5.4.3 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 on normally dry land from the following:

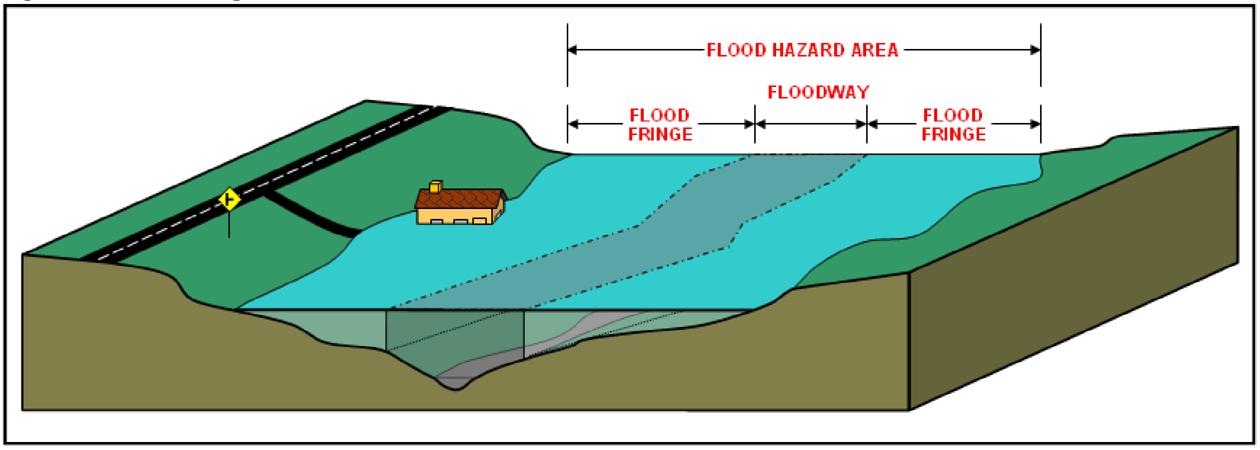
- Riverine flooding, including overflow from a river channel, flash floods, alluvial fan floods, dam-break floods and ice jam floods;
- Local drainage or high groundwater levels;
- Fluctuating lake levels;
- Coastal flooding;
- Coastal erosion (NYS HMP 2011)
- Unusual and rapid accumulation or runoff 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).

> One hundred-year floodplains (or 1% annual chance floodplain) can be described as a bag of 100 marbles, with 99 clear marbles and one black marble. Every time a marble is pulled out from the bag, and it is the black marble, it represents a 100-year flood event. The marble is then placed back into the bag and shaken up again before another marble is drawn. It is possible that the black marble can be picked one out of two or three times in a row, demonstrating that a 100-year flood event could occur several times in a row (Interagency Floodplain Management Review Committee, 1994).

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is not the flood that will occur once every 100 years, rather it is the flood that has a one-percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. With this term being misleading, FEMA has properly defined it as the 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, 2003).

Figure 5.4.3-1 depicts the flood hazard area, the flood fringe, and the floodway areas of a floodplain.

Figure 5.4.3-1. Floodplain



Source: NJDEP, Date Unknown

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 the County, riverine/flash, dam failure and ice jam flooding are the main flood types of concern for the Planning Area. These types of flood or 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, 2005; FEMA, 2008).

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).

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 occur when warm temperatures and heavy rains cause rapid snow melt. The melting snow, combined with the heavy rain, causes frozen rivers to swell. The rising water breaks the ice layers into large chunks, which float downstream and often pile up near narrow passages and obstructions (bridges and dams). 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 two different types of ice jams: freeze-up and breakup. Freeze-up jams occur when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement. Breakup 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).

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. Flooding is the primary natural hazard in New York State and they occur in every part of the State. Some areas are more flood prone than others, but no area is exempt, including Delaware County. Delaware County is characterized by glacially-dominated soils that result in significant volumes of run-off to less stable soils during extreme weather events. Delaware County residents are particularly vulnerable to repetitive flooding because historic population centers are clustered in valleys and along the shores of local tributaries, rivers, and reservoirs.

