State. The distribution of RLPs is a clear indicator of the location of the flood hazard in the State. According to the 2008 NYS HMP, Greene County has 27 RLPs, mostly in the Towns of Catskill (6), Prattsville (6), Hunter (4) and Lexington (4) (NYSDPC, 2008).

Figure 5.4.1-24 illustrates the 500-year flood boundary generated by HAZUS-MH MR3 as well as properties with repetitive and severe repetitive flooding; and properties with policies and claims within the County provided by FEMA Region II in December 2008. The location of the properties with policies, claims and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations are more accurate than others. This data is more current than the properties reported in the New York State HMP and may explain any difference in property count between the two sources. See Table 5.4.1-11 in the Vulnerability Assessment Section for more detailed information on NFIP policies, claims and repetitive loss properties in each municipality.

Figure 5.4.1-24. Severe Repetitive Loss and Repetitive Loss Properties, Policies and Claims in Greene County



Source: FEMA Region II, 2008

As an additional component of NFIP, the CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance (FEMA, 2008). According to the 2008 Flood Insurance Agent's Manual containing current and historical listings of all CRS communities; the Town of Ashland within Greene County has participated in CRS since October 1991 (FEMA, 2008; NYSDPC, 2008).

Probability of Future Events

Given the history of flood events that have impacted Greene County, it is apparent that future flooding of varying degrees will occur and people, property and infrastructure are at risk from the flood hazard. In Section 5.3, the identified hazards of concern for the County were ranked. The NYS HMP conducts a similar ranking process for hazards that affect the State. The probability of occurrence, or likelihood of the event, is one parameter used in this ranking process. Based on historical records and FIRMs provided through FEMA, the probability of occurrence for flood events in the County is considered 'frequent' (that is, likely to occur within 25 years). It is estimated that Greene County and all of its jurisdictions, will continue to experience flooding annually that may induce secondary hazards such as ground failure and water quality and supply concerns and could result in evacuations, infrastructure deterioration and failure, utility failures, power outages, transportation delays/accidents/inconveniences and public health concerns.

The Role of Global Climate Change on Future Probability

Global climate change poses risks to human health and to terrestrial and aquatic ecosystems. Important economic resources such as agriculture, forestry, fisheries, and water resources also may be affected. Warmer temperatures, more severe droughts, storms and floods, and sea level rise could have a wide range of impacts. All these stresses can add to existing stresses on resources caused by other influences such as population growth, land-use changes, and pollution.

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Human-induced climate change has the potential to alter the prevalence and severity of extremes such as heat waves, cold waves, severe storms, floods and droughts. Though predicting changes in these types of events under a changing climate is difficult, understanding vulnerabilities to such changes is a critical part of estimating future climate change impacts on human health, society and the environment.

It is important to understand that directly linking any one specific extreme event (for example, flood, severe hurricane) to climate change is not possible. However, climate change and global warming may increase the probability of some ordinary weather events reaching extreme levels or of some extreme events becoming more extreme [U.S. Environmental Protection Agency (USEPA), 2007]. It remains very difficult to assess the impact of global warming on extreme weather events, in large part because this analysis depends greatly on regional forecasts for global warming. Global warming will almost certainly have different effects on different regions of the Earth, so areas will not be equally susceptible to increased or more intense extreme weather events. Although regional climate forecasts are improving, they are still uncertain. Although many uncertainties may exist regarding magnitude or severity, many sources indicate that future weather patterns and increased intensities are anticipated as a result of climate change, along with atmospheric, precipitation, storm and sea level changes (USEPA, 2007).

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the flood hazard, areas identified as hazard areas include the 100- and 500-year flood plains. The following text evaluates and estimates the potential impact of flooding in the County including:

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

Overview of Vulnerability

Flood is a significant concern for Greene County. To assess vulnerability, potential losses were calculated for the County for riverine flooding for 100-year and 500-year MRP flood events. Historic loss data associated with ice jam events and dam failures is limited. Flooding, impacts and losses associated with ice jam and dam failure events are similar to flash flooding events. The flood hazard exposure and loss estimate analysis is presented below.

Data and Methodology

The 100- and 500-year MRP flood events were examined to evaluate Greene County's vulnerability to the flood hazard. These MRP flood events are generally those considered by planners and evaluated under federal programs such as the NFIP.

The preliminary (2006) Digital Flood Insurance Rate Maps (DFIRMs) GIS files (shapefiles) for Greene County (all jurisdictions) provided by Greene County Planning and Economic Development were used for analysis. The shapefiles did not provide base flood elevations for all riverine reaches where flood boundaries are present. Reaches with flood boundaries but no base flood elevations in the DFIRM shapefiles included the Hudson River; a creek in the Town of Halcott; reaches in the Towns of Cairo, Ashland and Windham; and all reaches within the Town of New Baltimore. Additionally, there were no flood boundaries or base flood elevations for the Catskill Creek within the Town of Durham and Basic Creek in the Town of Greenville. To provide the most accurate damage estimates, two methods were used to estimate flood loss damages to the general building stock and critical facilities in Greene County: 1) HAZUS-MH's Flood Information Tool (FIT) using Greene County's DFIRMs; and 2) Level 1 scenario in HAZUS-MH MR3 (no DFIRMs) where sufficient DFIRM data was not available.

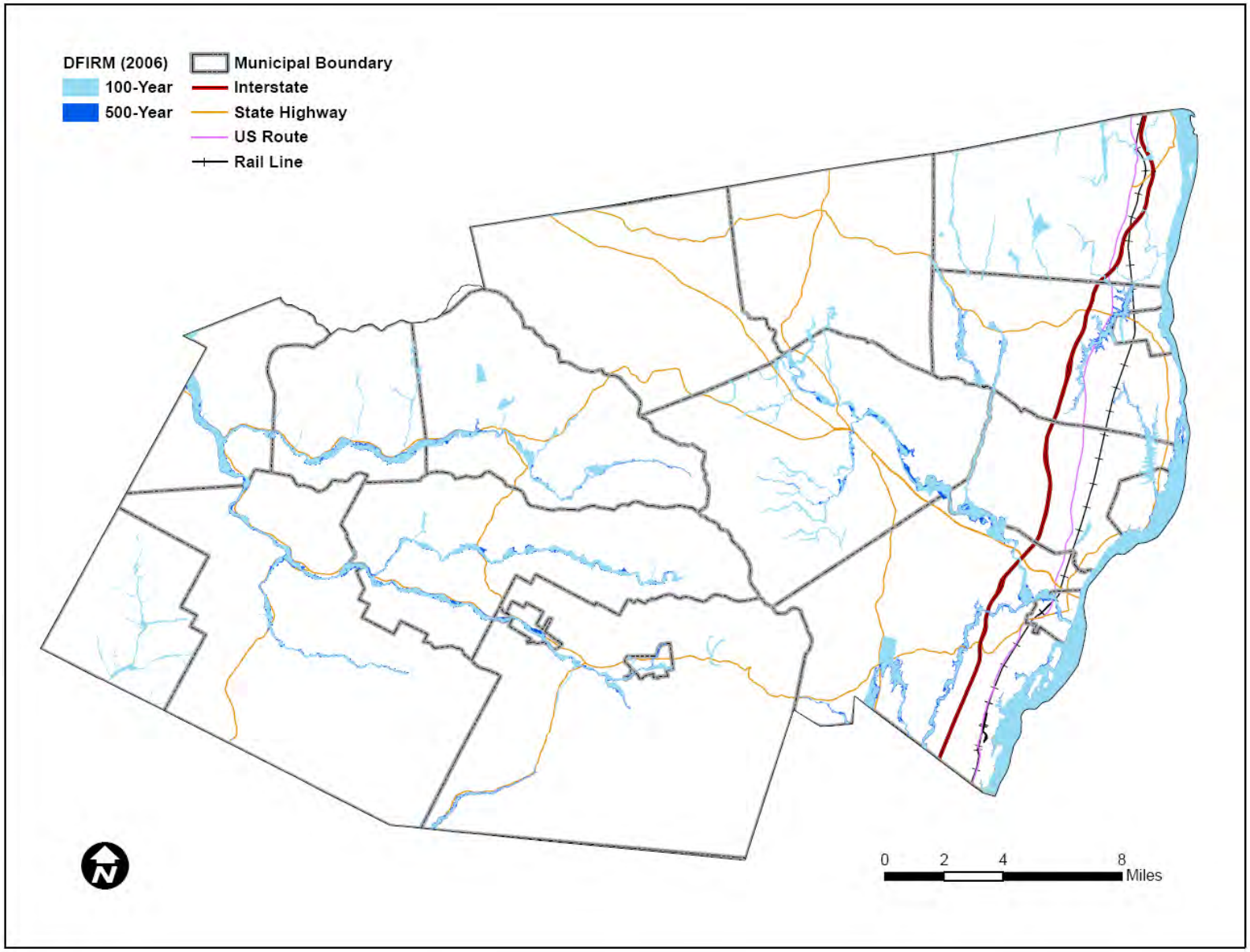
The DFIRM data (base flood elevations and flood boundaries) and a USGS one-third ArcSecond Digital Elevation Model (DEM) were supplied to the FIT. FIT's algorithms interpolated flood elevations between cross-sections to generate a flood depth grid for specified frequencies (100- and 500-year). HAZUS-MH MR3 then calculated the estimated damages to the general building stock and critical facilities.

