FLOOD

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

HAZARD PROFILE

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

Description

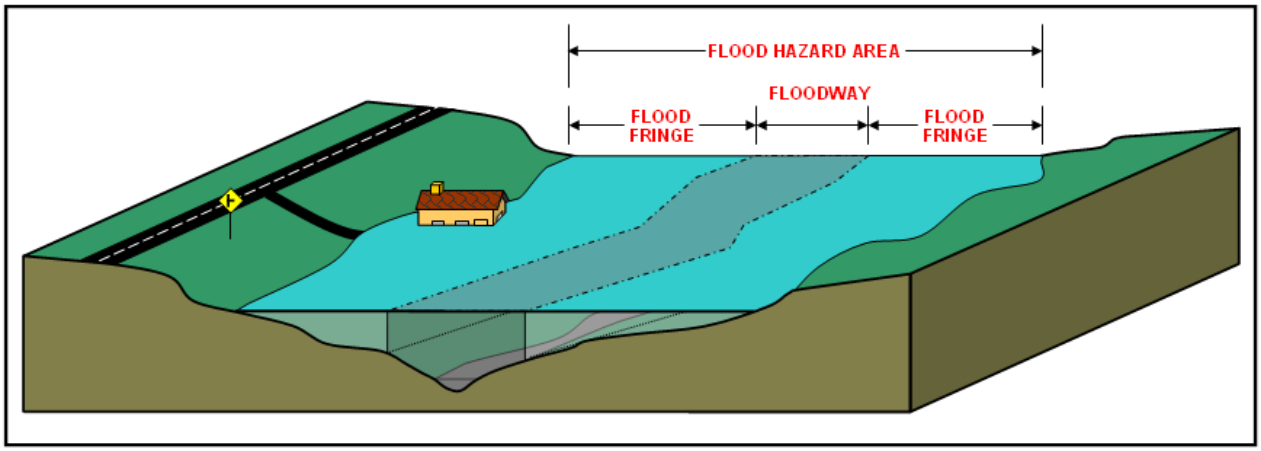
Floods are one of the most common natural hazards in the U.S. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (Federal Emergency Management Agency [FEMA], 2010). 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. As defined in the NYS HMP, flooding is a general and temporary condition of partial or complete inundation of normally dry land from the following:

- Riverine flooding, including overflow from a river channel, flash floods, alluvial fan floods, dam-break floods and ice jam floods;
- Local drainage or high groundwater levels;
- Fluctuating lake levels;
- Coastal flooding;
- Coastal erosion (Draft NYS HMP, 2011)
- 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 (Floodsmart.gov, 2012);
- Sea Level Rise; or
- Climate Change (USEPA, 2012).

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 now refers to this flood as the one-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 Flood hazard area, flood fringe, and the floodway



Source: NJDEP, Date Unknown

Notes: **Floodway** - the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without causing any cumulative increase in the water surface elevation. The floodway is intended to carry the dangerous and fast-moving water.

Flood Fringe - areas outside the regulatory floodway but still inundated by the designated 1 percent annual chance flood (often referred to as the floodway fringe).

Many floods fall into three categories: riverine, coastal and shallow (FEMA, 2008). http://www.floods.org/Certification/FEMA_480.asp Other types of floods may 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 Cayuga County, riverine/flash, lakeshore, dam failure and ice jam flooding are the main flood types of concern for the Planning Area. These types of flood are further discussed below.

Riverine/Flash Floods – Riverine floods are the most common flood type and occur along a channel, and include overbank and flash flooding. Channels are defined, ground features 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 (FEMA, 2008; The Illinois Association for Floodplain and Stormwater Management, 2006).

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, 2009).

Lakeshore Floods – Lakeshore flooding is a common flood type in Cayuga County, and occurs when high water levels inundate the shoreline. The damage to lake-side docks and shoreline development can be amplified by waves that carry the water to even higher elevations, causing additional wave action damage. As a result, debris is often left scattered along the shore when the water recedes. The shorelines of Cayuga Lake, Owasco Lake, Skaneateles Lake, Lake Ontario, Cross Lake, and Little Sodus Bay are all susceptible to lakeshore flooding. Development near wetlands may also experience auxiliary flood damages from lakeshore flood events (STCRPDB, 1999).

Ice Jam Floods – An ice jam is an accumulation of ice that acts as a natural dam and restricts flow of a body of water. Ice jams may build up to a thickness great enough to raise the water level and cause flooding (NESEC, Date Unknown; FEMA, 2008).

There are three different types of ice jams: freeze-up, break-up and frazil.

- Freeze-up jams occur in the early to mid-winter when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement.
- Break-up jams occur during periods of thaw, generally in late winter and early spring. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river discharge due to a heavy rainfall, snowmelt or warmer temperatures (USACE, 2002). 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 (bridges and dams).
- Ice jams may also be caused by frazil ice, which forms when mist freezes then floats down a river, stream or creek.

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 (FEMA, 2010). Dams are man-made structures built across a stream or river that impound water and reduce the flow downstream (FEMA, 2003). They are built for the purpose of power production, agriculture, water supply, recreation, and flood protection. Dam failure is any malfunction or abnormality outside of the design that adversely affect a dam's primary function of impounding water (FEMA, 2011). 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, 2010).

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, 2011).

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, 2001).

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.
- 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.
- 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, 1999).

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 is the primary natural hazard in New York State because the State exhibits a unique blend of climatological and meteorological features that influence the potential for flooding. These factors include topography, elevations, latitude and water bodies and waterways, allowing flooding to occur in every part of the State. Some areas are more flood prone than others, but no area is exempt, including Cayuga County. There are over 52,000 miles of river and streams in New York State, 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 areas subject to flooding. Areas outside recognized and mapped flood hazard zones can also experience flooding (Draft NYS HMP, 2011).

The NYSDEC conducted a vulnerability assessment that depicted how vulnerable a county may be to flood hazards. This was determined by a rating score; each county accumulated points based on the value of each vulnerability indicator. The higher the indication for flood exposure, the more points assigned, resulting in a final rating score. The result of this assessment presented an indication of a county's vulnerability to the flood hazard. Cayuga County's rating is 14, out of a possible 35. The rating was based on number of NFIP insurance policies, number of NFIP claims, total amount of NFIP claims, total amount of NFIP policy coverage, number of repetitive flood loss properties, and number of flood disasters (Draft NYS HMP, 2011).

Riverine flooding problems are most severe in the Delaware, Susquehanna, Chemung, Erie-Niagara, Genesse, Allegany, Hudson and Mohawk River Basins (Draft NYS HMP, 2011). Cayuga County is not part of any of these river basins; however, Cayuga County is part of the Oswego River/Seneca River/Finger Lakes and Lake Ontario Tributaries River Basins (NYSDEC, Date Unknown; County Input, 2013).

Cayuga County contains streams that are located within the Seneca River watershed and several streams in the north, within the Lake Ontario watershed. Three of the central New York Finger Lakes (Owasco Lake, Cayuga Lake, and Skaneateles Lake) are located either entirely within or partially within Cayuga County. Owasco Lake lies entirely within Cayuga County and is drained at its northern end by Owasco Outlet (also known as the Owasco River and Owasco Lake Outlet), which flows northward through the City of Auburn and into the Seneca River/Erie Canal. Cayuga Lake is partially located within Cayuga County and is located on the boundary between Cayuga, Seneca and Tompkins Counties. Many streams flow westward into this lake. It is drained at its northern end by the Seneca River/Seneca-Cayuga Canal. A portion of Skaneateles Lake is located within the eastern part of Cayuga County. Several streams flow eastward into this lake and it is drained at its northern end by Skaneateles Creek (FEMA FIS, 2007; Cayuga County, 2007).

Several major streams within Cayuga County are located in the watershed that drains into the Seneca River/Erie Canal. These streams include the following: Crane Brook, Owasco Outlet (also known as Owasco Lake Outlet or Owasco River), Cold Spring Brook, and Putnam Brook. Muskrat Creek runs through the Town of Cato into the Seneca River (FEMA FIS, 2007; County Input, 2013).

Flooding in Cayuga County may occur during any time of the year, primarily in response to severe or long-duration precipitation events. Before 1993, the highest recorded water levels for Cayuga Lake occurred following Tropical Storm Agnes in June 1972. This water level was exceeded by 0.75 inches during the snowmelt from the Blizzard of 1993. The highest levels ever reached on Owasco Lake were in 1936 and 1940, before the U.S. Army Corps of Engineers developed the Rule Curve followed by the City of Auburn since about 1960. These two flood events on Owasco Lake produced lake levels a half foot higher than Tropical Storm Agnes. Flooding in the watershed has also occurred in response to combined early spring heavy rain and snowmelt events. Streams draining into Cayuga Lake and Owasco Lake are subject to lake backwater effects (FEMA, 2007; County Input, 2013).

There are several roadways in the Cayuga County that are historically floodprone. These roadways include:

- Aurora Street in the Village of Moravia, near the ball fields and the wastewater treatment plant
- Fair Haven Short Cut Road in the Town of Sterling (County Input, 2012)

Other areas of flooding in Cayuga County include the following:

- The southern shore of Lake Como has poorly drained soil that floods several times a year. According to the preliminary FIRM (2005), there are houses located in the SFHA that are subject to 100-year floods (Cayuga County Department of Planning and Economic Development, 2007).
- In the Village of Union Springs, the shoreline of Cayuga Lake is subject to periodic flooding. There are also three areas, along tributaries, where large flooding events may cause widespread flooding. The first area is Frontenac Park, North Pond and Spring Street; the second area is near Foundry, Factory and Basin Streets; and the third area is in the area of Arnold and Evergreen Streets (Village of Union Springs Comprehensive Plan, 2007).
- In the Village of Meridian, SFHAs subject to 100-year floods are located along Ferris Road, to the east of the Meridian Fire Department and in some areas along Short Cut Road (Village of Meridian Comprehensive Plan, 2009).
- In the Town of Springport, areas within a 100-year floodplain include areas along Yawger Creek, Great Gully Creek and other unnamed tributaries to Cayuga Lake (Town of Springport Visioning Plan, 2011).

- In the Town of Fleming, flood hazard areas are generally found along Crane Brook, Van Ness Brook (Veness Brook), and Yawger Creek (Town of Fleming Comprehensive Plan, 2001).

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 indicated 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 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, 2005; FEMA, 2008).

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 Program's (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 depict 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, 2005; FEMA, 2003). As noted earlier, FEMA and most federal agencies now use the term "one-percent annual chance flood" in lieu of the "100-year flood" terminology.

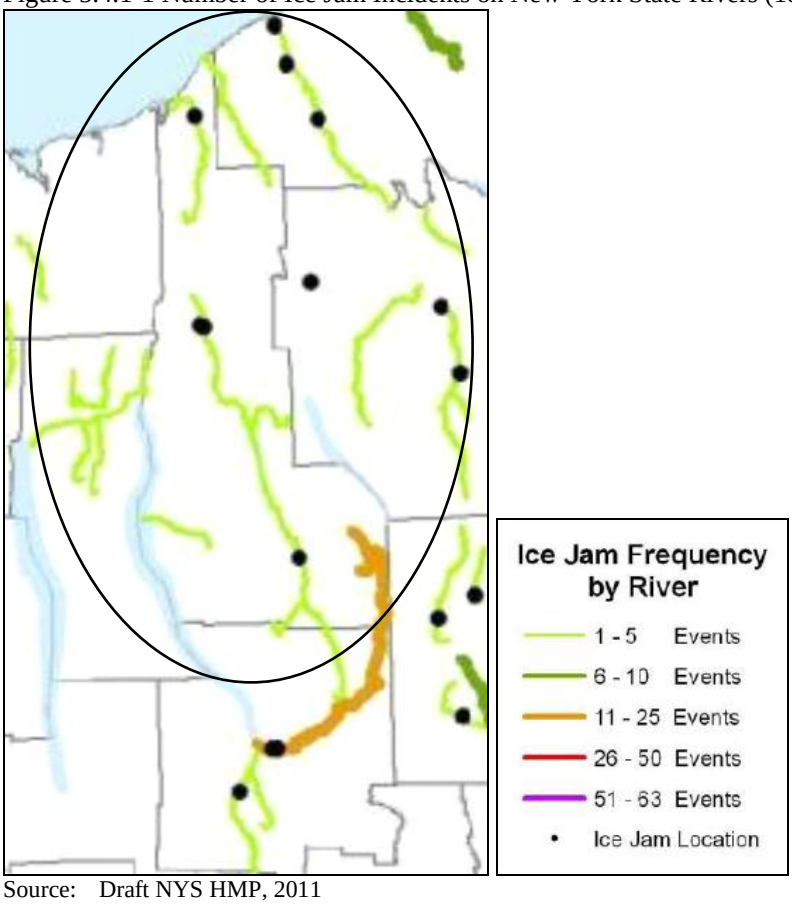
Flood Insurance Study (FIS)

In addition to FIRM and DFIRMs, FEMA also provides 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). A countywide FIS for Cayuga County has been completed. The 2007 FIS discussed the principal flood problems in Cayuga County (see above) (FEMA, 2007). The 2007 FIS, combined with County-wide LiDAR, were the basis for Cayuga County-wide map modernization resulting in completely updated, digital FIRMs for the entire County (County Input, 2013).