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. Delaware County's rating is 25, out of a possible 35. The County's ranking makes it the 13th most vulnerable to the flood hazard in New York State. 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 (NYS HMP 2011).

Riverine flooding problems are most severe in the Delaware, Susquehanna, Chemung, Erie-Niagara, Genesse, Allegany, Hudson and Mohawk River Basins (NYS HMP 2011). Delaware County is part of the Delaware, Susquehanna and Mohawk River Basins (NYSDEC, Date Unknown).

Mohawk River Basin

The Mohawk River Basin is centrally located in New York State. The Mohawk River is the largest tributary to the Hudson River. It has a total drainage area of approximately 3,460 square miles and represents approximately 25-percent of the entire Hudson River Basin. The Mohawk River starts between the Adirondack Mountains and Tug Hill Plateau in north-central New York State. It flows toward the east, carving a wide valley between the Adirondacks to the north and the Central Appalachian Mountains to the south. The entire basin is located within the borders of the State. The Mohawk River Basin area includes all of Montgomery County, most of Schoharie County, large portions of Schenectady, Greene, Fulton, Herkimer and Oneida Counties, and parts of Albany, Saratoga, Delaware, Otsego, Hamilton, Madison and Lewis Counties (NYSDEC, 2003). In Delaware County, the Schoharie Creek, a tributary of the Mohawk River, is located in the northeast portion of the County. The Schoharie

Reservoir, also located in the northeast corner of the County, is considered one of the significant reservoirs within the Mohawk River Basin (NYSDEC, Date Unknown).

Delaware River Basin

The Delaware River Basin is located in southeastern New York State. The headwaters of the Basin originate in the Catskill Mountains and flow in a generally southward direction, draining portions of south-central New York State, eastern Pennsylvania, western New Jersey and northern Delaware, before emptying into the Atlantic Ocean. This Basin drains approximately 12,800 square miles, with 2,390 square miles within New York State. The Delaware River Basin area, within New York State, includes most of Sullivan County, much of Delaware County, and smaller parts of Orange, Ulster, Greene, Schoharie, Broome and Chenango Counties (NYSDEC, 2002). In Delaware County, the West and East Branches of the Delaware River are major tributaries of the Delaware River Basin (NYSDEC, Date Unknown).

Susquehanna River Basin

The Susquehanna River Basin is the second largest basin east of the Mississippi River. The 444 miles of the Basin drain approximately 27,500 square miles, covering the large portions of New York State, Pennsylvania and Maryland, before emptying into the Chesapeake Bay. In New York State, the Susquehanna River Basin encompasses most of the south-central portion of the State. The Basin drains approximately 4,520 square miles in central New York State. Within the State, the drainage area includes most of Broome, Chenango, Cortland, Otsego and Tioga Counties, portions of Delaware, Madison and Chemung Counties, and small parts of Schuyler, Tompkins, Onondaga, Oneida, Herkimer and Schoharie Counties (NYSDEC, 2009). In Delaware County, the Susquehanna River flows along the west-southwest border of the County.

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 Programs (NFIP) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. The SFHA includes Zones A, AO, AH, A1-30, AE, A99, AR, AR/A1-30, AR/AE, AR/AO, AR/AH, AR/A, VO, V1-30, VE, and V. (FEMA, 2007). This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities since many communities have maps showing the extent of the base flood and likely depths that will be experienced. The base flood is often referred to as the "100-year" flood designation (or 1% annual chance event). 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 1% (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 1% (100-year) annual chance 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, 2003; FEMA, 2005).

It is important to recognize, however, that flood events and flood risk is not limited to the NFIP delineated flood hazard areas. In fact, in Delaware County significant flood events have resulted in devastating impacts to structures and infrastructure outside of currently mapped floodplains. Developing and maintaining accurate flood risk maps is an ongoing process involving direct input from the impacted communities and the county, and such mapping will only ever be able to help identify areas of statistically higher risk within the limits of current science and understanding of the myriad of factors (weather, topography, hydrology and hydraulics, development, etc) that affect flooding the region.