For reaches within the County where not enough data was provided by the DFIRM to utilize FIT, HAZUS-MH MR3 was used. HAZUS-MH MR3 ran the hydrology and hydraulics for the selected river

reaches in the County and generated the flood depth grid and flood boundary for the specified return periods (100- and 500-year mean return period). HAZUS-MH MR3 calculated the estimated damages to the general building stock and critical facilities based on this depth grid. Figure 5.4.1-25 illustrates the 100- and 500-year flood boundaries as provided by the 2006 preliminary DFIRM and Figure 5.4.1-26 illustrates the flood boundaries generated by the methods described above for analysis in Greene County.

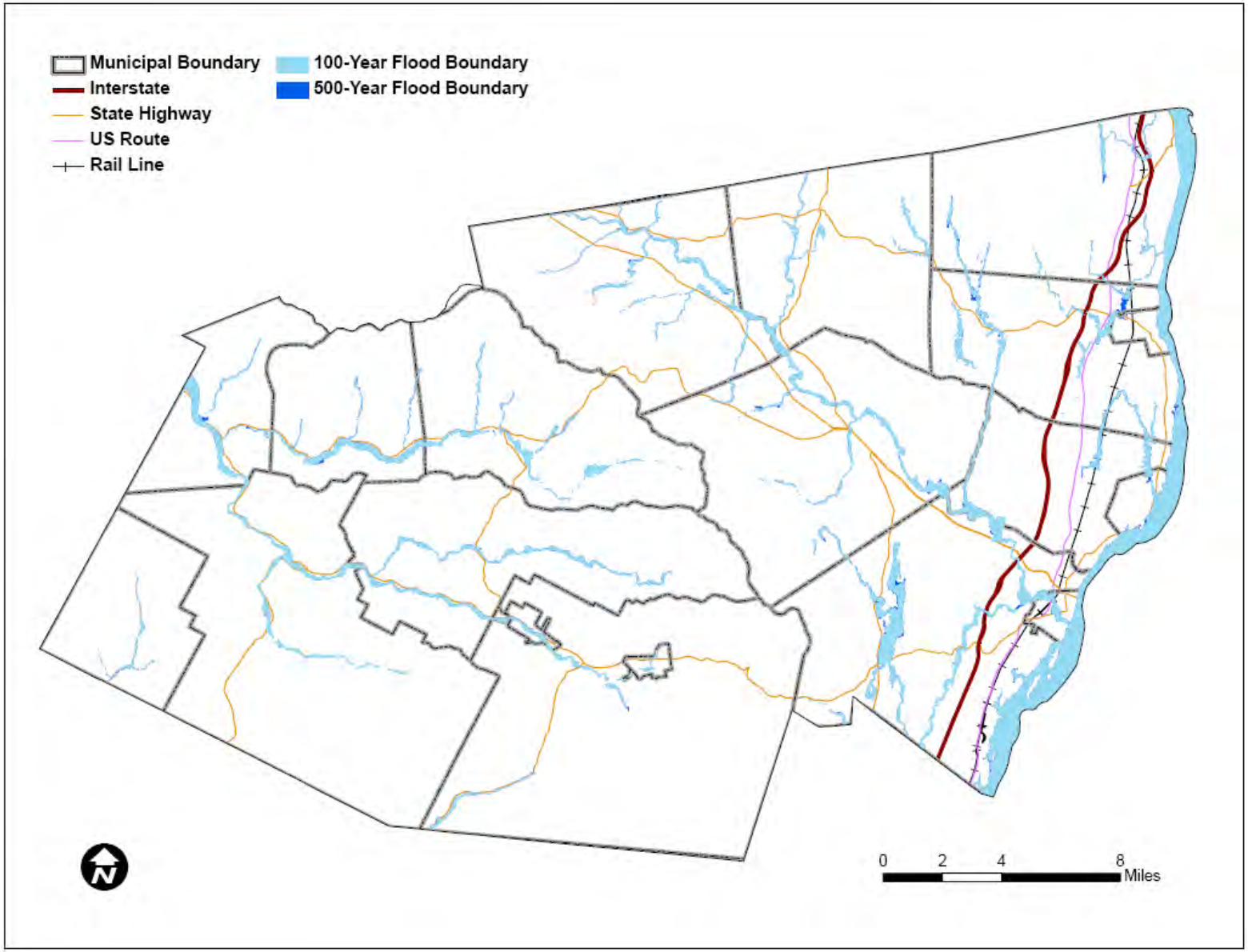
The default demographic data in HAZUS-MH MR3, based on the 2000 U.S. Census, was used for analysis. The valuation of general building stock and the loss estimates determined in Greene County were based on the default general building stock database provided in HAZUS-MH MR3. The general building stock valuations provided in HAZUS-MH MR3 are Replacement Cost Value from RSMeans as of 2006. The critical facility inventory (essential facilities, utilities, transportation features, high-potential loss facilities and user-defined facilities) was updated for all three hazard models (flood, wind and earthquake). This comprehensive inventory was developed by gathering input from numerous sources including HAZUS-MH MR3, Greene County and input from the Planning Committee.

Figure 5.4.1-25. FEMA 2006 DFIRM 100- and 500-Year Flood Boundaries for Greene County



Source: FEMA, 2006 as provided by Greene County Planning and Economic Development

Figure 5.4.1-26. 100- and 500-Year Flood Boundary Generated in HAZUS-MH MR3 for Greene County



Source: HAZUS-MH MR3, 2007

Impact on Life, Health and Safety

The impact of flooding on life, health and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not measurable.

To estimate the population exposed to the 100- and 500-year flood events, the flood boundaries generated in HAZUS were overlaid upon the population data available in HAZUS-MH MR3. The Census blocks with their center within the flood boundary were used to calculate the estimated population exposed to this hazard. Table 5.4.1-7 lists the estimated population located within the 100- and 500-year flood zones by jurisdiction.

Table 5.4.1-7. Estimated Population Exposed to the Flood Hazard

Jurisdiction	Total Population	Population in 100-Year SFHA		Population in 500-Year Flood Zone	
		Number	% of Total	Number	% of Total
Town of Ashland	752	109	14.5	109	14.5
Town of Athens	2,296	14	0.6	14	0.6
Town of Cairo	6,355	161	2.5	187	2.9
Town of Catskill	7,457	170	2.3	254	3.4
Town of Coxsackie	5,989	131	2.2	138	2.3
Town of Durham	2,592	112	4.3	134	5.2
Town of Greenville	3,316	18	0.5	56	1.7
Town of Halcott	193	3	1.6	4	2.1
Town of Hunter	1,783	54	3.0	54	3.0
Town of Jewett	970	7	0.7	10	1.0
Town of Lexington	830	86	10.4	86	10.4
Town of New Baltimore	3,417	42	1.2	42	1.2
Town of Prattsville	665	18	2.7	18	2.7
Town of Windham	1,660	51	3.1	52	3.1
Village of Athens	1,695	175	10.3	414	24.4
Village of Catskill	4,392	617	14.0	631	14.4
Village of Coxsackie	2,895	270	9.3	354	12.2
Village of Hunter	490	49	10.0	54	11.0
Village of Tannersville	448	48	10.7	48	10.7
Sleepy Hollow*	979	0	0	0	0
Greene County	**48,195**	**2,137**	**4.4**	**2,659**	**5.5**

Sources: HAZUS-MH MR3, 2007
Notes:
SFHA = Special Flood Hazard Area
Estimated Town population does not include the total for their Village(s).
*The Sleepy Hollow Lake community (SHL) is located within the Towns of Coxsackie and Athens, and Village of Athens. The total population for SHL was calculated based on the Census blocks located within an approximate area (polygon) generated in GIS of the community (2,474 acres). The Town of Coxsackie, Town of Athens and Village of Athens total population includes the population of SHL. Using the methodology described above, the population in SHL exposed to the flood hazard is underestimated (zero). According to the Emergency Action Plan for Sleepy Hollow Lake Dam (July 2008), 49 properties (including residential properties) are identified as vulnerable to inundation if a dam failure were to occur.