Ice Jam Hazard Areas

Ice jams are common in the Northeast U.S. and New York is not an exception. In fact, according to the USACE, New York State ranks second in the U.S. for total number of ice jam events, with over 1,500 incidents documented between 1867 and 2010. 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, the Mohawk Valley of central and eastern New York State and the North Country (Draft NYS HMP, 2011). Figure 5.4.1-2 presents the number of ice jam incidences within the vicinity of Cayuga County between 1780 and 2010.

Figure 5.4.1-1 Number of Ice Jam Incidents on New York State Rivers (1875 – 2007)



Source: Draft NYS HMP, 2011
Note (1): Oval indicates location of Cayuga 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 over 18,000 records from across the U.S. According to the USACE-CRREL, Cayuga County experienced nine historic ice jam events between 1875 and 2012 (Ice Engineering Research Group, 2012). Historical events are further mentioned in the "Previous Occurrences" section of this hazard profile.

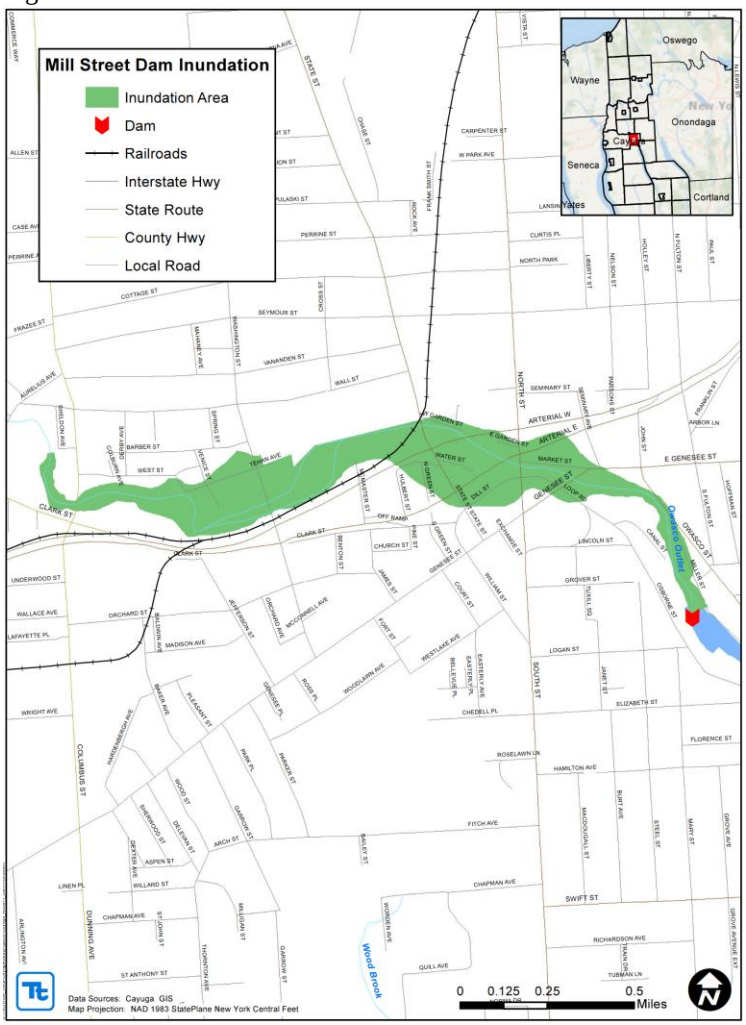
Dam Break Hazard Area

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, and 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, Date Unknown).

Refer to Table 4-26 and Figure 4-20 in the Cayuga County Profile (Section 4) for dams located in Cayuga County. Figure 5.4.1-2 illustrates the dam break inundation area for the Mill Street Dam in the City of Auburn.

Figure 5.4.1-2. Mill Street Dam Inundation Area



Source: Cayuga GIS

Previous Occurrences and Losses

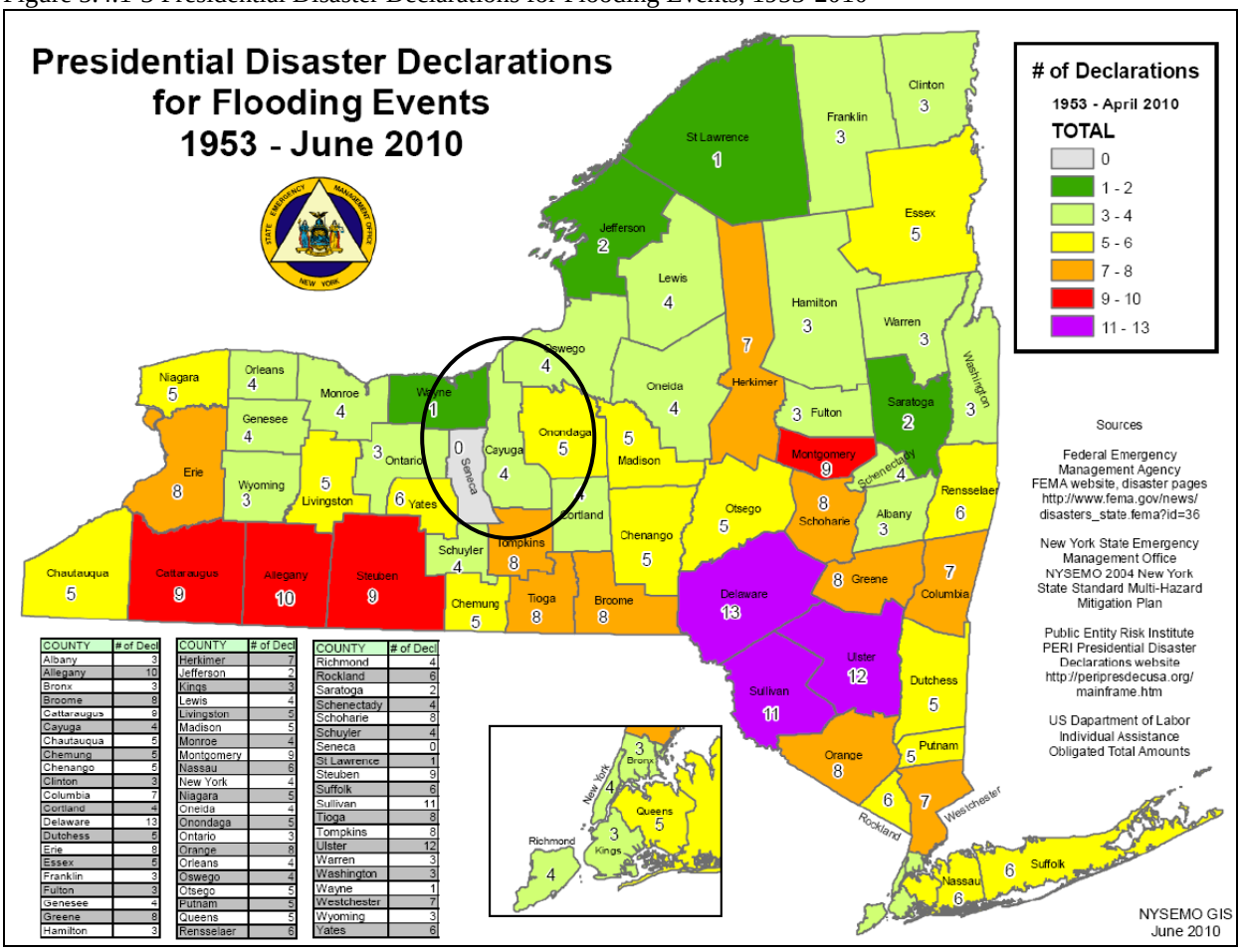
Many sources provided historical information regarding previous occurrences and losses associated with flooding events throughout New York State and Cayuga County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source.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

According to NOAA's NCDC storm events database, Cayuga County experienced 27 flood events between 1950 and July 2012. Total property damages, as a result of these flood events, were estimated at $8.86 million and $150,000 in crop damages; however, the estimate only includes damages identified in the database and the total may not agree with specific event information presented later in this plan. According to the Hazard Research Lab at the University of South Carolina's Spatial Hazard Events and Losses Database for the U.S. (SHELDUS), between 1960 and 2010, 34 flood events occurred within Cayuga County. The database indicated that flood events and losses specifically associated with Cayuga County and its municipalities totaled over $3.6 million in property damage and over $966,000 in crop damage. However, these numbers may vary due to the database identifying the location of the hazard event in various forms or throughout multiple counties or regions.

Between 1954 and 2012, FEMA declared that New York State experienced 38 flood-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: severe storms, coastal storms, flash flooding, heavy rain, tropical storm, hurricane, high winds, ice jam, wave action, high tide and tornado. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, the NYS HMP and other sources indicate that Cayuga County has been declared as a disaster area as a result of five flood events (FEMA, 2012).

Figure 5.4.1-3 shows the FEMA disaster declarations (DR) for flooding events in New York State, from 1953 to June 2010. This figure indicates that Cayuga County was included in four disaster declarations; however, between 1953 and 2010, Cayuga County has been included in five disaster declarations. Since the date of this figure, Cayuga County has not been included in any additional FEMA disaster declarations for flooding.

Figure 5.4.1-3 Presidential Disaster Declarations for Flooding Events, 1953-2010



COUNTY	# of Decl
Albany	3
Allegany	10
Bronx	3
Broome	8
Cattaraugus	9
Cayuga	4
Chautauqua	5
Chemung	5
Chenango	5
Clinton	3
Columbia	7
Cortland	4
Delaware	13
Dutchess	5
Erie	8
Essex	5
Franklin	3
Fulton	3
Genesee	4
Greene	8
Hamilton	3

COUNTY	# of Decl
Herkimer	7
Jefferson	2
Kings	3
Lewis	4
Livingston	5
Madison	5
Monroe	4
Montgomery	9
Nassau	6
New York	4
Niagara	5
Oneida	4
Onondaga	5
Ontario	3
Orange	8
Orleans	4
Oswego	4
Otsego	5
Putnam	5
Queens	5
Rensselaer	6

COUNTY	# of Decl
Richmond	4
Rockland	6
Saratoga	2
Schenectady	4
Schoharie	8
Schuyler	4
Seneca	0
St Lawrence	1
Steuben	9
Suffolk	6
Sullivan	11
Tioga	8
Tompkins	8
Ulster	12
Warren	3
Washington	3
Wayne	1
Westchester	7
Wyoming	3
Yates	6

Source: Draft NYS HMP, 2011
Note: The black circle indicates the approximate location of Cayuga County.

Based on all sources researched, known flooding events that have affected Cayuga County and its municipalities are identified in Table 5.4.1-1. With flood documentation for New York State being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.1-1 may not include all events that have occurred throughout Cayuga County and the region.