Flood Insurance Study (FIS)

The following discussion presents flood information as directly provided in the FEMA FIS document(s), however stakeholders in the County note that there are numerous inaccuracies and gaps in their coverage of flood events and hazard areas in the County. The County has identified working with FEMA to amend the FIS narratives as a high-priority County level initiative in this plan update.

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 Delaware County has been completed; however, it is a preliminary document. The 2009 preliminary FIS discussed the principal flood problems in the County.

- **Town of Colchester -** The largest flood on the East Branch Delaware River, during the 30-year period since the Pepacton Rservoir was constructed, occurred on May 30, 1984. The peak discharge was 9,400 cubic feet per second (cfs). Further downstream, a peak discharge of 10,700 cfs was recorded. This flood inundated farmland along the River, as well as some homes.

  Another significant flood occurred in the Town on October 1903, known as the Pumpkin Flood of 1903, and was caused by heavy rains from a hurricane that passed east of the Delaware River Basin. This flood is the flood of record at Fishs Eddy on the East Branch of the Delaware and at Hale Eddy on the West Branch.

  The flood of August 1940 washed out the grist mill in Downsville on Downs Brook. This was the largest flood on Downs Brook and Wilson Hollow Brook since the grist mill dam was constructed in 1848. It was reported that the Wilson Hollow Brook washed over the road above Tub Mill Falls and Wilson Hollow Road. Many of the bridges and roads in the area around Downsville were washed out or overflowed.

- **Town of Davenport** – In recent years, the most severe flooding event in the Charlotte Creek watershed was on April 4, 1960. This flood had an estimated recurrence interval of a four-percent annual chance.

- **Town of Delhi** – Major floods in this Town have occurred along the West Branch of the Delaware and the Little Delaware River. Major floods occurred in December 1973, June 1973, July 1935 and September 1938.

- **Village of Delhi** – The greatest flood on record for the Village occurred in September 1938. In December 1973, flooding was caused by heavy rains falling on a snow-covered ground (12 inches of snow) and warm temperatures that caused snowmelt. The June 1973 flood damages was the result of a blocked culvert that forced Steele Brook to overflow its banks and cause sheet flow.

  The West Branch of the Delaware and the Steele Brook valleys are susceptible to hurricane activity, floods from snowmelt, and high backwater caused by ice jams obstructing the channel.

- **Town and Village of Hancock** – In February 1981, ice break up and heavy rainfall caused flooding along the East Branch of the Delaware River. The tributaries of the River contributed to flash floods, causing the ice to break up, jamming up as far as three miles upstream from Cadaosia Creek.

- **Village of Margaretville** – In the past 40 years, two floods caused the East Branch of the Delaware River to overflow its banks. The greatest flood occurred in November 1950 and the second in March 1986. The March flood was a result of heavy rains and snow melt.

- **Town of Middletown** – Low-lying areas near the East Branch of the Delaware River and the confluence of Dry Brook are subject to periodic flooding. Flooding occurs in the Town at any time of the year. The largest floods typically occur in April and May when snowmelt combines with heavy rains and increases runoff.

- **Town of Sidney** – The most recent flood occurred on March 14, 1977 when a stream gage on the Susquehanna River measured a peak flow of 23,500 cfs.

- **Town of Walton** – In the Town, flood problems are caused primarily by overflow of the West Branch of the Delaware River and five of its tributaries. Flooding near the confluences of these tributaries is the result of backwater effects from the West Branch.