The table above shows that approximately 4.4 percent of the total population is exposed to the 100-year flood event and that approximately 5.5 percent of the total population is exposed to the 500-year flood zone. Of the population exposed, the most vulnerable include the economically disadvantaged (households with an income of less than $20,000) and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention which may not be available to due isolation during a flood event and they may have more difficulty evacuating.

Emergency Action Plans (EAPs) have been prepared for the Potuck Reservoir Dam located on Potic Creek Road in the Town of Coxsackie and the Sleepy Hollow Lake Dam located on Sleepy Hollow Road in the Village of Athens. According to the EAP for the Potuck Reservoir Dam, the area proximate to the dam is sparsely populated. The number of vulnerable residents was not determined. In the event the Potuck Reservoir Dam fails, the Village of Catskill's water supply will become compromised causing a public health emergency for Village residents. According to the EAP for Sleepy Hollow Dam, 49 properties were identified as vulnerable if a dam failure were to occur. The number of vulnerable residents was not indicated. Similarly for Sleepy Hollow Lake residents, the community's water supply (Murderers Creek) will become compromised in the event of a dam failure (Crawford & Associates, 2002; Crawford & Associates, 2008).

HAZUS-MH estimates the potential sheltering needs of the County's population as a result of a 100- and 500-year MRP flood event. Table 5.4.1-8 summarizes the estimated number of displaced persons and persons seeking temporary shelter from the 100- and 500-year MRP events.

The total number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results form persons trying to cross flooded roadways or channels during a flood.

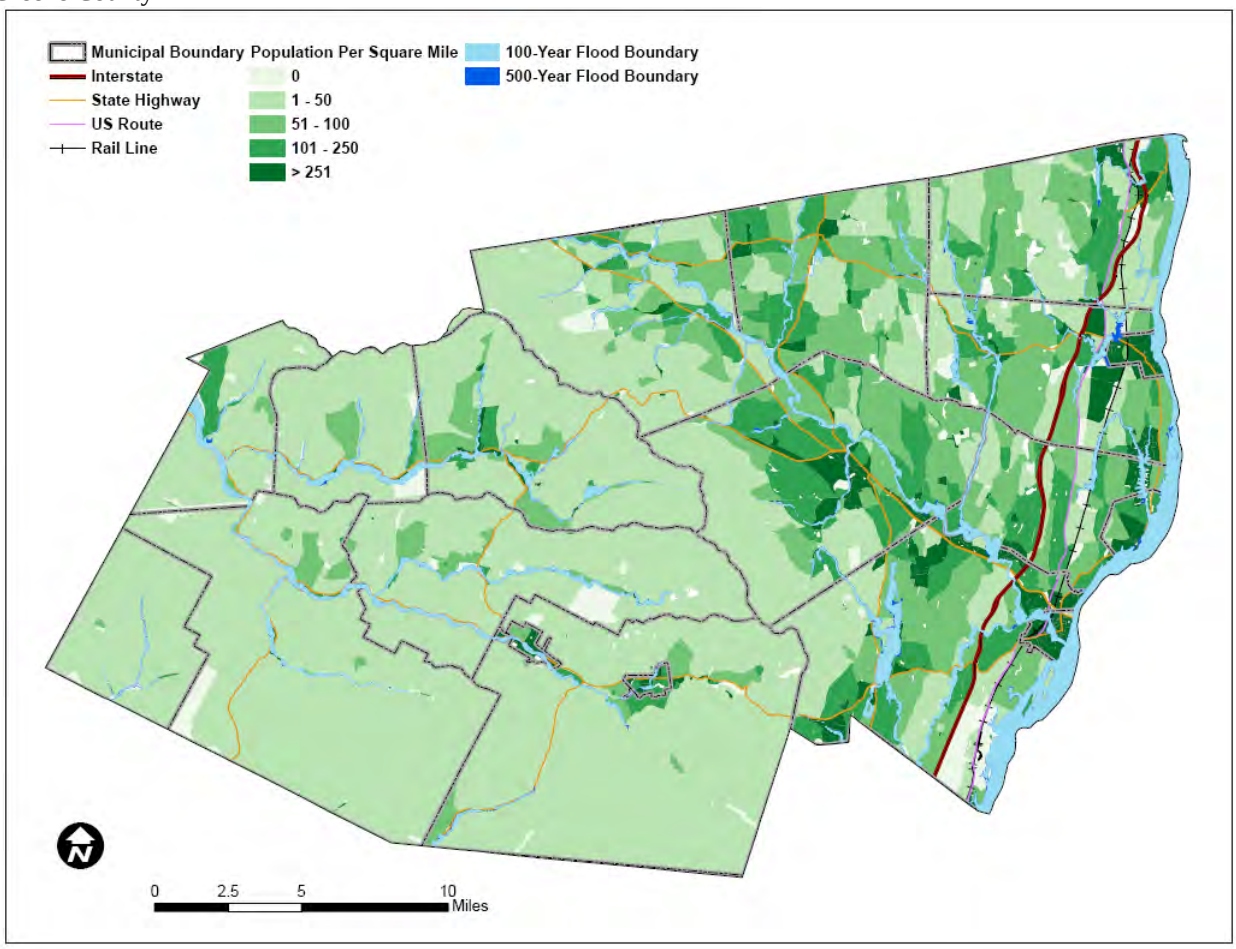
Table 5.4.1-8. Estimated Greene County Population Displaced or Seeking Short-Term Shelter from the 100-Year and 500-Year MRP Events

Jurisdiction	Total Population	100-Year				500-Year			
		Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter
Town of Ashland	752	151	20.1	113	15.0	158	21.0	116	15.4
Town of Athens	2,296	99	4.3	32	1.4	113	4.9	36	1.6
Town of Cairo	6,355	298	4.7	68	1.1	317	4.6	94	1.4
Town of Catskill	7,457	473	6.3	136	1.8	538	7.2	183	2.5
Town of Coxsackie	5,989	247	4.1	28	0.5	286	4.8	33	0.6
Town of Durham	2,592	173	6.7	29	1.1	189	7.3	40	1.5
Town of Greenville	3,316	107	3.2	19	0.6	108	3.3	19	0.6
Town of Halcott	193	5	2.6	0	0.0	5	2.6	0	0.0
Town of Hunter	1,783	71	4.0	10	0.6	75	4.2	12	0.7
Town of Jewett	970	47	4.8	0	0.0	47	4.8	0	0.0
Town of Lexington	830	90	10.8	18	2.2	83	10.0	15	1.8
Town of New Baltimore	3,417	151	4.4	47	1.4	161	4.7	48	1.4
Town of Prattsville	665	53	8.0	5	0.8	54	8.1	6	0.9
Town of Windham	1,660	156	9.4	25	1.5	177	10.7	28	1.7
Village of Athens	1,695	392	23.1	185	10.9	550	32.4	310	18.3
Village of Catskill	4,392	871	19.8	742	16.9	931	21.2	788	17.9
Village of Coxsackie	2,895	312	10.8	230	7.9	388	13.4	312	10.8
Village of Hunter	490	128	26.1	98	20.0	131	26.7	99	20.2
Village of Tannersville	448	45	10.0	7	1.6	46	10.3	6	1.3
Sleepy Hollow Lake*	979	41	4.2	0	0.0	41	1	4.2	0.1
Greene County	**48,195**	**3,869**	**8.0**	**1,792**	**3.7**	**4,357**	**9.0**	**2,145**	**4.4**

Source: HAZUS-MH MR3, 2007
Notes:
Estimated Town population does not include the total for their Village(s).
*Sleepy Hollow Lake is located within the Town of Coxsackie, Town of Athens and Village of Athens. The total population listed for Sleepy Hollow Lake was calculated based on the approximate area of the community generated in GIS (2,474 acres) and the Census blocks therein. The Town of Coxsackie, Town of Athens and Village of Athens include the sheltering needs for the community of Sleepy Hollow Lake.