Table 5.4.1-1 Flooding Events between 1950 and 2012

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
April 4-8, 1960	Severe Storms, Flooding	N/A	N/A	Moderate to heavy rains caused flooding in Cayuga County. Cayuga County had over $8 K in property damage.	SHELDUS
March 4-6, 1964	Severe Storms, Flooding, Wind	N/A	N/A	Rain, flooding and wind occurred in Cayuga County, causing over $8 K in property damage.	SHELDUS
June 25-28, 1968	Severe Storms, Flooding, Wind	N/A	N/A	Rain, flooding and wind occurred in Cayuga County, causing over $9 K in property damage and $9 K in crop damage.	SHELDUS
May 19-20, 1969	Severe Storms, Flooding	N/A	N/A	Rain and flooding in Cayuga County caused approximately $25 K in property damage.	SHELDUS
June 20-25, 1972	Severe Storms, Flooding (Remnants of Tropical Storm Agnes)	DR-338	Yes	Rain and flooding in Cayuga County caused over $3.7 M in residential, commercial and public property damages and $4.46M in crop damages. Two major dams damaged in the City of Auburn.	FEMA, SHELDUS, U.S. Army Corp of Engineers, County Input
March 17-19, 1973	High Winds, Wave Action, Flooding	DR-367	Yes	Flooding, winds and rain caused approximately $200 K in property damage in Cayuga County.	FEMA, SHELDUS
September 25-27, 1975	Severe Storms, Heavy Rain, Landslides, Flooding (Remnants of Hurricane Eloise)	DR-487	Yes	Cayuga County had approximately $6.25 M in property damage.	FEMA, SHELDUS
October 26-28, 1981	Flooding	N/A	N/A	This flood event was worse than the 1972 or 1975 events. Significant damages in Cayuga and Tompkins Counties, especially in the Town of Locke and the Village of Moravia. Damages estimated at over $2M. More than six inches of rain fell in two days, flooding between four and eight businesses and forcing evacuations in the Village of Moravia. The sewer system had to be closed. In the Town of Locke, everything east of Main Street was flooded. Twenty-four families had to be evacuated. Routes 38 and 90 were under two feet of water. Cayuga County declared a state of emergency.	The Citizen, Post Standard, County Input
April 25, 1983	Severe Storm, Flooding	N/A	N/A	Rain and flooding caused approximately $50 K in property damage.	SHELDUS

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
April 13, 1993	Flood after Blizzard	N/A	N/A	A wet spring and snowmelt caused levels of the Finger Lakes to reach flood stage and remain high throughout the month. A state of emergency was declared on Seneca, Cayuga, Owasco and Canandaigua Lakes. Motor boats were not allowed on the lakes. Wakes from the boats created additional flooding along the shores due to the water level being high. Onondaga, Cayuga, Wayne, Seneca, Oswego and Tompkins Counties were declared disaster areas. Overall, Cayuga County had approximately $5 M in property damage.	NOAA-NCDC, SHELDUS, County Input
March 23, 1994	Flood	N/A	N/A	Flooding caused approximately $500 K in property damage in Cayuga County.	NOAA-NCDC, SHELDUS
April 13, 1994	Flood	N/A	N/A	Flooding caused approximately $50 K in property damage in Cayuga County.	NOAA-NCDC
August 18, 1994	Flash Flood (Remnants of Tropical Storm Beryl)	N/A	N/A	Tropical Storm Beryl caused damage to Cayuga County, with approximately $500 K in property damage.	NOAA-NCDC, SHELDUS
January 19-20, 1996	Flash Flood	DR-1095	Yes	Cayuga County had approximately $1.4 M in property damage and one fatality from this snowmelt/flash flood event.	FEMA, NOAA-NCDC, SHELDUS, County Input
November 8-9, 1996	Flash Flood	DR-1148	No	Three to four inches of rain fell in less than 12 hours, causing flash flooding in Cayuga County. Several roads were closed due to the flooding and power outages were reported. In the Village of Weedsport, flash flooding occurred, closing several roads and caused power outages. Cayuga County had approximately $150 K in property damage.	NOAA-NCDC, SHELDUS
January 8, 1998	Flooding	DR-1196	No	Western and central NYS experienced unprecedented rainfalls over a 36-hour period for the month of January. The region received between two and four inches of rain, causing urban flooding and flooding of small streams and creeks. Cayuga County had approximately $27 K in property damage from this flooding event.	NOAA-NCDC, SHELDUS
June, 2000	Flooding	DR-1335	No	Severe TSTMs caused severe damage along the Cayuga Lake shore in the Town of Genoa. Approximately $100 K in damages along Fire Lanes 5, 6 and 7 near King Ferry Station. Tompkins County was included in this disaster; however, Cayuga County was not.	County Input

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
May, 2002	Flood			Road flooding in Union Springs and Meridian.	County Input
June 14-15, 2002	Flooding	N/A	N/A	A narrow band of rain fell from Lake Ontario across Wayne and northern Cayuga Counties. A TSTM produced downpours that resulted in flash flooding in Cayuga County. As much as five inches fell, flooding basements. In the Towns of Conquest, Ira, and Cato, roadways were flooded. Cayuga County had approximately $35 K in property damage from this flooding event.	NOAA-NCDC, SHELDUS
August 30, 2004	Flooding	DR-1564	No	Heavy rain caused flash flooding and washed out roads. In Cayuga County, between two and four inches of rain fell. The Owasco Inlet overflowed its banks and flooded roadways. Cayuga County had approximately $20 K in property damage from this flooding event.	NOAA-NCDC, SHELDUS
April 2-4, 2005	Flood	DR-1589	Yes	Between two and three inches of rain fell in the area. The rain combined with snowmelt caused flooding. Evacuations occurred in Wayne County. Overall, New York State had $66.21 M in damages. In Cayuga County, all towns were affected by flash flooding. Roads, bridges and buildings were damaged. The hardest hit areas from flash flooding were the southern quarter of Cayuga County. The Owasco Outlet that flows through the City of Auburn rose to its flood stage of five feet and crested at 8.27 feet. The Mill Street Bridge in Port Byron was lost in the Owasco Outlet flooding and cost approximately $320 K to replace. Cayuga County had approximately $800 K in property damage.	NYS HMP, FEMA, SHELDUS, County Input
July 12, 2006	Flooding	N/A	N/A	Heavy rain fell over the counties along the south shore of Lake Ontario. Two to four inches fell across Orleans and Monroe Counties; with over five inches falling over a portion of Wayne and northern Cayuga Counties. Roads, buildings and crops were inundated. Approximately six homes were destroyed by the flood waters in Wayne County. In Cayuga County, heavy rains caused flash flooding, closing many roads. Heavy rains caused many streams to overflow their banks in the City of Auburn. In the Town of Moravia, many creeks and small streams overflowed their banks. Cayuga County had approximately $313 K in property damage and $150	NOAA-NCDC, SHELDUS

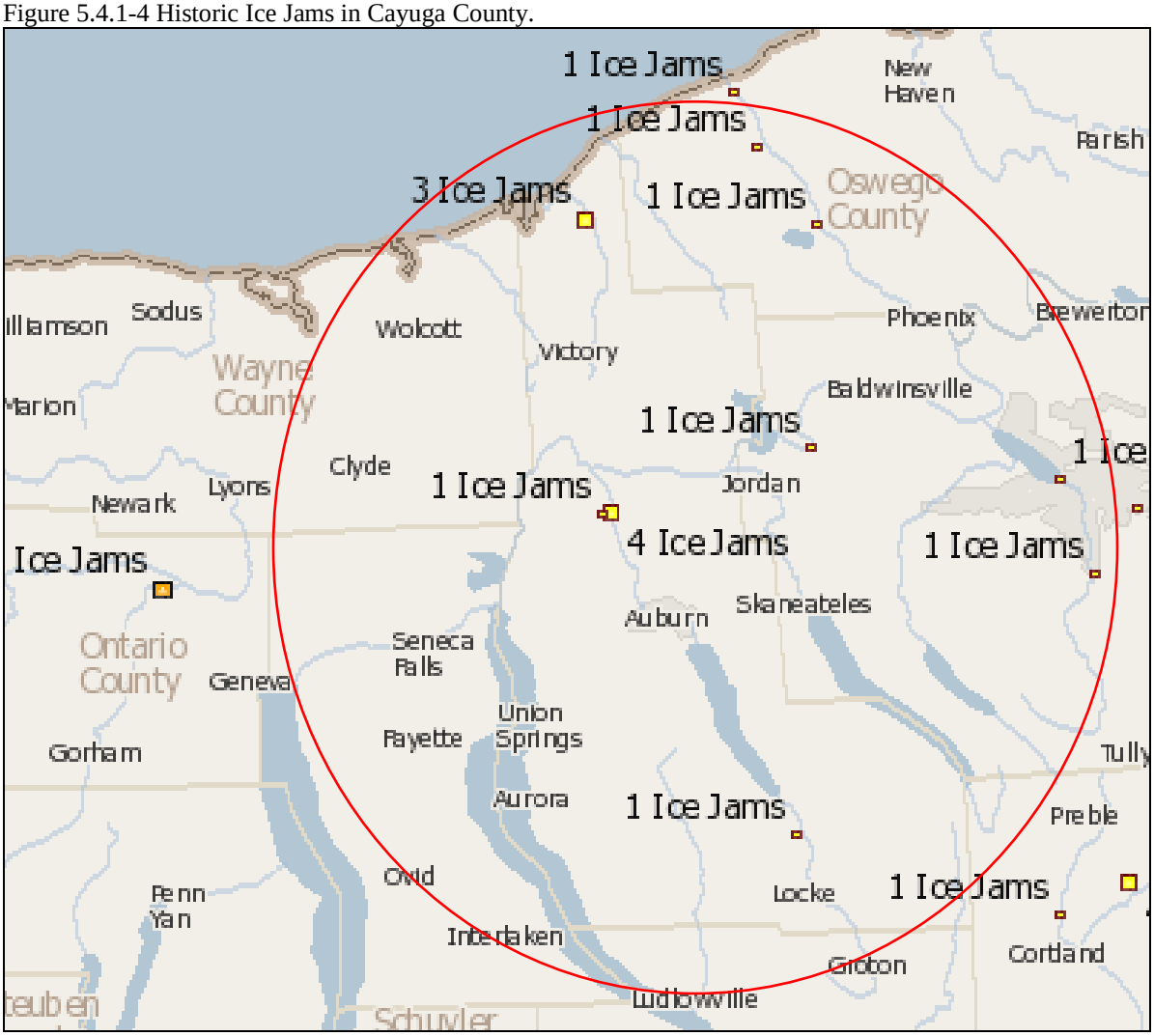
Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				K in crop damage from this event.	
July 28, 2006	Flooding	N/A	N/A	TSTMs brought heavy rain to the area. Rainfall totals between two and four inches fell in a few hours resulting in flash flooding. Roads and basements flooded. Cayuga County had approximately $50 K in property damage from this flooding event.	NOAA-NCDC, SHELDUS
November 16-17, 2006	Flash Flood	DR-1670	No	A line of TSTMs produced 45 to 74 mph winds across central New York State. This area experienced heavy rainfall, with amounts of 1.5 to four inches within three hours that caused significant flash flooding. Overall, New York State had $32.59 M in damages. In Cayuga County, roads flooded in the City of Auburn. Cayuga County had approximately $10 K in property damage.	NYS HMP, SHELDUS, FEMA, NOAA-NCDC
September 30 – October 1, 2010	Heavy Rainfall and Flooding	N/A	N/A	Rainfall totals in Cayuga County ranged from 3.01 inches to 3.45 inches.	NWS
August 28, 2011	Remnants of Hurricane Irene	DR-4020	No	In Cayuga County, rainfall totals ranged from 0.91 inches in the Village of Aurora to 1.27 inches in the Town of Locke. In the Town of Victory, trees were downed.	NWS
September 7-8, 2011	Remnants of Tropical Storm Lee	DR-4031	No	Remnants of Tropical Storm Lee produced heavy rains and caused flash flooding and river flooding across parts of central New York State and northeast Pennsylvania. In Cayuga County, rainfall totals ranged from 0.91 inches in the Town of Victory to 4.39 inches in the Town of Genoa.	NWS

Note (1): 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 increased U.S. Inflation Rates.