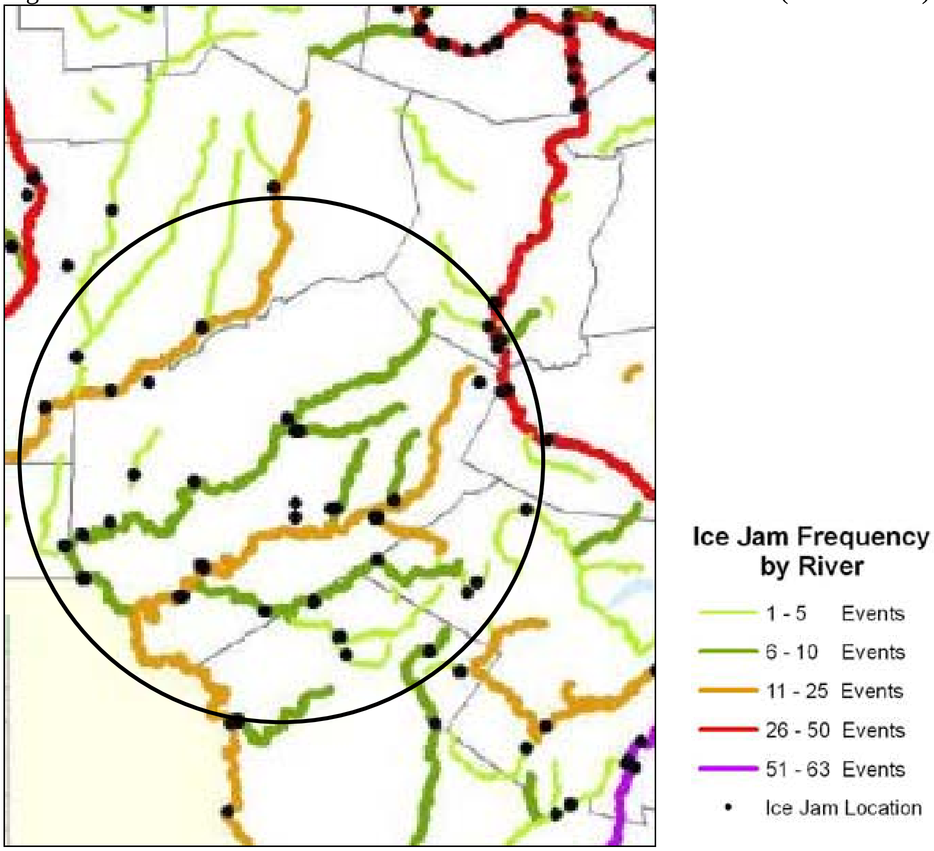
  The largest flood on record in the Town occurred on June 28, 2006 and had a peak discharge of 28,600 cfs (West Branch of the Delaware River). The largest flood on Third Brook occurred in June 1973.

- **Village of Walton** – The probability of flooding in the Village is increased during hurricane season (FEMA, 2009).

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 (NYS HMP 2011). Figure 5.4.3-2 presents the number of ice jam incidences within the vicinity of Delaware County between 1780 and 2010.

Figure 5.4.3-2. Number of Ice Jam Incidents on New York State Rivers (1875 – 2007)



Source: NYS HMP, 2011
Note (1): Circle indicates location of Delaware 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, Delaware County experienced 18 historic ice jam events between 1875 and 2011 (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 mis-operation would result in no probable loss of human life. Losses are principally limited to the owner's property
- *Intermediate Hazard (Class B)* is a dam located in an area where failure may damage isolated homes, main highways, minor railroads, interrupt the use of relatively important public utilities,

and/or will cause significant economic loss or serious environmental damage. Failure or mis-operation 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 4-24 and Figure 4-21 in the County Profile (Section 4) for dams located in Delaware County.

The County further notes that there are numerous dams that are below the threshold impoundment size for monitoring by NYSDEC, however such dams still pose significant risk and threat to the region that must be managed to protect public safety.

Additional documentation provided the following information regarding location of flooding in the municipalities of Delaware County:

- **Town of Delhi** – Flooding along the West Branch of the Delaware River has been a problem for over 100 years (Town of Delhi Comprehensive Plan, Date Unknown)
- **Village of Fleischmanns -** Areas in the Village that are subject to flooding include those lands adjoining the Emory Brook where flooding results from snow melt, heavy rains or other weather conditions. By identifying these areas, it is possible to restrict development to open space uses, including recreation, which are tolerant of flooding and do not obstruct the flow of water (Fleischmanns Comprehensive Plan, 2009).
- **Town of Franklin** – Areas in the Town that are flood-prone include lands adjoining streams, lakes, ponds, or wetlands where flooding results from heavy snow melt, heavy rains or other weather conditions (Town of Franklin Comprehensive Plan, 2006).
- **Town of Hamden** – Areas along the West Branch of the Delaware River see serious flooding problems. One area in particular is the section near the Octagon Farm (Town of Hamden Planning Board, 2000).
- **Town of Walton** – The West Branch of the Delaware River flows through the center of the Village of Walton. East Brook, West Brook and Third Brook all flow into the Delaware River within the limits of the Village. The convergence of these four waterways, in a very small area, has the potential to create a serious flood hazard area, especially within the Village (Town of Walton Comprehensive Plan, 2006).

Previous Occurrences and Losses

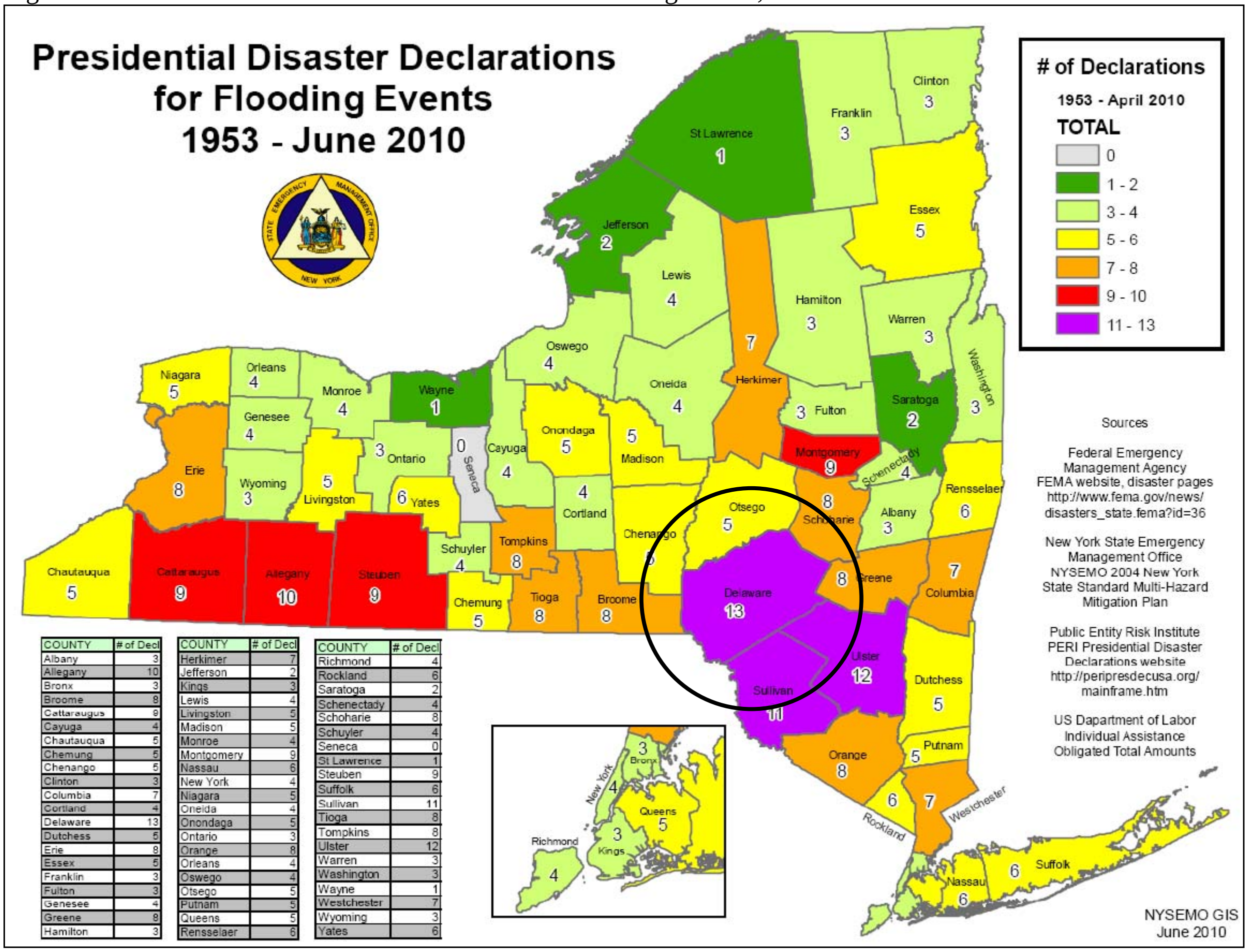
Many sources provided historical information regarding previous occurrences and losses associated with flooding events throughout New York State and Delaware County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. 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, Delaware County experienced 92 flood events between April 30, 1950 and October 31, 2011. Total property damages, as a result of these flood events, were estimated at $371.541 million. Total crop damages, as a result of these flood events, were estimated at $500,000. This total also includes damages to other counties. 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, 73 flood events occurred within the County. The database indicated that severe storm events and losses specifically associated with Delaware County and its municipalities totaled over $322.5 million in property damage and over $1.5 million 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 40 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 Delaware County has been declared as a disaster area as a result of 13 flood events (FEMA, 2012).