Figure 5.4.1-27 shows the extent of the 500-year flood boundary generated in HAZUS-MH MR3 in relation to the population density to illustrate areas where a higher density of population is exposed to the flood hazard.

Figure 5.4.1-27. Distribution of Population Density Relative to the HAZUS-MH Generated 500-Year MRP Flood in Greene County



Source: HAZUS-MH MR3, 2007

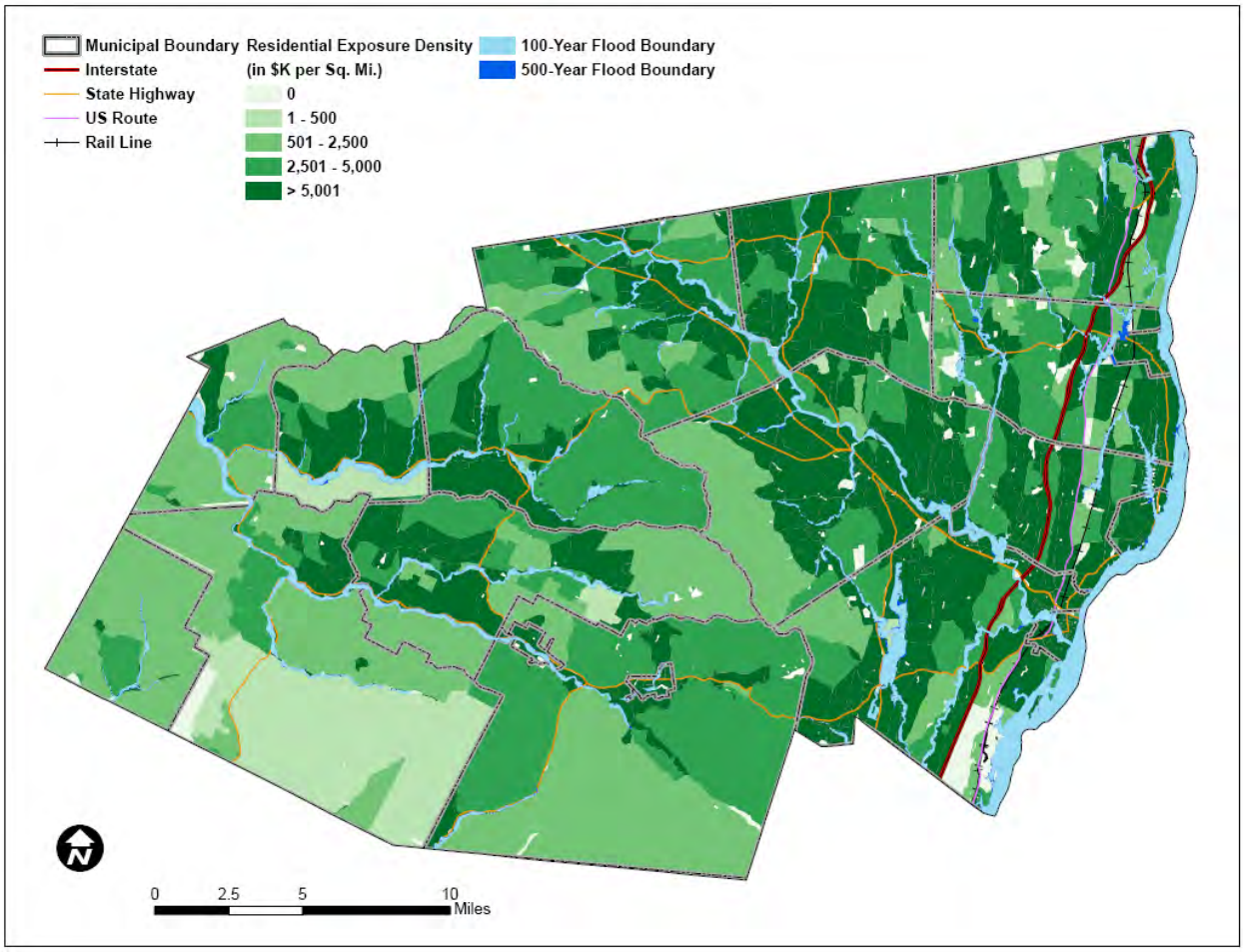
Impact on General Building Stock

After considering the population exposed to the flood hazard, the HAZUS-MH MR3 default value of general building stock exposed to, and damaged by (Figure 5.4.1-10), the 100- and 500-year MRP flood events was evaluated. Exposure in the flood zone includes those buildings located in the flood zone that are exposed to the flood hazard. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value.

HAZUS-MH MR3 does not estimate general building stock exposure to the flood hazard. To provide a general exposure estimate, the 100- and 500-year MRP flood boundaries generated by HAZUS-MH MR3 were overlaid upon the general building stock data inventory. The Census blocks with their center within the flood boundary were used to estimate the building count (for residential single-family dwellings and manufactured housing only) and replacement cost value exposed to this hazard (Tables 5.4.1-9 and 5.4.1-10, respectively). Only RES1 and RES2 occupancy class building counts are provided because they are based on census housing unit costs. All other occupancy class building counts are calculated in HAZUS-

MH MR3 based on regional average square footage values for specific occupancy class/building types, and may significantly over- or under-estimate actual structure counts and therefore, those building counts were not included in the summary table. Figure 5.4.1-28 illustrates the distribution of residential general building stock density relative to the 500-year HAZUS-MH MR3 generated flood boundary.

Figure 5.4.1-28. Distribution of Residential General Building Stock Density Relative to the HAZUS-MH Generated 500-Year MRP Flood in Greene County



Source: HAZUS-MH MR3, 2007

Table 5.4.1-9. Estimated Number of Residential Buildings (Single-Family Dwellings and Manufactured Housing) Located in the 100- and 500-year Floodplains

Jurisdiction	Total in County		RES1		RES2	
	RES1	RES2	100-Year	500-Year	100-Year	500-Year
Town of Ashland	479	102	47	47	12	12
Town of Athens	928	167	4	4	2	2
Town of Cairo	2,271	493	64	69	18	18
Town of Catskill	2,578	662	60	100	19	28
Town of Coxsackie	1,045	330	36	36	17	17
Town of Durham	1,259	323	45	70	13	18
Town of Greenville	1,262	261	11	22	7	9
Town of Halcott	237	47	2	3	2	3
Town of Hunter	1,234	100	22	22	4	4
Town of Jewett	921	104	11	14	7	8
Town of Lexington	705	137	60	60	14	14
Town of New Baltimore	1,069	296	17	17	4	4
Town of Prattsville	298	91	6	7	4	5
Town of Windham	1,539	97	29	29	7	7
Village of Athens	593	67	66	155	12	21
Village of Catskill	1,042	31	122	123	5	5
Village of Coxsackie	802	44	72	90	8	9
Village of Hunter	365	33	20	21	2	3
Village of Tannersville	375	24	39	39	3	3
Sleepy Hollow Lake*	0	0	0	0	0	0
Greene County	**19,002**	**3,409**	**733**	**928**	**160**	**190**

Source: HAZUS-MH MR3, 2007
Notes:
RES 1 = Single-Family Dwellings
RES2 = Manufactured Housing
Town estimate does not include the total for their Village(s).
* The Sleepy Hollow Lake community is located within the Town of Coxsackie, Town of Athens and Village of Athens. The Town of Coxsackie, Town of Athens and Village of Athens total residential buildings includes the community of Sleepy Hollow Lake. Although no residential buildings are identified within the 100- and 500-year flood boundaries using the methodology described above, this does not mean there are zero residential buildings vulnerable to the flood hazard in Sleepy Hollow Lake. As illustrated on the Dam Failure Inundation Map in the Emergency Action Plan for Sleepy Hollow Lake Dam (July 2008), 49 properties (including residential properties) are identified as vulnerable to inundation if a dam failure were to occur.