Cfs Cubic feet per second
DR Federal Disaster Declaration
EM Federal Emergency Declaration
FEMA Federal Emergency Management Agency
FSA Farm Service Agency
HMP Hazard Mitigation Plan
IA Individual Assistance
K Thousand ($)
M Million ($)
N/A Not applicable
NCDC National Climate Data Center
NOAA National Oceanic Atmospheric Administration
NWS National Weather Service
NYS New York State
PA Public Assistance
SHELDUS Spatial Hazard Events and Losses Database for the U.S.
TSTM Thunderstorm

According to the CRREL database, ice jams have historically formed at various points along Sterling Creek, Owasco Inlet and Owasco Outlet (Ice Engineering Research Group, 2012). Locations of historical ice jam events are indicated in Figure 5.4.1-4 below.

Figure 5.4.1-4 Historic Ice Jams in Cayuga County.



Source: CRREL, 2012
Note: Cayuga County has experienced nine ice jams between 1780 and 2012.

Based on review of the CRREL Database, Table 5.4.1-2 Ice Jam Events in Cayuga County between 1780 and 2012 lists the ice jam events that have occurred in Cayuga County between 1780 and 2012. Information regarding losses associated with these reported ice jams was limited.

Table 5.4.1-2 Ice Jam Events in Cayuga County between 1780 and 2012

Event Date	River / Location	Description	Source(s)
March 12, 1962	Owasco Inlet at the Town of Moravia	Due to backwater from ice, the maximum annual gage height of 10.61 feet and maximum annual discharge of 4,100 cfs were recorded.	CRREL
March 23, 1978	Sterling Creek at the Town of Sterling	The USGS reported backwater from ice on the Sterling Creek. The water discharge was 716 cfs and the gage height was 4.52 feet.	CRREL
January 2,	Sterling Creek at the	The USGS reported an ice jam on the Sterling Creek. The	CRREL, County

Event Date	River / Location	Description	Source(s)
1979	Town of Sterling	discharge was 380 cfs. The gage height was 4.13 feet.	Input
February 15, 1979	Owasco Outlet at the Village of Port Byron	Severe ice jamming required heavy equipment and dynamite to clear the ice. The Village's schools were closed for at least three days. Ice jams in the Outlet resulted in flooding and evacuation of several homes. Cayuga County declared the area as a disaster site.	CRREL
March 6, 1979	Sterling Creek at the Town of Sterling	The USGS reported an ice jam on the Sterling Creek. The water discharge was 1,800 cfs. The gage height was 5.69 feet.	CRREL, County Input
December 1, 1982	Owasco Outlet at the Village of Port Byron	Ice jams at the Owasco Outlet caused major floods.	CRREL
March 1, 1993	Owasco Outlet at the Village of Port Byron	The ice-clogged Owasco River forced water over its banks in two places in the Village and impacted proper functioning of the sewage treatment plant.	CRREL
January 19, 1994	Owasco Outlet at the Village of Port Byron	A freeze-up ice jam was reported in the Village of Port Byron and existed from the abandoned railroad grade (downstream from the Village) up through the entire Village limits. The entire river was chocked with frazil deposits that were now consolidated and refroze. The ice made contact with the underside of two bridges in the jammed area and the sewage treatment plant and the access road became impassable. About 30 to 40 homes in the Green Street area were vulnerable and 30 homes were evacuated. Some homes had basement flooding and one residence had extensive basement flooding due to seepage. Local officials mobilized a clam shell crane to break up the ice jam and the City of Auburn reduced the flow in the Owasco Outlet.	CRREL, County Input
January 1, 1996	Owasco Outlet at the Village of Port Byron	This storm event required the leasing of a crane to remove logs from the Green Street Bridge and other emergency response. The Village had approximately $1,800 in costs with County and Town emergency response costs of about $700. These damages have been used as the five-year ice jam event.	CRREL

Source: CRREL, 2012
Note: This table may not represent all ice jam events in Cayuga County.

At least three other locations that frequently experience ice jams are the mouth of Dutch Hollow Brook on Owasco Lake, Mill Creek in the Village of Moravia, and Putnum Brook just northeast of the Village of Weedsport. These ice jams can cause localized flooding impacting from three to 12 homes and temporary road closures (County Input, 2013).

According to Planning Committee input, the City of Auburn and Cayuga County Planning Department have worked together to reduce the ice jam flooding in Port Byron through controlling the flow of the Owasco Outlet during very cold periods. The Green Street Bridge in Port Byron was replaced in 2004 from a three span to a single span which reduced ice jam flooding.

National Flood Insurance Program

The U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968 (FEMA's 2002 *National Flood Insurance Program (NFIP): Program Description*). 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. As stated in the NYS HMP, the NFIP collects and stores a vast quantity of information on insured structures, including the number and location of flood insurance

policies, 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).

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, 2008).

NFIP data for Cayuga County is presented further in Table 5.4.1-10 in the Vulnerability Assessment section of this profile.

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, 2007). According to FEMA, the Village of Moravia participates in the CRS program (FEMA, 2012).

Probability of Future Events

Given the history of flood events that have impacted Cayuga County, it is apparent that future flooding of varying degrees will occur. The fact that the elements required for flooding exist and that major flooding has occurred throughout Cayuga County in the past suggests that many people and properties are at risk from the flood hazard in the future.

In addition to riverine flooding, ice jams frequently occur in New York State, and Cayuga County is no exception. According to the New York State HMP, New York State is ranked as the state with the second highest number of ice jam events compared to the remainder of the U.S. (Draft NYSHMP, 2011). Refer to the Vulnerability Assessment for a complete discussion of vulnerable population, facilities, utilities and infrastructure in Cayuga County.

It is estimated that Cayuga County will continue to experience direct and indirect impacts of floods annually. Table 5.4.1-3 summarizes the occurrences of flood events and their annual occurrence (on average).

Table 5.4.1-3 Occurrences of Flood Events in Cayuga County, 1960 - 2012

Event Type	Total Number of Occurrences	Annual Number of Events (average)
Coastal Flood	2	0.04
Flash Flood	19	0.37
Flood	6	0.16
Total:	**27**	**0.52**

Source: NOAA-NCDC, 2012
Note: On average, Cayuga County experiences 0.52 flood events each year. This table may not include all flood events that occurred between 1960 and 2012, as it is only based on the NOAA-NCDC storm database events.

Of note is that lake flooding seems to be less severe on Owasco Lake since the 1970s, but intensifying on Cayuga Lake during the same period. Cayuga Lake flood levels may be impacted by habitat management activities at the Montezuma National Wildlife Refuge, which has implemented measures to control wetland flooding, potentially reducing flood storage in the Cayuga Lake/Seneca River area (County Input, 2013).

In Section 5.3, the identified hazards of concern for Cayuga County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for flood in Cayuga County is considered 'frequent' (likely to occur within 25 years, as presented in Table 5.3-6).

The Role of Global Climate Change on Future Probability

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Cayuga County is part of Region 1, Western New York Great Lakes Plain. Some of the issues in this region, affected by climate change, include: agricultural revenue is the highest in New York State; relatively low rainfall, increased summer drought risk; high-value crops could need irrigation; and improved conditions for grapes projected (NYSERDA, 2011).

Temperatures are expected to increase throughout the state, by 1.5 to 3ºF by the 2020s, 3.5 to 5.5ºF by the 2050s and 4.5 to 8.5ºF by the 2080s. The lower ends of these ranges are for lower greenhouse gas emissions scenarios and the higher ends for higher emissions scenarios. Annual average precipitation is projected to increase by up to five-percent by the 2020s, up to 10-percent by the 2050s and up to 15-percent by the 2080s. During the winter months is when this additional precipitation will most likely occur, in the form of rain, and with the possibility of slightly reduced precipitation projected for the late summer and early fall. Table 5.4.1-4 displays the projected seasonal precipitation change for the Southern Tier ClimAID Region (NYSERDA, 2011).

Table 5.4.1-4 Projected Seasonal Precipitation Change in Region 1, 2050s (% change)

Winter	Spring	Summer	Fall
+5 to +15	0 to +15	-10 to +10	-5 to +10

Source: NYSERDA, 2011

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. The increase in heavy downpours has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA, 2011).

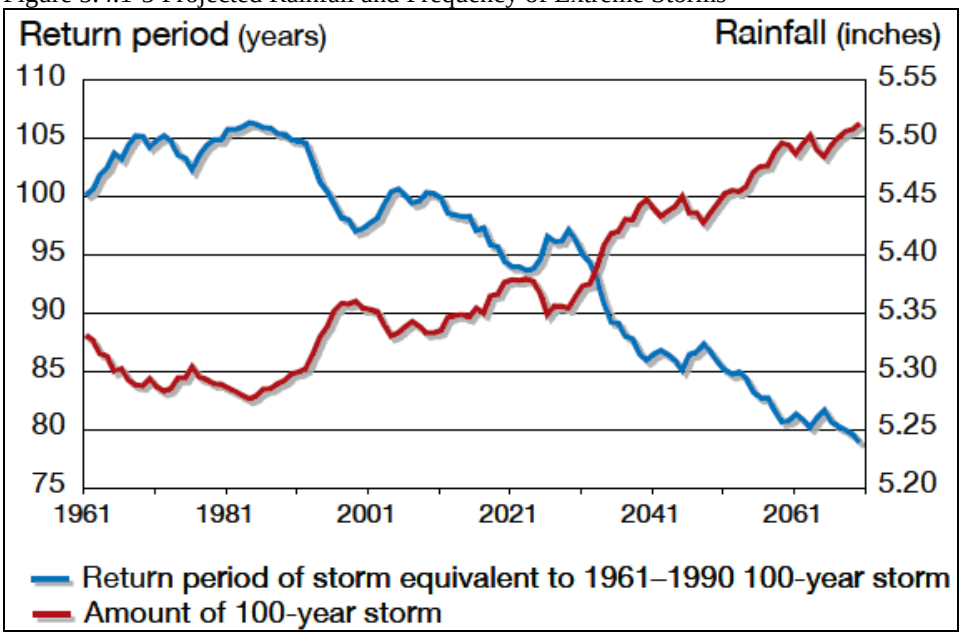
Increasing air temperatures intensify the water cycle by increasing evaporation and precipitation. This can cause an increase in rain totals during events with longer dry periods in between those events. These changes can have a variety of effects on the State's water resources (NYSERDA, 2011).

Over the past 50 years, heavy downpours have increased and this trend is projected to continue. This can cause an increase in localized flash flooding in urban areas and hilly regions. Flooding has the potential to increase pollutants in the water supply and inundate wastewater treatment plants and other vulnerable facilities located within floodplains. Less frequent rainfall during the summer months may impact the ability of water supply systems. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate wastewater treatment plant effluent (NYSERDA, 2011).

It is highly likely that increased winter precipitation will increase the potential for floods and ice jams in Cayuga County. Increased rain and/or snowmelt while cropland is bare and potentially frozen, greatly increases runoff volumes and peaks. Increased runoff may cause an increase in streamflow variability, that contributes to ice break-up and subsequent ice jamming (County Input, 2013).

Figure 5.4.1-5 displays the project rainfall and frequency of extreme storms in New York State. The amount of rain fall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA, 2011).

Figure 5.4.1-5 Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA, 2011

Total precipitation amounts have slightly increased in the Northeast U.S., by approximately 3.3 inches over the last 100 years. There has also been an increase in the number of two-inch rainfall events over a

48-hour period since the 1950s (a 67-percent increase). The number and intensity of extreme precipitation events are increasing in New York State as well. More rain heightens the danger of localized flash flooding, streambank erosion and storm damage (DeGaetano et al [Cornell University], 2010).