Figure 5.4.3-3 shows the FEMA disaster declarations (DR) for flooding events in New York State, from 1953 to June 2010. This figure indicates that Delaware County was included in 13 disaster declarations. Since the date of this figure, Delaware County has not been included in any additional FEMA disaster declarations for flooding.

Figure 5.4.3-3. Presidential Disaster Declarations for Flooding Events, 1953-2010



Source: NYS HMP 2011

Note: The black circle indicates the approximate location of Delaware County.

Based on all sources researched, known flooding events that have affected Delaware County and its municipalities are identified in Table 5.4.3-1. With flood documentation for New York State being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.3-1 may not include all events that have occurred throughout the County and region.

Table 5.4.3-1. Flooding Events Between 1950 and 2012

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
July 3, 1970	Severe Storms and Flooding	DR-290 (PA)	Yes	Delaware County had approximately $250 K in property damage and $25 K in crop damage.	FEMA, SHELDUS
July 1973	Severe Storms and Flooding	DR-401 (IA and PA)	Yes	No reference and/or no damage reported.	FEMA
April 3-7, 1987	Flooding	DR-792 (IA and PA)	Yes	This flood event affected eastern Delaware County, with over $19 K in damages (FSA). However, according to SHELDUS, Delaware County had over $2 M in property damage and over $200 K in crop damage.	Delaware County Farm Service Agency, FEMA, SHELDUS
August 21,1991	Flood	N/A	N/A	This flood event affected Beenerua/China Road, with over $3 K in damages. Overall, Delaware County had $50 K in property damage.	Delaware County Farm Service Agency, SHELDUS
April 1993	Flood	N/A	N/A	This flood event affected acres of cropland; however, total damages for the County is unknown.	Delaware County Farm Service Agency
January 19-20, 1996	Severe Storms and Flooding	DR-1095 (IA and PA)	Yes	Flash flood event resulted in six deaths and an estimated $9.3 M in property damages. Farms were also damaged from this flood event, which included Harmony Farms in Downsville, River Haven in Delancey and Del-Rose. Crop damage was estimated at $131 K.	NWS, Delaware County Farm Service Agency
November 8-9, 1996	Severe Storms and Flooding	DR-1148 (IA and PA)	Yes	Severe TSTMs caused widespread damage in Broome, Chenango and Delaware Counties. Several trees and wires were down in the Hamlet of Bloomville. Delaware County had approximately $500 K in property damage.	FEMA, NOAA-NCDC
July 8, 1998	Severe Storms and Flooding	DR-1233 (PA)	Yes	Heavy rain and TSTMs moved into northern Delaware County, bringing two to four inches of rain. In the Town of Sidney, the Carrs Creek started to quickly rise and resulted in significant flooding. Several homes in Sidney Center were affected. Many yards and driveways were damaged. Most of Route 35 was closed in Sidney due to flooding. The County had approximately $650 K in property damage. Flash flood occurred in the northern portion of Delaware County, near Sidney Center. Several homes were affected, many yards and driveways suffered damage as large divets were carved by rushing water, and many roadways were closed due to flooding (Route 35). The County had over $500 K in property damage.	FEMA, NOAA-NCDC, NWS