Table 5.4.1-10. Estimated General Building Stock Replacement Value (Structure and Contents) Located in the 100- and 500-Year Floodplains

Jurisdiction	Total Buildings				Residential Buildings		Commercial Buildings		Industrial Buildings	
	100-Year	% Total	500-Year	% Total	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Town of Ashland	$11,155,000	9.2	$11,335,000	9.4	$10,733,000	$10,733,000	$0	$0	$422,000	$602,000
Town of Athens	$1,538,000	0.5	$1,538,000	0.5	$1,538,000	$1,538,000	$0	$0	$0	$0
Town of Cairo	$23,773,000	3.4	$25,960,000	3.8	$18,210,000	$19,197,000	$3,986,000	$4,392,000	$755,000	$755,000
Town of Catskill	$16,878,000	1.6	$28,816,000	2.8	$14,708,000	$25,070,000	$734,000	$2,144,000	$1,200,000	$1,200,000
Town of Coxsackie	$12,028,000	3.0	$12,424,000	3.1	$8,989,000	$8,989,000	$2,169,000	$2,565,000	$480,000	$480,000
Town of Durham	$9,583,000	2.6	$19,955,000	5.4	$9,583,000	$18,927,000	$0	$1,028,000	$0	$0
Town of Greenville	$6,167,000	1.5	$9,140,000	2.3	$2,385,000	$5,256,000	$1,698,000	$1,698,000	$2,084,000	$2,084,000
Town of Halcott	$276,000	0.7	$414,000	1.0	$276,000	$414,000	$0	$0	$0	$0
Town of Hunter	$5,648,000	1.5	$5,648,000	1.5	$5,648,000	$5,648,000	$0	$0	$0	$0
Town of Jewett	$9,910,000	3.1	$10,514,000	3.3	$3,188,000	$3,792,000	$4,360,000	$4,360,000	$2,226,000	$2,226,000
Town of Lexington	$16,779,000	12.3	$16,779,000	12.3	$10,451,000	$10,451,000	$0	$0	$210,000	$210,000
Town of New Baltimore	$4,053,000	1.1	$4,053,000	1.1	$3,799,000	$3,799,000	$0	$0	$254,000	$254,000
Town of Prattsville	$4,203,000	5.3	$4,171,000	5.2	$1,710,000	$1,844,000	$1,949,000	$1,949,000	$204,000	$204,000
Town of Windham	$15,016,000	3.3	$15,016,000	3.3	$6,067,000	$6,067,000	$5,345,000	$5,345,000	$1,948,000	$1,948,000
Village of Athens	$44,829,000	20.0	$76,646,000	34.1	$17,219,000	$41,446,000	$11,789,000	$15,723,000	$15,345,000	$15,549,000
Village of Catskill	$88,960,000	15.2	$96,436,000	16.4	$43,293,000	$49,053,000	$32,336,000	$34,052,000	$3,785,000	$3,785,000
Village of Coxsackie	$46,169,000	11.5	$56,284,000	14.1	$28,973,000	$33,787,000	$14,592,000	$19,000,000	$630,000	$1,193,000
Village of Hunter	$5,052,000	4.2	$5,208,000	4.3	$5,052,000	$5,208,000	$0	$0	$0	$0
Village of Tannersville	$12,982,000	15.5	$12,982,000	15.5	$7,705,000	$7,705,000	$786,000	$786,000	$4,425,000	$4,425,000
Sleepy Hollow Lake*	$0	0.0	$0	0.0	$0	$0	$0	$0	$0	$0
Greene County	**$334,999,000**	**5.2**	**$413,319,000**	**6.4**	**$199,527,000**	**$258,924,000**	**$79,744,000**	**$93,042,000**	**$33,968,000**	**$34,915,000**

Source: HAZUS-MH MR3, 2007

Notes:

(1) Values represent replacement values (RV) for building structure and contents.

(2) The valuation of general building stock and the loss estimates determined in Greene County were based on the default general building stock database provided in HAZUS-MH MR3. The general building stock valuations provided in HAZUS-MH MR3 are Replacement Cost Value from RSMeans as of 2006.

(3) Town estimate does not include the total for their Village(s).

* The Sleepy Hollow Lake community is located within the Town of Coxsackie, Town of Athens and Village of Athens. The Town of Coxsackie, Town of Athens and Village of Athens total residential buildings includes the community of Sleepy Hollow Lake. Although no buildings are identified within the 100- and 500-year flood boundaries using the methodology described above, this does not mean there are buildings vulnerable to the flood hazard in Sleepy Hollow Lake. As illustrated on the Dam Failure Inundation Map in the Emergency Action Plan for Sleepy Hollow Lake Dam (July 2008), 49 properties (including residential properties) are identified as vulnerable to inundation if a dam failure were to occur.

Table 5.4.1-10. Estimated General Building Stock Replacement Value (Structure and Contents) Located in the 100- and 500-Year Floodplains (Continued)

Jurisdiction	Agricultural Buildings		Religious Buildings		Government Buildings		Educational Buildings	
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Town of Ashland	$0	$0	$0	$0	$0	$0	$0	$0
Town of Athens	$0	$0	$0	$0	$0	$0	$0	$0
Town of Cairo	$0	$0	$822,000	$1,616,000	$0	$0	$0	$0
Town of Catskill	$236,000	$402,000	$0	$0	$0	$0	$0	$0
Town of Coxsackie	$390,000	$390,000	$0	$0	$0	$0	$0	$0
Town of Durham	$0	$0	$0	$0	$0	$0	$0	$0
Town of Greenville	$0	$102,000	$0	$0	$0	$0	$0	$0
Town of Halcott	$0	$0	$0	$0	$0	$0	$0	$0
Town of Hunter	$0	$0	$0	$0	$0	$0	$0	$0
Town of Jewett	$0	$0	$0	$0	$136,000	$136,000	$0	$0
Town of Lexington	$92,000	$92,000	$740,000	$740,000	$5,286,000	$5,150,000	$0	$0
Town of New Baltimore	$0	$0	$0	$0	$0	$0	$0	$0
Town of Prattsville	$0	$0	$0	$0	$340,000	$340,000	$0	$0
Town of Windham	$166,000	$166,000	$1,150,000	$1,150,000	$340,000	$340,000	$0	$0
Village of Athens	$0	$0	$0	$2,054,000	$476,000	$1,874,000	$0	$0
Village of Catskill	$0	$0	$1,724,000	$1,724,000	$1,440,000	$1,440,000	$6,382,000	$6,382,000
Village of Coxsackie	$242,000	$572,000	$256,000	$256,000	$816,000	$816,000	$660,000	$660,000
Village of Hunter	$0	$0	$0	$0	$0	$0	$0	$0
Village of Tannersville	$0	$0	$0	$0	$66,000	$66,000	$0	$0
Sleepy Hollow Lake*	$0	$0	$0	$0	$0	$0	$0	$0
Greene County	$1,126,000	$1,724,000	$4,692,000	$7,540,000	$8,900,000	$10,162,000	$7,042,000	$7,042,000

Source: HAZUS-MH MR3, 2007

Notes:

(1) Values represent replacement values (RV) for building structure and contents.

(2) The valuation of general building stock and the loss estimates determined in Greene County were based on the default general building stock database provided in HAZUS-MH MR3. The general building stock valuations provided in HAZUS-MH MR3 are Replacement Cost Value from RSMeans as of 2006.

(3) Town estimate does not include the total for their Village(s).

* The Sleepy Hollow Lake community is located within the Town of Coxsackie, Town of Athens and Village of Athens. The Town of Coxsackie, Town of Athens and Village of Athens total residential buildings includes the community of Sleepy Hollow Lake. Although no buildings are identified within the 100- and 500-year flood boundaries using the methodology described above, this does not mean there are buildings vulnerable to the flood hazard in Sleepy Hollow Lake. As illustrated on the Dam Failure Inundation Map in the Emergency Action Plan for Sleepy Hollow Lake Dam (July 2008), 49 properties (including residential properties) are identified as vulnerable to inundation if a dam failure were to occur.