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 1- and 0.2-percent annual chance floodplains. The following text evaluates and estimates the potential impact of flooding in Cayuga County including:

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

Overview of Vulnerability

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 (Foster, Date Unknown).

The flood hazard is a concern for Cayuga County. To assess vulnerability, potential losses were calculated for Cayuga County for riverine and lake flooding for 1- and 0.2-percent annual chance 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 1- and 0.2-percent chance flood events were examined to evaluate Cayuga County's risk and vulnerability to the flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as the NFIP.

A Level 2 HAZUS-MH riverine flood analysis was performed. The default building inventory in HAZUS-MH was updated and replaced with a custom building inventory developed for Cayuga County. The updated building inventory was built using detailed structure-specific assessor data, as well as parcel and structure location information. An updated critical facility inventory was also developed and incorporated into HAZUS-MH replacing the default essential facility (police, fire, schools, etc.) and utility inventories.

The Cayuga County FEMA DFIRMs dated August 2007 were used to evaluate exposure and determine potential future losses. The terrain was built using the 3-meter grid available from NOAA which was developed based on the 2000 LiDAR of Cayuga County. However, the USGS 10-meter grid was used to supplement where data was missing. The final Digital Elevation Model (DEM) was resampled to 3-meters (10 feet). Depth grids were developed for the 1- and 0.2-percent flood events for Cayuga County.

To estimate exposure to the 1- and 0.2-percent annual chance flood events, the DFIRM flood boundaries, updated building and facility inventories and 2010 U.S. Census population data were used. The HAZUS-MH 2.1 flood model was run to estimate potential losses for these events. HAZUS-MH 2.1 calculated the estimated potential losses to the population (default 2000 U.S. Census data) and potential damages to the updated general building stock and critical facility inventories based on the depth grid generated and the default HAZUS damage functions in the flood model.

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 strictly measurable.

To estimate the population exposed to the 1- and 0.2-percent annual chance flood events, the FEMA DFIRM floodplain boundaries were used. Census blocks do not follow the boundaries of the floodplain and can grossly over or under estimate the population exposed when using the centroid or intersect of the Census block with the flood boundaries. Therefore, the methodology used to generate these estimates counted the number of residential structures within the floodplain, and then estimated the total population by multiplying the number of residential structures by the average Cayuga County household size of 2.37 persons per household (based on 2007-2011 Census data). This methodology may underestimate the population at risk to flooding by as much as half; because it does not take into consideration physical access into the area where the property is located such as the ability to travel into the area either on foot or by vehicle. However we feel it is more accurate than the other methods described.

Using this approach, it was estimated that the population within the 1-percent floodplain is 3,252 (4.1-percent of the total planning area population) with an additional 376 in the 0.2-percent flood boundary. Table 5.4.1-5 lists the estimated population located within the 1- and 0.2-percent annual chance flood boundaries by municipality for Cayuga County.

Table 5.4.1-5 Estimated Cayuga County Population Vulnerable to the 1-Percent and 0.2-Percent Flood Hazard Areas

Municipality	Total Population	1-Percent Event		0.2-Percent Event	
		Estimated Population in Boundary	Percent of Total	Estimated Population in Boundary	Percent Population
Auburn (C)	27,687	76	0.3	104	0.4
Aurelius (T)	2,243	92	4.1	137	6.1
Aurora (V)	724	14	1.9	14	1.9
Brutus (T)	2,649	149	5.6	166	6.3
Cato (T)	2,020	571	28.3	574	28.4
Cato (V)	533	2	0.4	2	0.4
Cayuga (V)	549	38	6.9	50	9.1
Conquest (T)	1,819	126	6.9	135	7.4
Fair Haven (V)	703	36	5.1	36	5.1
Fleming (T)	2,636	284	10.8	318	12.1
Genoa (T)	1,935	62	3.2	85	4.4

Municipality	Total Population	1-Percent Event		0.2-Percent Event	
		Estimated Population in Boundary	Percent of Total	Estimated Population in Boundary	Percent Population
Ira (T)	1,881	40	2.1	40	2.1
Ledyard (T)	1,158	47	4.1	73	6.3
Locke (T)	1,951	159	8.1	159	8.1
Mentz (T)	1,096	62	5.7	62	5.7
Meridian (V)	309	9	2.9	9	2.9
Montezuma (T)	1,277	130	10.2	140	11.0
Moravia (T)	2,347	123	5.2	145	6.2
Moravia (V)	1,279	519	40.6	547	42.8
Niles (T)	1,194	38	3.2	40	3.4
Owasco (T)	3,793	102	2.7	135	3.6
Port Byron (V)	1,282	95	7.4	107	8.3
Scipio (T)	1,713	7	0.4	12	0.7
Sempronius (T)	890	12	1.3	12	1.3
Sennett (T)	3,595	71	2.0	71	2.0
Springport (T)	1,176	71	6.0	83	7.1
Sterling (T)	2,337	55	2.4	55	2.4
Summerhill (T)	1,222	28	2.3	28	2.3
Throop (T)	1,990	62	3.1	62	3.1
Union Springs (V)	1,195	31	2.6	50	4.2
Venice (T)	1,368	24	1.8	24	1.8
Victory (T)	1,660	26	1.6	26	1.6
Weedsport (V)	1,815	90	5.0	128	7.1
Cayuga County	**80,026**	**3,252**	**4.1**	**3,628**	**4.5**

Source: U.S. Census 2010; FEMA, 2007

Of the population exposed, the most vulnerable include the economically disadvantaged 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 due to isolation during a flood event and they may have more difficulty evacuating.

Using 2000 U.S. Census data, HAZUS-MH 2.1 estimates the potential sheltering needs as a result of a 1- and 0.2-percent annual chance flood events at the Census-block level. For the 1-percent event, HAZUS-MH 2.1 estimates 5,078 people will be displaced and 2,298 people will seek short-term sheltering, representing 6.2% and 2.8% of the Cayuga County population, respectively. For the 0.2-percent event, HAZUS-MH 2.1 estimates 5,552 people will be displaced and 2,605 people will seek short-term sheltering, representing 6.8% and 3.2% of Cayuga County's population, respectively. These statistics, by municipality, are presented in Table 5.4.1-6.

HAZUS' sheltering estimates are greater than the estimated population exposed. This may be because HAZUS sheltering estimates take into consideration many factors including demographics and the estimated damages to buildings calculated at the Census-block level. As explained in the following

section (Impact to General Building Stock), we estimate building potential loss for Cayuga County at the structure level, not the Census-block level, while using HAZUS' damage functions. We feel this methodology provides a more accurate estimate of potential losses. When comparing the potential building losses for Cayuga County, we find that at the total estimated loss at structure level for the 1-percent event is $24,649,025; and the total estimated loss at the Census-block level for the 1-percent event is $58,586,000. Both methodologies used same number of buildings and replacement cost values, damage functions and depth grid; however the results at the Census-block level are more than two times higher. This explains why the sheltering estimates calculated by HAZUS (at the Census-block level) are much higher than our exposure level (based on the structure level).

The limitations of these analyses are recognized, and as such the results are only used to provide a general estimate. Please take this into consideration when estimating for flood sheltering needs.

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 from persons trying to cross flooded roadways or channels during a flood.

Table 5.4.1-6 Estimated Cayuga County Population Displaced or Seeking Short-Term Shelter from the 1- and 0.2-Percent Annual Chance Flood Events

Municipality	1-Percent Event				0.2-Percent Event			
	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter
Auburn (C)	623	2.2	204	0.7	752	2.6	249	0.9
Aurelius (T)	210	7.2	176	6.0	232	7.9	195	6.6
Aurora (V)	46	6.4	14	1.9	48	6.7	14	1.9
Brutus (T)	190	4.0	60	1.3	215	4.5	67	1.4
Cato (T)	289	10.5	81	3.0	296	10.8	85	3.1
Cato (V)	29	4.8	8	1.3	29	4.8	8	1.3
Cayuga (V)	31	6.1	9	1.8	36	7.1	24	4.7
Conquest (T)	188	9.8	44	2.3	192	10.0	46	2.4
Fair Haven (V)	40	4.5	18	2.0	38	4.3	8	0.9
Fleming (T)	219	8.3	129	4.9	240	9.1	160	6.0
Genoa (T)	63	3.3	10	0.5	64	3.3	10	0.5
Ira (T)	108	4.5	11	0.5	108	4.5	11	0.5
Ledyard (T)	51	2.8	46	2.5	54	2.9	49	2.7
Locke (T)	194	10.2	56	2.9	193	10.2	56	2.9
Mentz (T)	170	7.0	65	2.7	180	7.4	68	2.8
Meridian (V)	8	2.3	0	0.0	8	2.3	0	0.0
Montezuma (T)	274	19.1	151	10.6	282	19.7	152	10.6
Moravia (T)	217	5.4	138	3.4	226	5.6	145	3.6
Moravia (V)	724	53.1	576	42.3	800	58.7	643	47.2
Niles (T)	19	1.6	0	0.0	19	1.6	0	0.0
Owasco (T)	193	5.1	100	2.7	228	6.1	117	3.1
Port Byron (V)	170	13.1	81	6.2	196	15.1	115	8.9
Scipio (T)	18	1.2	2	0.1	19	1.2	2	0.1
Sempronius (T)	15	1.7	0	0.0	15	1.7	0	0.0
Sennett (T)	166	5.1	37	1.1	166	5.1	37	1.1
Springport (T)	108	4.8	14	0.6	115	5.1	16	0.7
Sterling (T)	121	3.5	9	0.3	123	3.6	9	0.3
Summerhill (T)	63	5.7	9	0.8	63	5.7	9	0.8
Throop (T)	152	8.3	28	1.5	152	8.3	29	1.6
Union Springs (V)	34	3.2	1	0.1	80	7.4	11	1.0
Venice (T)	23	1.8	2	0.2	23	1.8	2	0.2
Victory (T)	77	4.2	2	0.1	77	4.2	2	0.1
Weedsport (V)	245	12.1	217	10.8	283	14.0	266	13.2
Cayuga County	**5,078**	**6.2**	**2,298**	**2.8**	**5,552**	**6.8**	**2,605**	**3.2**

Source: HAZUS-MH 2.1
Note: The percent of the population displaced and seeking shelter was calculated using the 2000 U.S. Census data.

Impact on General Building Stock

After considering the population exposed and vulnerable to the flood hazard, the built environment was evaluated. Exposure includes those buildings located in the flood zone. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value.

The total land area located in the 1- and 0.2-percent annual chance flood zones was calculated for each municipality, as presented in Table 5.4.1.7 below. To provide a general estimate of number of structures and structural/content replacement value exposure, the FEMA DFIRM flood boundaries (1- and 0.2-percent flood zones) were overlaid upon Cayuga County's updated building stock inventory point shapefiles. The structures within the boundaries were totaled for each municipality. Refer to Table 5.4.1-8.