Table 5.4.1-11. Estimated General Building Stock Loss (Structure and Contents) Damaged by the 100-Year and 500-Year MRP Flood Events

Jurisdiction	Total Buildings		Percentage of Total Building Value		Residential Buildings		Commercial Buildings		Industrial Buildings	
	100 Yr	500 Yr	100 Yr	500 Yr	100 Yr	500 Yr	100 Yr	500 Yr	100 Yr	500 Yr
Town of Ashland	$6,394,000	$6,862,000	5.3	5.7	$6,044,000	$6,454,000	$14,000	$18,000	$311,000	$360,000
Town of Athens	$3,341,000	$4,051,000	1.2	1.4	$2,963,000	$3,584,000	$143,000	$169,000	$160,000	$209,000
Town of Cairo	$13,652,000	$14,936,000	2.0	2.2	$10,179,000	$11,108,000	$1,854,000	$2,147,000	$922,000	$876,000
Town of Catskill	$26,206,000	$30,927,000	2.5	3.0	$17,214,000	$20,300,000	$4,398,000	$4,868,000	$1,545,000	$1,939,000
Town of Coxsackie	$6,737,000	$7,725,000	1.7	1.9	$5,258,000	$5,858,000	$1,031,000	$1,267,000	$257,000	$356,000
Town of Durham	$12,756,000	$15,361,000	3.5	4.2	$6,912,000	$8,645,000	$2,376,000	$2,769,000	$244,000	$270,000
Town of Greenville	$4,451,000	$5,880,000	1.1	1.5	$2,851,000	$3,676,000	$1,000,000	$1,399,000	$410,000	$528,000
Town of Halcott	$271,000	$343,000	0.7	0.8	$127,000	$178,000	$0	$0	$0	$0
Town of Hunter	$3,284,000	$3,466,000	0.9	0.9	$3,187,000	$3,366,000	$4,000	$5,000	$62,000	$60,000
Town of Jewett	$8,938,000	$8,638,000	2.8	2.7	$4,458,000	$4,456,000	$2,712,000	$2,526,000	$1,395,000	$1,314,000
Town of Lexington	$6,343,000	$5,902,000	4.6	4.3	$4,455,000	$4,262,000	$18,000	$12,000	$122,000	$129,000
Town of New Baltimore	$6,047,000	$6,703,000	1.7	1.9	$5,578,000	$6,184,000	$89,000	$106,000	$307,000	$326,000
Town of Prattsville	$3,478,000	$3,654,000	4.4	4.6	$1,838,000	$1,969,000	$1,227,000	$1,274,000	$94,000	$93,000
Town of Windham	$15,583,000	$17,066,000	3.4	3.7	$7,534,000	$8,104,000	$4,825,000	$5,268,000	$1,612,000	$1,862,000
Village of Athens	$53,929,000	$65,033,000	24.0	29.0	$18,866,000	$25,614,000	$11,498,000	$13,855,000	$22,352,000	$23,383,000
Village of Catskill	$72,528,000	$81,581,000	12.4	13.9	$33,173,000	$36,961,000	$26,523,000	$30,061,000	$3,074,000	$3,500,000
Village of Coxsackie	$26,801,000	$32,238,000	6.7	8.0	$15,891,000	$19,208,000	$8,850,000	$10,534,000	$562,000	$627,000
Village of Hunter	$8,435,000	$8,636,000	7.0	7.2	$8,371,000	$8,555,000	$58,000	$74,000	$2,000	$3,000
Village of Tannersville	$3,904,000	$3,628,000	4.7	4.3	$1,843,000	$1,749,000	$290,000	$264,000	$1,750,000	$1,596,000
Sleepy Hollow Lake*	$1,503,000	$1,595,000	1.3	1.3	$1,174,000	$1,245,000	$75,000	$90,000	$254,000	$260,000
Greene County	**$283,078,000**	**$322,630,000**	**4.4**	**5.0**	**$156,742,000**	**$180,231,000**	**$66,910,000**	**$76,616,000**	**$35,181,000**	**$37,431,000**

Source: HAZUS-MH MR3, 2007

Notes:

(1) Values represent replacement values (RV) for building structure and contents.

(2) The valuation of general building stock and the loss estimates determined in Greene County were based on the default general building stock database provided in HAZUS-MH MR3. The general building stock valuations provided in HAZUS-MH MR3 are Replacement Cost Value from RSMeans as of 2006.

(3) Town estimate does not include the total for their Village(s).

* The Sleepy Hollow Lake community is located within the Town of Coxsackie, Town of Athens and Village of Athens. The estimated losses for the Town of Coxsackie, Town of Athens and Village of Athens include the community of Sleepy Hollow. The total building replacement value for Sleepy Hollow Lake was calculated based on the approximate area of the community generated in GIS and the HAZUS-MH MR3 default general building stock therein ($119,103,000).

Table 5.4.1-11. Estimated General Building Stock Loss (Structure and Contents) Damaged by the 100-Year and 500-Year MRP Flood Events (Continued)

Jurisdiction	Agriculture Buildings		Religious Buildings		Government Buildings		Education Buildings	
	100 Yr	500 Yr	100 Yr	500 Yr	100 Yr	500 Yr	100 Yr	500 Yr
Town of Ashland	$16,000	$17,000	$9,000	$13,000	$0	$0	$0	$0
Town of Athens	$2,000	$3,000	$37,000	$43,000	$36,000	$43,000	$0	$0
Town of Cairo	$2,000	$2,000	$450,000	$579,000	$237,000	$217,000	$8,000	$7,000
Town of Catskill	$1,013,000	$1,159,000	$1,557,000	$1,938,000	$427,000	$655,000	$52,000	$68,000
Town of Coxsackie	$70,000	$67,000	$114,000	$167,000	$6,000	$9,000	$1,000	$1,000
Town of Durham	$42,000	$48,000	$195,000	$221,000	$2,969,000	$3,387,000	$18,000	$21,000
Town of Greenville	$47,000	$56,000	$21,000	$46,000	$105,000	$138,000	$17,000	$37,000
Town of Halcott	$0	$0	$0	$0	$0	$165,000	$144,000	$0
Town of Hunter	$0	$0	$30,000	$34,000	$1,000	$1,000	$0	$0
Town of Jewett	$7,000	$6,000	$14,000	$11,000	$266,000	$247,000	$86,000	$78,000
Town of Lexington	$25,000	$23,000	$268,000	$241,000	$1,445,000	$1,227,000	$10,000	$8,000
Town of New Baltimore	$0	$0	$41,000	$48,000	$1,000	$1,000	$31,000	$38,000
Town of Prattsville	$2,000	$2,000	$23,000	$22,000	$294,000	$294,000	$0	$0
Town of Windham	$224,000	$233,000	$876,000	$1,034,000	$490,000	$542,000	$22,000	$23,000
Village of Athens	$0	$0	$515,000	$1,057,000	$539,000	$856,000	$159,000	$268,000
Village of Catskill	$57,000	$59,000	$2,639,000	$2,989,000	$1,907,000	$2,245,000	$5,155,000	$5,766,000
Village of Coxsackie	$301,000	$377,000	$164,000	$252,000	$597,000	$714,000	$436,000	$526,000
Village of Hunter	$0	$0	$1,000	$1,000	$3,000	$3,000	$0	$0
Village of Tannersville	$0	$0	$0	$0	$21,000	$19,000	$0	$0
Sleepy Hollow Lake*	$0	$0	$0	$0	$0	$0	$0	$0
Greene County	**$1,808,000**	**$2,052,000**	**$6,954,000**	**$8,696,000**	**$9,344,000**	**$10,763,000**	**$6,139,000**	**$6,841,000**

Source: HAZUS-MH MR3, 2007

Notes:

(1) Values represent replacement values (RV) for building structure and contents.

(2) The valuation of general building stock and the loss estimates determined in Greene County were based on the default general building stock database provided in HAZUS-MH MR3. The general building stock valuations provided in HAZUS-MH MR3 are Replacement Cost Value from RSMeans as of 2006.

(3) Town estimate does not include the total for their Village(s).

* The Sleepy Hollow Lake community is located within the Town of Coxsackie, Town of Athens and Village of Athens. The estimated losses for the Town of Coxsackie, Town of Athens and Village of Athens include the community of Sleepy Hollow. The total building replacement value for Sleepy Hollow Lake was calculated based on the approximate area of the community generated in GIS and the HAZUS-MH MR3 default general building stock therein ($119,103,000).

The estimated total loss for the 500-year flood event is greater than $320 million or five (5) percent of Greene County's building stock. This shows significant flood hazard risk.

According to the EAP for the Potuck Reservoir Dam, the probability property damage due to inundation from a dam failure is 'relatively low.' The EAP identifies ten (10) structures located downstream of the Potuck Reservoir Dam before Cob Creek meets the Potic Creek. The Water Filtration Plant, its buildings and 3 or 4 residences are located at "an elevation that is within 20-feet of the stream course's natural elevation." According to the EAP for Sleepy Hollow Dam, 49 properties are identified as vulnerable if a dam failure were to occur including residential, commercial and municipal structures (Crawford & Associates, 2002; Crawford & Associates, 2008).

In addition to total building stock modeling, individual data available on flood policies, claims, RLP and severe RLP (SRL's) were analyzed. FEMA Region 2 provided a list of residential properties with NFIP policies, past claims and multiple claims (RLPs). According to the metadata provided: "The NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are two or more losses reported which were paid more than $1,000 for each loss. The two losses must be within 10 years of each other & be as least 10 days apart. Only losses from (*sic* since) 1/1/1978 that are closed are considered."

Severe RLP identified by FEMA Region II were then examined in Greene County. According to section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a, a severe RLP property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- 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

- 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 of the above, at least two of the referenced claims must have occurred within any 10-year period, and must be greater than 10 days apart.

A summary table of NFIP Loss Claims and Payment Data, including outstanding claims as of August 31, 2008 is displayed below in Table 5.4.1-12. This table also displays Repetitive Loss and Severe Repetitive Loss Property statistics (refer to Figure 5.4.1-24). According to FEMA, there are twenty (20) RL properties in the Greene County. Of these 20 RL properties, five RL properties are classified as 'single family', five RL properties are 'assumed condominiums', four RL properties are 'non-residential' and six properties are not classified (FEMA Region 2, 2008). The location of the properties with policies, claims and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations are more accurate than others. This data is more current than the properties reported in the New York State HMP and may explain any difference in property count between the two sources.

Table 5.4.1-12. NFIP Policies, Claims and Repetitive Loss Statistics

Jurisdiction	# Policies (1)	Insurance (3)	# Claims (Losses) (4)	Total Loss Payments (4)	# Rep. Loss Prop. (2)	# Severe Rep. Loss Prop. (2)	# Polices in 100-year Boundary (1)	# Polices in 500-Boundary (1)	# Policies Outside the 500-year Flood Hazard (1)
Town of Ashland	7	$4,751,000	27	$298,360.27	0	0	6	6	1
Town of Athens	5	$937,000	4	$76,690.68	0	0	2	2	3
Town of Cairo	49	$7,834,100	23	$103,016.30	0	0	10	12	37
Town of Catskill	52	$10,145,400	74	$2,466,327.56	5	3	5	6	46
Town of Coxsackie	4	$1,347,500	2	$1,617.00	0	0	1	1	3
Town of Durham	12	$2,522,500	6	$15,441.11	0	0	6	6	6
Town of Greenville	9	$3,239,200	1	$12,100.00	0	0	1	1	8
Town of Halcott	1	$50,000	1	$17,770.81	0	0	0	0	1
Town of Hunter	30	$6,429,500	16	$68,862.64	1	0	11	11	19
Town of Jewett	22	$4,438,600	13	$48,419.21	1	0	7	7	15
Town of Lexington	27	$4,343,800	25	$280,869.91	3	0	4	4	23
Town of New Baltimore	11	$1,695,200	1	$0	0	0	4	4	7
Town of Prattsville	35	$3,374,000	56	$243,857.51	8	0	19	19	16
Town of Windham	41	$6,710,000	4	$35,703.51	0	0	16	16	25
Village of Athens	18	$2,585,400	6	$70,819.32	1	0	12	14	4
Village of Catskill	17	$7,814,500	10	$270,006.08	0	0	6	8	9
Village of Coxsackie	17	$2,667,500	7	$63,158.56	0	0	8	9	8
Village of Hunter	33	$7,198,600	13	$88,146.85	1	0	9	9	24
Village of Tannersville	11	$1,559,300	20	$76,723.09	0	0	1	1	10
Greene County	**401**	**$79,643,100**	**309**	**$4,237,890.41**	**20**	**3**	**128**	**136**	**265**

Source:

(1) Policies provided by FEMA Region II, December 2008 using the "Comm_Name". To calculate policies located within the 100- and 500-year flood boundaries, the boundaries generated by HAZUS-MH MR3 were used.

(2) FEMA Region II, December 2008. For repetitive loss and severe repetitive loss properties, only insured properties are included. Claims closed without payment are not included.

(3) http://bsa.nfipstat.com/reports/1011.htm#NYT As of August 31, 2008

(4) http://bsa.nfipstat.com/reports/1040.htm#36 As of August, 31, 2008

Impact on Critical Facilities

In addition to considering general building stock at risk, the risk of flood to critical facilities, utilities and user-defined facilities was evaluated. Tables 5.4.1-13 and 5.4.1-14 list the facilities and percent damage HAZUS-MH MR3 estimates to structures and/or contents as a result of a 100- and 500-year MRP event, respectively. Tables 5.4.1-15 and 5.4.1-16 list the utilities and percent damage HAZUS-MH MR3 as a result of a 100- and 500-year MRP event, respectively. In select cases, HAZUS-MH did not estimate any damage to a facility even though the facility is located in the floodplain. Therefore, the estimated depth of water (rounded to the nearest whole number) associated with that facility was compared against general building stock or utility damage functions available in HAZUS-MH, and the estimated percent damage to the structure/utility is listed.

As listed in the tables below, there are critical facilities estimated to be impacted by the flood hazard. Transportation features are not accounted for in Tables 5.4.1-13 to 5.4.1-16. Based on their location, the Catskill Valley Airpark and Freehold Airport are located within the 100-year regulatory floodplain.

In cases where short-term functionality is impacted by a hazard, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce impact to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs.

Table 5.4.1-13. Estimated Damage to Critical Facilities in Greene County from the 100-Year MRP Event

Name	Town	Type	Percent Building Damage	Percent Content Damage	Estimated Flood Depth (feet)
Post Office	Ashland (T)	User Defined	8	NA	1.7
Ashland Fire Dept	Ashland (T)	Fire/EMS	10	NA	1.1
Greene County Highway Garage [1]	Ashland (T)	User Defined	NA	NA	NA
Kiskatom Volunteer Fire Dept.	Catskill (T)	Fire/EMS	5.6	6.4	0.8
Grapeville Baptist School	Catskill (V)	School	6.3	34.0	1.6
Catskill Middle School	Catskill (V)	School	7.5	41.7	12.4
Catskill Senior High School	Catskill (V)	School	20	NA	10.1
Earlton Fire Dept.	Coxsackie (T)	Fire/EMS	4.2	25.9	0.5
Hunter Fire Co. #1	Hunter (V)	Fire/EMS	55.6	100	15.9
Town of Lexington Fire co.	Lexington (T)	Fire/EMS	12.0	54.9	4.0
Prattsville Hose Co.	Prattsville (T)	Fire/EMS	10.9	35.8	1.7
Greene County Sheriff Prattsville SubStation	Prattsville (T)	Police	9.4	17.5	1.8
Greene County Head Start	Prattsville (T)	School	54.2	100	20.6
Village Hall/Court	Tannersville (V)	User Defined	5	NA	0.2
Village Garage [1]	Tannersville (V)	User Defined	NA	NA	NA
Windham Hose Co. #1	Windham (T)	Fire/EMS	12.1	55.4	5.5
School Bus Garage	Windham (T)	User Defined	51	NA	12.6
Town Hall	Windham (T)	User Defined	8	NA	2.5
Windham-Ashland Jewett School	Windham (T)	School	13.2	72.3	7.7

Source: HAZUS-MH MR3, 2007
Notes: NA = Not available. T = Town. V = Village.
[1] = Located within the regulatory 100-year floodplain. HAZUS-MH MR3 did not estimate damages for this facility.

Table 5.4.1-14. Estimated Damage to Critical Facilities in Greene County from the 500-Year MRP Event

Name	Town	Type	Percent Building Damage	Percent Content Damage	Estimated Flood Depth (feet)
Post Office	Ashland (T)	User Defined	13	NA	3.3
Ashland Fire Dept	Ashland (T)	Fire/EMS	10	NA	1.8
Greene County Highway Garage[1]	Ashland (T)	User Defined	NA	NA	NA
County Annex [1]	Cairo (T)	User Defined	NA	NA	NA
Kisatom Volunteer Fire Dept	Catskill (T)	Fire/EMS	4.6	5.3	1.3
Grapeville Baptist School	Catskill (V)	School	9.0	56.7	4.0
Catskill Middle School	Catskill (V)	School	7.0	38.3	3.1
Catskill Senior High School	Catskill (V)	School	39	NA	14.1
Earlton Fire Dept.	Coxsackie (T)	Fire/EMS	1.1	1.3	8.9
Hunter Fire Co. #1	Hunter (V)	Fire/EMS	61.3	100	23.4
Hunter Elementary School	Hunter (V)	School	< 5	NA	0.9
Highway Building [1]	Jewett (T)	User Defined	NA	NA	NA
Town of Lexington Fire co.	Lexington (T)	Fire/EMS	12.8	58.8	4.0
Greene County Head Start	Prattsville (T)	School	51.9	100	19.2
Greene County Sheriff Prattsville SubStation	Prattsville (T)	Police	8.3	13.1	1.8
Prattsville Hose Co.	Prattsville (T)	Fire/EMS	10.9	36.6	4.8
Village Hall/Court	Tannersville (V)	User Defined	5	NA	0.2
Village Garage [1]	Tannersville (V)	User Defined	NA	NA	NA
School Bus Garage	Windham (T)	User Defined	48	NA	11.5
Town Hall	Windham (T)	User Defined	14	NA	4.3
Windham Hose Co. #1	Windham (T)	Fire/EMS	12.1	55.6	5.3
Windham-Ashland Jewett School	Windham (T)	School	13.2	72.3	6.6

Source: HAZUS-MH MR3, 2007
Notes: NA = Not available. T = Town. V = Village.
[1] = Located within the regulatory 500-year floodplain. HAZUS-MH MR3 did not estimate damages for this facility.