Table 5.4.1-7 Total land area located in the 1- and 0.2-percent annual chance flood zones

Municipality	Total Area (Sq. mi.)	1% Flood Event Hazard Area		0.2% Flood Event Hazard Area	
		Area Exposed (Sq. mi.)	% of Total	Area Exposed (Sq. mi.)	% of Total
Auburn (C)	8.40	0.40	4.8	0.47	5.6
Aurelius (T)	30.70	1.66	5.4	1.69	5.5
Aurora (V)	0.91	0.046	5.1	0.053	5.8
Brutus (T)	21.43	4.19	19.6	4.46	20.8
Cato (T)	34.87	7.22	20.7	7.26	20.8
Cato (V)	1.03	0.15	14.6	0.15	14.6
Cayuga (V)	1.36	0.52	38.2	0.53	38.7
Conquest (T)	36.31	5.95	16.4	6.07	16.7
Fair Haven (V)	1.76	0.14	8.0	0.14	8.0
Fleming (T)	24.01	2.82	11.7	2.85	11.9
Genoa (T)	43.18	3.79	8.8	3.79	8.8
Ira (T)	34.34	1.64	4.8	1.64	4.8
Ledyard (T)	47.57	12.62	26.5	12.63	26.6
Locke (T)	24.48	0.76	3.1	0.76	3.1
Mentz (T)	16.22	2.45	15.1	2.53	15.6
Meridian (V)	0.68	0.022	3.2	0.02	3.2
Montezuma (T)	18.74	4.91	26.2	4.93	26.3
Moravia (T)	27.92	3.14	11.2	3.15	11.3
Moravia (V)	1.72	0.70	40.7	0.75	43.7
Niles (T)	43.30	4.64	10.7	4.65	10.7
Owasco (T)	23.74	3.36	14.2	3.42	14.4
Port Byron (V)	0.93	0.20	21.5	0.22	23.3
Scipio (T)	39.20	2.76	7.0	2.77	7.1
Sempronius (T)	29.73	0.80	2.7	0.80	2.7
Sennett (T)	28.80	1.56	5.4	1.56	5.4
Springport (T)	25.31	5.98	23.6	6.01	23.7
Sterling (T)	44.18	3.42	7.7	3.42	7.7
Summerhill (T)	26.09	0.87	3.3	0.87	3.3

Municipality	Total Area (Sq. mi.)	1% Flood Event Hazard Area		0.2% Flood Event Hazard Area	
		Area Exposed (Sq. mi.)	% of Total	Area Exposed (Sq. mi.)	% of Total
Throop (T)	18.75	1.46	7.8	1.46	7.8
Union Springs (V)	1.77	0.09	5.1	0.12	6.6
Venice (T)	41.24	0.38	0.9	0.38	0.9
Victory (T)	34.47	1.68	4.9	1.68	4.9
Weedsport (V)	0.98	0.25	25.5	0.29	29.4
Cayuga County	**734.09**	**80.58**	**11.0**	**81.53**	**11.1**

Source: FEMA, 2007
Note: sq. mi. = Square miles; % = Percent
These estimates are based on the provided Cayuga GIS municipal boundaries and should be treated as estimates. The area presented includes the area of inclusive waterbodies.

The depth grids developed for the 1- and 0.2-pecent flood events for Cayuga County were integrated into the HAZUS-MH riverine flood model. The model was then run to estimate the potential general building stock losses for these events. The potential estimated losses are summarized by municipality in Table 5.4.1-9.

In addition to looking at exposure and potential losses to the flood hazard using the DFIRM boundaries and depth grids developed, the Mill Street Dam dam break inundation area was used to estimate exposure and potential losses for the City of Auburn. Refer to Figure 5.4.1-2. Mill Street Dam Inundation Area earlier in this profile for a map of the inundation area.

In summary, there are 79 buildings located within the inundation area, the majority of which are residential (28) and commercial (46) buildings with the remainder in the industrial and government sectors. In general, all persons occupying structures in the dam inundation area are exposed. However, the time of day also exposes different sectors of the community to the hazard. HAZUS considers the residential occupancy at its maximum at 2:00 a.m. Using the methodology described in the Impact to Population subsection above, there are approximately 66 residents located in the inundation zone (number of residential buildings multiplied by 2.37 people per household). HAZUS considers the education, commercial and industrial sectors are considered at their maximum at 2:00 p.m. Therefore, the population that occupies the commercial, industrial and government buildings is more vulnerable at this time. Whether directly or indirectly impacted, the City will have to deal with the consequences of a dam break to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

Table 5.4.1-8 Estimated General Building Stock Exposure to the 1-Percent and 0.2-Percent Annual Chance Flood Events

Municipality	Total Number of Buildings	Total RCV	Exposure							
			1% Flood Event				0.2% Flood Event			
			Number of Buildings	% of Total	RCV	% of Total	Number of Buildings	% of Total	RCV	% of Total
Auburn (C)	8,279	$1,878,218,033	48	0.6	$12,812,150	0.7	62	0.7	$28,184,750	1.5
Aurelius (T)	924	$235,842,408	42	4.5	$6,555,850	2.8	62	6.7	$8,808,150	3.7
Aurora (V)	204	$78,145,146	6	2.9	$1,126,800	1.4	6	2.9	$1,126,800	1.4
Brutus (T)	737	$137,559,741	73	9.9	$11,307,693	8.2	81	11.0	$12,484,392	9.1
Cato (T)	1,045	$123,559,352	244	23.3	$20,972,410	17.0	245	23.4	$21,016,660	17.0
Cato (V)	203	$25,489,778	3	1.5	$185,650	0.7	3	1.5	$185,650	0.7
Cayuga (V)	218	$30,622,602	16	7.3	$1,303,200	4.3	24	11.0	$2,334,700	7.6
Conquest (T)	858	$80,886,230	56	6.5	$3,820,250	4.7	60	7.0	$4,032,800	5.0
Fair Haven (V)	663	$81,256,714	17	2.6	$2,119,050	2.6	17	2.6	$2,119,050	2.6
Fleming (T)	1,128	$224,901,456	122	10.8	$23,386,686	10.4	137	12.1	$25,877,615	11.5
Genoa (T)	991	$157,595,339	27	2.7	$2,973,350	1.9	37	3.7	$4,808,300	3.1
Ira (T)	773	$141,248,229	17	2.2	$1,790,115	1.3	17	2.2	$1,790,115	1.3
Ledyard (T)	666	$121,217,136	20	3.0	$1,801,050	1.5	31	4.7	$3,457,950	2.9
Locke (T)	654	$80,900,298	68	10.4	$7,142,700	8.8	68	10.4	$7,142,700	8.8
Mentz (T)	427	$70,917,868	27	6.3	$2,298,815	3.2	27	6.3	$2,298,815	3.2
Meridian (V)	116	$13,281,419	5	4.3	$657,750	5.0	5	4.3	$657,750	5.0
Montezuma (T)	493	$50,517,527	58	11.8	$4,853,086	9.6	62	12.6	$5,204,018	10.3
Moravia (T)	654	$139,466,396	56	8.6	$5,979,183	4.3	65	9.9	$6,754,683	4.8
Moravia (V)	495	$110,235,862	257	51.9	$44,792,262	40.6	296	59.8	$54,036,262	49.0
Niles (T)	905	$134,855,774	16	1.8	$2,022,000	1.5	17	1.9	$2,128,500	1.6
Owasco (T)	1,741	$392,636,885	43	2.5	$11,584,338	3.0	58	3.3	$15,563,059	4.0
Port Byron (V)	414	$74,854,644	41	9.9	$4,410,450	5.9	48	11.6	$14,072,650	18.8
Scipio (T)	740	$115,757,295	3	0.4	$288,644	0.2	5	0.7	$583,562	0.5
Sempronius (T)	457	$55,409,787	5	1.1	$619,650	1.1	5	1.1	$619,650	1.1
Sennett (T)	1,383	$421,576,376	32	2.3	$6,838,904	1.6	32	2.3	$6,838,904	1.6
Springport (T)	561	$101,711,905	31	5.5	$7,528,682	7.4	37	6.6	$8,534,147	8.4

Municipality	Total Number of Buildings	Total RCV	Exposure							
			1% Flood Event				0.2% Flood Event			
			Number of Buildings	% of Total	RCV	% of Total	Number of Buildings	% of Total	RCV	% of Total
Sterling (T)	1,136	$111,783,180	28	2.5	$7,909,550	7.1	28	2.5	$7,909,550	7.1
Summerhill (T)	498	$62,016,044	12	2.4	$1,410,300	2.3	12	2.4	$1,410,300	2.3
Throop (T)	782	$117,821,212	27	3.5	$3,265,100	2.8	27	3.5	$3,265,100	2.8
Union Springs (V)	440	$96,036,680	14	3.2	$3,563,448	3.7	41	9.3	$8,538,195	8.9
Venice (T)	570	$94,806,303	11	1.9	$1,435,100	1.5	11	1.9	$1,435,100	1.5
Victory (T)	677	$70,156,430	11	1.6	$1,477,281	2.1	11	1.6	$1,477,281	2.1
Weedsport (V)	658	$121,709,134	40	6.1	$9,754,542	8.0	58	8.8	$12,815,761	10.5
Cayuga County	**30,490**	**$5,752,993,179**	**1,476**	**4.8**	**$217,986,036**	**3.8**	**1,695**	**5.6**	**$277,512,915**	**4.8**

Source: Cayuga County, 2012
Notes: % = Percent; RCV = Replacement cost value

Table 5.4.1-9 Estimated General Building Stock Potential Loss to the 1-Percent and 0.2-Percent Annual Chance Flood Events

Municipality	Total Number of Buildings	Total RCV	Estimated Potential Loss							
			1% Flood Boundary				0.2% Flood Boundary			
			Number of Buildings	% of Total	RCV	% of Total	Number of Buildings	% of Total	RCV	% of Total
Auburn (C)	8,279	$1,878,218,033	40	0.5	$1,773,446	0.1	55	0.7	$2,832,370	0.2
Aurelius (T)	924	$235,842,408	40	4.3	$890,558	0.4	49	5.3	$1,446,168	0.6
Aurora (V)	204	$78,145,146	5	2.5	$60,503	0.1	6	2.9	$119,487	0.2
Brutus (T)	737	$137,559,741	66	9.0	$1,905,030	1.4	70	9.5	$2,176,840	1.6
Cato (T)	1,045	$123,559,352	235	22.5	$3,998,191	3.2	239	22.9	$4,718,340	3.8
Cato (V)	203	$25,489,778	0	0.0	$0	0.0	2	1.0	$956	0.0
Cayuga (V)	218	$30,622,602	10	4.6	$89,792	0.3	19	8.7	$178,004	0.6
Conquest (T)	858	$80,886,230	42	4.9	$669,613	0.8	50	5.8	$896,903	1.1
Fair Haven (V)	663	$81,256,714	7	1.1	$63,247	0.1	8	1.2	$78,175	0.1
Fleming (T)	1,128	$224,901,456	117	10.4	$2,691,781	1.2	130	11.5	$3,468,337	1.5
Genoa (T)	991	$157,595,339	8	0.8	$156,769	0.1	21	2.1	$286,969	0.2
Ira (T)	773	$141,248,229	11	1.4	$113,543	0.1	15	1.9	$147,308	0.1
Ledyard (T)	666	$121,217,136	13	2.0	$148,186	0.1	14	2.1	$204,573	0.2
Locke (T)	654	$80,900,298	58	8.9	$611,042	0.8	60	9.2	$815,998	1.0
Mentz (T)	427	$70,917,868	23	5.4	$232,933	0.3	23	5.4	$260,326	0.4
Meridian (V)	116	$13,281,419	1	0.9	$8,911	0.1	3	2.6	$12,328	0.1
Montezuma (T)	493	$50,517,527	43	8.7	$381,278	0.8	52	10.5	$740,403	1.5
Moravia (T)	654	$139,466,396	44	6.7	$511,301	0.4	60	9.2	$788,870	0.6
Moravia (V)	495	$110,235,862	229	46.3	$5,027,030	4.6	265	53.5	$7,881,622	7.1
Niles (T)	905	$134,855,774	10	1.1	$331,688	0.2	11	1.2	$404,598	0.3
Owasco (T)	1,741	$392,636,885	35	2.0	$857,644	0.2	43	2.5	$1,302,814	0.3
Port Byron (V)	414	$74,854,644	28	6.8	$169,922	0.2	34	8.2	$311,120	0.4
Scipio (T)	740	$115,757,295	3	0.4	$92,682	0.1	5	0.7	$171,176	0.1
Sempronius (T)	457	$55,409,787	3	0.7	$46,605	0.1	4	0.9	$49,083	0.1
Sennett (T)	1,383	$421,576,376	28	2.0	$510,188	0.1	28	2.0	$632,542	0.2

Municipality	Total Number of Buildings	Total RCV	Estimated Potential Loss							
			1% Flood Boundary				0.2% Flood Boundary			
			Number of Buildings	% of Total	RCV	% of Total	Number of Buildings	% of Total	RCV	% of Total
Springport (T)	561	$101,711,905	20	3.6	$469,769	0.5	31	5.5	$712,305	0.7
Sterling (T)	1,136	$111,783,180	18	1.6	$202,947	0.2	21	1.8	$252,197	0.2
Summerhill (T)	498	$62,016,044	12	2.4	$170,290	0.3	11	2.2	$197,502	0.3
Throop (T)	782	$117,821,212	22	2.8	$360,757	0.3	24	3.1	$462,809	0.4
Union Springs (V)	440	$96,036,680	12	2.7	$362,807	0.4	38	8.6	$1,740,599	1.8
Venice (T)	570	$94,806,303	9	1.6	$194,735	0.2	10	1.8	$244,110	0.3
Victory (T)	677	$70,156,430	9	1.3	$221,576	0.3	10	1.5	$100,237	0.1
Weedsport (V)	658	$121,709,134	28	4.3	$1,324,260	1.1	49	7.4	$2,001,414	1.6
Cayuga County	**30,490**	**$5,752,993,179**	**1,229**	**4.0**	**$24,649,025**	**0.4**	**1,460**	**4.8**	**$35,636,482**	**0.6**

Source: Cayuga County, 2012
Notes: % = Percent; RCV = Replacement cost value

In addition to total building stock modeling, individual data available on flood policies, claims, Repetitive Loss Properties (RLP) and severe RLP (SRLs) 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 (*sic* National Flood Insurance Program) 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."