Table 5.4.1-15. Estimated Damage to Utilities in Greene County from the 100-Year MRP Event

Name	Town	Type	Percent Damage	Estimated Flood Depth (feet)
Athens (V) STP - Main Plant	Athens (V)	WW Facility	> 40	14.3
Athens Village Pump	Athens (V)	WW Pump	> 40	16.7
Central Hudson General Electric 3	Catskill (V)	Electric Substation	9	6.4
Catskill Waste Water Treatment Plant	Catskill (V)	WW Facility	> 40	23.6
Water Pressure Reducing Valve Vault 2	Catskill (V)	WW Facility	> 40	13.7
Sewer Pump Station 1	Catskill (V)	WW Pump	40	5.2
Sewer Pump Station 2	Catskill (V)	WW Pump	40	8.8
Sewer Pump Station 3	Catskill (V)	WW Pump	> 40	14.4
Water Pressure Reducing Valve Vault 2	Catskill (V)	WW Facility	> 40	10.3
Coxsackie (V) STP	Coxsackie (V)	WW Facility	> 40	14.7
Waste Water Pump Station 2	Hunter (T)	WW Pump	40	9.2
Well 2	Hunter (V)	Potable Water	3.2	2.4
Well 3	Hunter (V)	Potable Water	40	8.6
New Baltimore (T) SD STP	New Baltimore (T)	WW Facility	40	9.4
Hensonville West Winds Well	Windham (T)	Potable Water	40	0.1
Waste Water Pump House 3	Windham (T)	WW Pump	14.5	2.2
Waste Water Pump House 1	Windham (T)	WW Pump	0.0	1.8
Town Water Pump House	Windham (T)	WW Pump	40	7.2

Source: HAZUS-MH MR3, 2007
Notes: NA = Not available. T = Town. V = Village.

Table 5.4.1-16. Estimated Damage to Utilities in Greene County from the 500-Year MRP Event

Name	Town	Type	Percent Damage	Estimated Flood Depth (feet)
Athens (V) STP – Main Plant	Athens (V)	WW Facility	> 40	17.0
Athens Village Pump	Athens (V)	WW Pump	> 40	20.3
Catskill Waste Water Treatment Plant	Catskill (V)	WW Facility	> 40	28.2
Central Hudson General Electric 3	Catskill (V)	Electric Substations	15	10.8
Sewer Pump Station 1	Catskill (V)	WW Pump	40	7.0
Sewer Pump Station 2	Catskill (V)	WW Pump	> 40	12.9
Sewer Pump Station 3	Catskill (V)	WW Pump	> 40	10.6
Water Pressure Reducing Valve Vault 1	Catskill (V)	WW Facility	NA	3.0
Water Pressure Reducing Valve Vault 2	Catskill (V)	WW Facility	> 40	10.3
Coxsackie (V) STP	Coxsackie (V)	WW Facility	> 40	18.8
Waste Water Pump Station 2	Hunter (V)	WW Pump	> 40	11.3
Well 2	Hunter (V)	Potable Water Facility	17.45	4.2
Well 3	Hunter (V)	Potable Water Facility	40	8.1
New Baltimore (T) SD STP	New Baltimore (T)	WW Facility	> 40	12.9
Hensonville West Winds Well	Windham (T)	Potable Water	40	4.0
Hensonville 2 Water Wells [1]	Windham (T)	Potable Water	NA	NA
Town Water Pump House	Windham (T)	WW Pump	40	6.8
Waste Water Pump House 3	Windham (T)	WW Pump	40	1.7

Source: HAZUS-MH MR3, 2007
Notes: NA = Not available. T = Town. V = Village.
[1] = Located within the regulatory 500-year floodplain. HAZUS-MH MR3 did not estimate damages for this facility.

Impact on Economy

For impact on economy, estimated losses from a flood event are considered. Losses include but are not limited to general building stock damages, agricultural losses, business interruption, impacts to tourism and tax base to Greene County. Additionally, compromised water supplies due to dam failures will also impact the local economy. Damages to general building stock can be quantified using HAZUS-MH as discussed above. Other economic components such as loss of facility use, functional downtime and social economic factors are less measurable with a high degree of certainty. For the purposes of this analysis, general building stock damages are discussed further.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. The potential damage estimated to the general building stock inventory associated with the 100-year flood is greater than $283 million. This estimate represents 82% of the total value exposed (building value located in the floodplain) to the 100-year flood and greater than 4% of the County's overall total general building stock inventory. For the 500-year event, the potential damage estimate is greater than $322 million (structure and contents), or 78% of the total exposed building value. This is approximately 5% of the County's total general building stock replacement value inventory. These dollar value losses to the County's total building inventory replacement value would greatly impact Greene's tax base and the local economy.

When a flood occurs, the agricultural industry is at risk in terms of economic impact and damage (i.e., damaged crop, financial loss to the farmer). In 2002, the market value of agricultural products sold from Greene County totaled $14.4 million, with total sales averaging $42,352 per farm. The leading agricultural products sold were dairy products, nursery and greenhouse products, vegetables, hay and other crops (USDA NASS, 2005). Table 5.4.1-17 shows acreage, yield and production of crops for Greene County that would be exposed to the flood hazard.

Table 5.4.1-17. Acreage, Yield and Production of Crops in Greene County for 2003

Crop Type	Harvested (acres)	Yield per acre	Total Production
Hay (alfalfa and other)	17,800	1.7 tons	30,900 tons
Corn (grain)	600	83 bushels	49,500 bushels
Corn (silage)	900	17.6 tons	15,800 tons

Source: USDA NASS, 2005

Table 5.4.1-18 shows 40-percent and 60-percent loss estimates for hay and corn based on 2003 production. Given professional knowledge and historic loss information available, these are considered conservative estimates of potential losses for this hazard.

Table 5.4.1-18. Estimated Losses to Crops in Greene County

Crop Type	Total Production	40% Loss Estimate	60% Loss Estimate
Hay (alfalfa and other)	30,900 tons	12,360 tons	18,540 tons
Corn (grain)	49,500 bushels	19,800 bushels	29,700 bushels
Corn (silage)	15,800 tons	6,320 tons	9,480 tons

Source: USDA NASS, 2005

The resort and tourism industry can also be impacted by flood events. These losses impact Greene's tax base and the local economy. Specific loss information (monetary losses per day or season) was not available at the time this Plan was drafted. However, over time additional data will be collected to quantify losses to this sector of Greene County's economy.

Future Growth and Development

As discussed in Section 4 and Section 9 within each jurisdiction's annex, areas targeted for future growth and development have been identified across the County. Any new development within the identified flood hazard areas will be at risk to flooding.

Additional Data Needs and Next Steps

A modified Level 1 HAZUS-MH flood analysis was conducted for Greene County using the default model data, with the exception of the updated critical facility inventory which included user-defined data. For future plan updates, a Level 2 HAZUS analysis can be conducted. A Level 2 analysis provides more accurate loss estimates by replacing the national default inventories with more accurate local inventories. Updated demographic and general building stock data would be needed to conduct a Level 2 HAZUS-MH analysis. Current replacement values of critical facilities would also further support the refined analysis.

Overall Vulnerability Assessment

The flood hazard is evaluated as a significant threat, which was ranked overall as a 'High' risk by the Planning Committee (see Tables 5.3-3 through 5.3-6). This hazard can be managed and planned for through the mitigation strategy and specific activities outlined in Volume II Section 9, which build on efforts already undertaken by this community.