SRLs were then examined for Cayuga County. According to section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a, an SRL 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.

Table 5.4.1-10 summarizes the NFIP policies, claims and repetitive loss statistics for Cayuga County. According to FEMA, the two (2) repetitive loss properties in Cayuga County are single family residences (FEMA Region 2, 2012). This information is current as of June 30, 2012.

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.

Table 5.4.1-10 indicates the repetitive loss areas within Cayuga County. Information regarding the locations of the NFIP policies and claims is cataloged at Cayuga County.

Table 5.4.1-10 NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)	# Policies in the 0.2% Flood Boundary (3)	# Policies Outside the Combined 1% and 0.2% Flood Boundaries Hazard Areas (3)
Auburn (C)	20	6	$13,308	0	0	10	1	9
Aurelius (T)	30	7	$32,333	0	0	13	3	14
Aurora (V)	3	3	$12,567	0	0	3	0	0
Brutus (T)	15	8	$31,355	0	0	11	0	4
Cato (T)	52	34	$221,054	0	0	23	0	29
Cato (V)	0	8*	$17,978	0	0	0	0	0
Cayuga (V)	11	10	$42,024	0	0	4	2	5
Conquest (T)	4	4	$48,261	0	0	3	0	1
Fair Haven (V)	7	0	$0	0	0	0	0	7
Fleming (T)	33	3	$3,618	0	0	25	4	4
Genoa (T)	15	2	$5,889	0	0	1	1	13
Ira (T)	2	0*	$0	0	0	1	0	1
Ledyard (T)	18	11	$43,078	1	0	3	0	15
Locke (T)	20	5	$10,707	0	0	15	0	5
Mentz (T)	1	3	$12,359	0	0	1	0	0
Meridian (V)	3	3*	$34,201	1	0	1	0	2
Montezuma (T)	12	5	$17,784	0	0	4	2	6
Moravia (T)	21	1	$242	0	0	11	1	9
Moravia (V)	121	16	$76,025	0	0	114	3	4
Niles (T)	9	2	$2,044	0	0	1	0	8
Owasco (T)	25	6	$4,803	0	0	13	3	9
Port Byron (V)	10	3	$4,717	0	0	7	0	3
Scipio (T)	5	1	$6,596	0	0	0	0	5
Sempronius (T)	1	3*	$15,395	0	0	0	0	1
Sennett (T)	5	0	$0	0	0	3	0	2
Springport (T)	14	8	$69,657	0	0	5	1	8
Sterling (T)	1	0	$0	0	0	0	0	1

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)	# Policies in the 0.2% Flood Boundary (3)	# Policies Outside the Combined 1% and 0.2% Flood Boundaries Hazard Areas (3)
Summerhill (T)	5	3	$61,345	0	0	0	0	5
Throop (T)	2	2	$1,937	0	0	0	0	2
Union Springs (V)	7	12	$120,664	0	0	2	0	5
Venice (T)	8	1	$6,441	0	0	4	0	4
Victory (T)	0	1*	$2,678	0	0	0	0	0
Weedsport (V)	17	0	$0	0	0	13	1	3
Cayuga County	**497**	**171**	**$919,060**	**2**	**0**	**291**	**22**	184

Source: FEMA Region 2, 2012

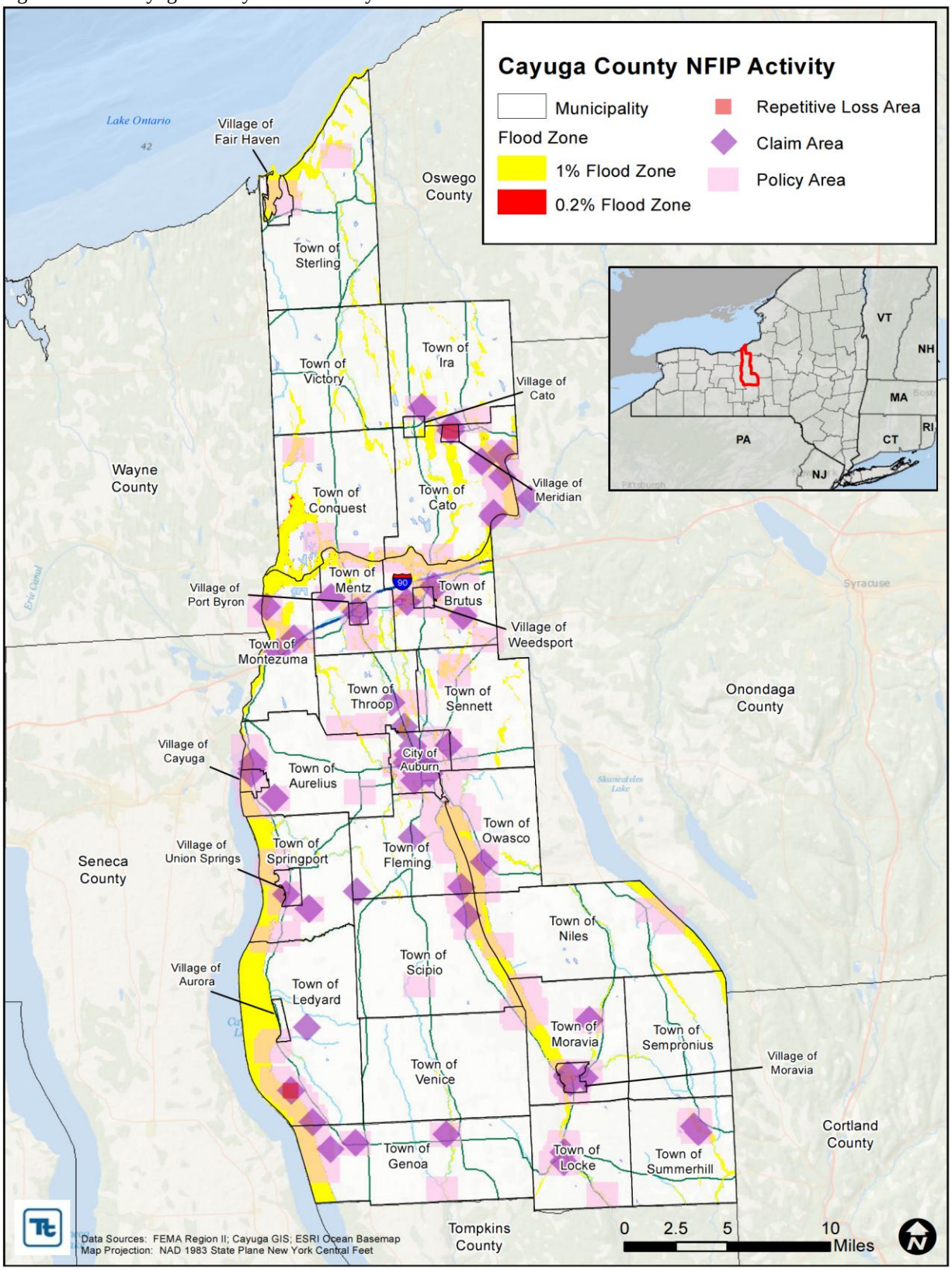
(1) Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of June 30, 2012 and summarized using the Community name. Please note the total number of repetitive loss properties includes the severe repetitive loss properties. The number of claims represents the number of claims closed by June 30, 2012.

(2) Total building and content losses from the claims file provided by FEMA Region 2.

(3) The number of policies located inside and outside of the flood zones is based on the latitude and longitude provided by FEMA Region 2 in the policy file and the FEMA DFIRM 2007 boundaries. FEMA noted that where there is more than one entry for a property, there may be more than one policy in force or more than one GIS possibility.

*For the Village of Cato, claims appear to have been miscoded with three located outside of Cayuga County and 5 located within other municipalities in Cayuga County (four in the Town of Ira and one in the Village of Meridian). For the Town of Victory, one claim is indicated using the Community name however the geographic coordinates for this property are located outside Cayuga County. For the Village of Meridian, it appears to be understating the number of claims by one. For the Town of Ira, it appears to be understating the number of claims by four. For the Town of Sempronius, two of the three claims are located outside Cayuga County.

Figure 5.4.1-6 Cayuga County NFIP Activity Areas



Source: Cayuga County GIS; FEMA Region 2, 2012
Note: Twelve of the 171 claims are not displayed as their geographic coordinates were not provided by FEMA.

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. HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves, HAZUS estimates the percent of damage to the building and contents of critical facilities. Table 5.4.1-11 lists the critical facilities and utilities located in the FEMA flood zones and the percent damage HAZUS-MH 2.1 estimates to the facility as a result of the 1% and 0.2% events.

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. Actions addressing shared services agreements are included in Section 9 (Mitigation Strategies) of this plan.

Based on the locations provided by Cayuga County GIS, the Auburn Fire Department #1, three electric substations (Clark Street, North Green Street and North Division Street Dam), the City of Auburn CSO (wastewater) and a portion of the rail line and roadways are located in the Mill Street Dam break inundation area.

Table 5.4.1-11 Critical Facilities Located in the 1-Percent and 0.2-Percent Annual Chance Flood Boundaries and Estimated Potential Damage

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event			Potential Loss from 0.2% Flood Event		
			1% Zone	0.2% Zone	Percent Structure Damage	Percent Content Damage	Days to 100-Percent[1]	Percent Structure Damage	Percent Content Damage	Days to 100-Percent[1]
Substation (Clark St)	Auburn (C)	Electric Substation	X							
North Division Street Dam	Auburn (C)	Electric Power	X							
Mill Street Dam	Auburn (C)	Electric Power	X							
Penske Truck Leasing Co., LP	Auburn (C)	HAZMAT	X							
Xylem Inc. Water Systems U.S.A., LLC	Auburn (C)	HAZMAT		X						
City of Auburn Sewerage Facility	Auburn (C)	WWTF	X							
City of Auburn CSO (17)	Auburn (C)	WWTF	X							
City of Auburn CSO (07)	Auburn (C)	WWTF		X						
Canoga St	Auburn (C)	WW Pump Station	X							
John Walsh Blvd (Walmart)	Auburn (C)	WW Pump Station	X							
Intake	Aurelius (T)	Potable Water	X							
Treatment Plant	Aurelius (T)	Potable Water		X						
Town of Brutus	Brutus (T)	Highway Department		X						
Fair Haven Senior Apartments	Fair Haven (V)	Senior	X					4.53	24.6	NA
Treatment Plant	Ledyard (T)	Potable Water	X							
Intake	Ledyard (T)	Potable Water	X							
HEWITT BROTHERS, INC.	Locke (T)	HAZMAT	X							
Village Of Meridian Fire Department #1	Meridian (V)	Fire	X							
Town Hall	Montezuma (T)	Municipal Hall	X							
Four Town First Aid Squad, Inc.	Moravia (V)	Fire		X						
Town Hall	Moravia (V)	Municipal Hall		X						
Village of Moravia	Moravia (V)	Highway Department		X						
Moravia (V)	Moravia (V)	Electric Substation	X							
Moravia Justice Center	Moravia (V)	Police	X							
Moravia Sewage Plant	Moravia (V)	WWTF	X							

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event			Potential Loss from 0.2% Flood Event		
			1% Zone	0.2% Zone	Percent Structure Damage	Percent Content Damage	Days to 100-Percent(1)	Percent Structure Damage	Percent Content Damage	Days to 100-Percent(1)
Millstream Court	Moravia (V)	Senior	X		15	86.1	NA	16.43	95.3	NA
Northwoods	Moravia (V)	Senior	X		15.31	89.86	NA	16.32	94.95	NA
Town of Moravia	Moravia (V)	Highway Department	X		63	78	NA	63.82	78.82	NA
Well #2,#3,#4 & Treatment Plant	Moravia (V)	Potable Water	X							
Maus Marineland	Niles (T)	Airport	X							
Owasco and Oakridge	Owasco (T)	WW Pump Station	X							
Archie St. Severe High Flow Pump	Owasco (T)	WW Pump Station	X							
Burtis Point	Owasco (T)	WW Pump		X						
Intake	Owasco (T)	Potable Water	X							
Intake	Owasco (T)	Potable Water	X							
Port Byron Fire Department	Port Byron (V)	Fire	X					10.89	35.93	480
Village Of Port Byron Fire Department	Port Byron (V)	Fire	X					10.89	35.93	480
Town Hall	Throop (T)	Municipal Hall		X						
Castelli's Marina Inc.	Union Springs (V)	HAZMAT	X							
Fox Lane Apartments	Union Springs (V)	Senior	X		0.25	1.34	NA	5.35	29.02	NA
Village of Union Springs	Union Springs (V)	Highway Department	X		4.67	4.24	NA	14.5	13.18	NA
Verizon CO (NY70596)	Union Springs (V)	HAZMAT		X						
Union Springs Sewage Plant	Union Springs (V)	WWTF		X						
Weedsport Sewage Plant	Weedsport (V)	WWTF	X							
Village of Weedsport	Weedsport (V)	Highway Department	X							

Source: HAZUS-MH 2.1
Note: C = City; NA = Not available; T = Town; V = Village
X = Facility located within the DFIRM boundary.
(1) HAZUS-MH 2.1 provides a general indication of the maximum restoration time for 100% operations. Clearly, a great deal of effort is needed to quickly restore essential facilities to full functionality; therefore this will be an indication of the maximum downtime (HAZUS-MH 2.1 User Manual).
(2) In some cases, a facility may be located in the DFIRM flood hazard boundary; however HAZUS did not calculate potential loss. This may be because the depth of flooding does not amount to any damages to the structure according to the depth damage function used in HAZUS for that facility type. The flood model does not estimate damages for HAZMAT facilities.

Impact on the 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 Cayuga County. 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.

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur; and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges (Foster, Date Unknown).

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 1-percent flood is nearly $25 million which represents less than one-percent of Cayuga County's overall total general building stock inventory. The potential damage estimated to the general building stock inventory associated with the 0.2-percent flood is greater than $35 million, or less than one-percent of Cayuga County's total building inventory. These dollar value losses to Cayuga County's total building inventory replacement value, in addition to damages to roadways and infrastructure, would greatly impact the local economy.

HAZUS-MH defines business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood. For the 100-year event, HAZUS-MH estimates $400,000 in business interruption costs. For the 500-year event, HAZUS-MH estimates $480,000 in business interruption costs. These costs are from estimated loss of income, lost wages and relocation costs.

HAZUS-MH estimates the amount of debris generated from the flood events as a result of 1- and 0.2-percent events. The model breaks down debris into three categories: 1) finishes (dry wall, insulation, etc.); 2) structural (wood, brick, etc.); and 3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. Table 5.4.1-12 summarizes the debris HAZUS-MH 2.1 estimates for these events.

Table 5.4.1-12 Estimated Debris Generated from the 1-Percent and 0.2-Percent Flood Events

Municipality	1% Flood Event				0.2% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Auburn (C)	455	267	111	77	595	342	149	104
Aurelius (T)	794	454	142	198	1,098	523	280	296
Aurora (V)	186	184	1	0	303	208	58	37
Brutus (T)	832	263	242	326	951	302	282	367
Cato (T)	1,203	713	194	296	1,485	831	281	373
Cato (V)	0	0	0	0	3	3	0	0
Cayuga (V)	93	93	0	0	150	108	26	16

Municipality	1% Flood Event				0.2% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Conquest (T)	831	334	199	298	962	383	235	344
Fair Haven (V)	96	80	5	11	127	107	6	14
Fleming (T)	140	130	5	5	174	171	1	2
Genoa (T)	635	316	104	215	830	376	180	273
Ira (T)	18	14	1	2	29	19	3	7
Ledyard (T)	878	442	135	302	1,114	557	195	361
Locke (T)	114	83	12	19	153	109	18	26
Mentz (T)	290	151	56	82	336	172	67	97
Meridian (V)	3	3	0	0	1	1	0	0
Montezuma (T)	559	252	119	188	1,080	480	245	354
Moravia (T)	117	100	9	9	141	130	4	6
Moravia (V)	351	281	38	31	632	494	77	61
Niles (T)	161	63	56	43	164	69	53	42
Owasco (T)	248	240	5	3	304	293	7	4
Port Byron (V)	34	24	4	6	61	46	6	9
Scipio (T)	68	54	6	9	69	55	6	9
Sempronius (T)	65	18	26	21	69	19	27	22
Sennett (T)	44	43	1	1	66	63	2	2
Springport (T)	338	298	13	27	565	355	114	96
Sterling (T)	217	112	47	58	274	140	60	74
Summerhill (T)	74	43	13	19	102	59	17	25
Throop (T)	436	126	167	143	166	118	26	22
Union Springs (V)	15	12	2	1	202	78	77	47
Venice (T)	35	35	0	0	47	43	2	3
Victory (T)	121	29	50	42	19	13	2	3
Weedsport (V)	62	57	2	4	106	96	3	7
Cayuga County	**9,512**	**5,312**	**1,763**	**2,437**	**12,378**	**6,766**	**2,510**	**3,102**

Source: HAZUS-MH 2.1

Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as flood events. While predicting changes of flood events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

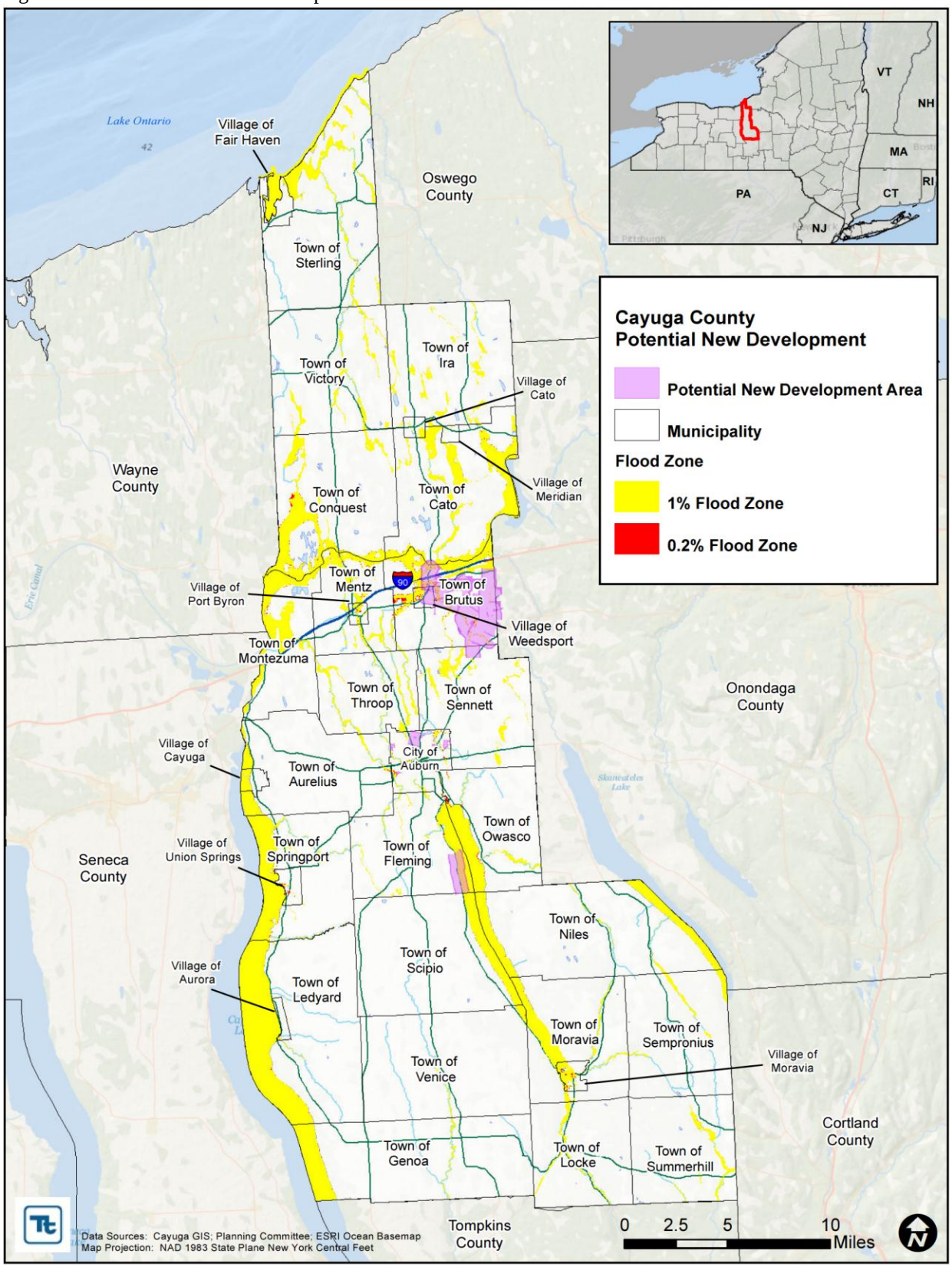
The 2011 'Responding to Climate Change in New York State' report was prepared for New York State Energy Research and Development Authority to study the potential impacts of global climate change on New York State. According to the synthesis report, heavy rains are increasing and are projected to increase further. Increased frequency and intensity of rainfall may lead to increased flooding and related

impacts on water quality, infrastructure, and agriculture in the State as noted earlier in this section (NYSERDA, 2011).

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across Cayuga County. Any areas of growth could be potentially impacted by the flood hazard if located within the identified hazard areas. Figure 5.4.1-7. Potential New Development and Flood Boundaries illustrates the identified areas of potential new development in relation to the flood boundaries. It is the intention of Cayuga County to discourage development in vulnerable areas or to encourage higher regulatory standards on the local level.

Figure 5.4.1-7. Potential New Development and Flood Boundaries



Source: Cayuga GIS, Planning Committee

Additional Data and Next Steps

A HAZUS-MH riverine flood analysis was conducted for Cayuga County using the most current and best available data including updated building and critical facility inventories, DFIRM data, and a 3-meter grid available from NOAA which was developed based on the 2000 LiDAR of Cayuga County. For future plan updates, more accurate exposure and loss estimates can be produced by replacing the national default demographic inventory with 2010 U.S. Census data when it becomes available in the HAZUS-MH model. As Assessor databases continue to be updated, the building inventory should also be maintained.

FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) will be providing the flood depth and analysis grids as part of the publicly available DFIRM deliverable for the entire County and multiple return periods. Once these depth grids are available, they can be incorporated into HAZUS and used to recalculate the potential losses to Cayuga County's inventory for these recurrence intervals.

Specific mitigation actions addressing improved data collection and further vulnerability analysis is included in Section 9 (Mitigation Strategies) of this plan.