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
July 21, 2003	Severe Storm, Tornadoes and Flooding	DR-1486 (IA and PA)	Yes	A TSTM brought strong winds ranged from 60 to 90 mph between the Towns of Walton and Delhi. Multiple trees were snapped or uprooted, four cabins at 4-H camp were crushed, building roves were torn off, 14 homes were damaged and 10,000 customers were without power. The Town of Hancock declared a state of emergency. The County had approximately $500 K in property damages.	FEMA, NOAA-NCDC
May 23-27, 2004	Severe Storms and Flooding	DR-1534 (PA)	Yes	On May 23rd, TSTM winds downed trees and wires along Route 23 in the Town of Davenport, causing $20 K in damages. A F1 tornado touched down near Sanford, NY (Broome County) and tracked east into Delaware County, where it lifted near the Town of Deposit. The tornado uprooted and snapped trees in its path. It demolished a trailer, damaged siding of a house and destroyed a barn. Between May 26th and 27th, severe flooding occurred from the Town of Meredith to the Town of Delhi. The entire Town of Meredith was shut down due to flooding. Many roads and culverts were damaged. This series of events caused over $470 K in damages to Delaware County.	FEMA, NOAA-NCDC
August 13, 2004	Severe Storm and Flooding	DR-1564 (PA)	Yes	Remnants of Tropical Storm Bonnie brought heavy rain to the area. Between two and four inches of rain fell in Delaware County, causing the Beaver Kill at Cooks Falls to crest at 10.01 feet (flood stage of 10 feet).	FEMA, NOAA-NCDC
September 18-19, 2004	Flood (remnants of Hurricane Ivan)	DR-1565 (IA and PA)	Yes	Remnants of Tropical Storm Ivan brought heavy rain to the County. Between four and six inches of rain fell, causing flash floods. Most streams and creeks overflowed their banks. The East and West Branches of the Delaware River and the Beaver Kill River had major flooding. Seven people were rescued by State Police helicopter, 26 homes were destroyed, 60 homes suffered major damage, 60 homes with minor damage, 15 businesses were affected and two campgrounds were destroyed. This was the worst flooding since Hurricane Diane in 1955. The County had approximately $14.5 M in damages. Remnants of Hurricane Ivan caused major flooding in Delaware County. The Towns of Cooks Falls, Hancock, Margaretville, Walton, Delhi, and Downsville were the hardest hit in the County. The East and West Branches of the Delaware River and the Beaver Kill at Cooks Falls experienced major flooding. Estimated damages were over $6 M.	NWS, FEMA, SHELDUS

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
April 2-4, 2005	Severe Storms and Flooding	DR-1589 (IA and PA)	Yes	A slow moving storm brought two to three inches or rain to the area. Along with the snow melt and previous rain event, flooding occurred. The Beaver Kill at Cooks Falls crested at 18.97 feet (flood stage of 10 feet). The East Branch of the Delaware River at Fishs Eddy crested at 22,49 feet. The heavy rain and flooding damaged roads and bridges. For several hours, Route 17 and Interstate 86 were closed in the County. This event caused over $4 M in property damages to the County. A flooding event in the County resulted in 100 buildings destroyed or damaged, six bridges were closed, all roads were closed due to a declared state of emergency. The damage totals were approximately $4.7 M in the County. The hardest hit areas were the Towns of Colchester, Hancock and Margaretville.	FEMA, NOAA-NCDC, NWS
June 26 – July 10, 2006	Severe Storm and Flooding	DR-1650 (IA and PA)	Yes	Between June 26th and June 27th, three to five inches of rain fell in Delaware County. The heavy rains caused flash flooding in the Towns of Hancock and Colchester and surrounding areas. The Town of Hancock experienced the worst flooding it had ever seen, with most of the downtown area underwater. The Towns of Walton, Downsville, Delhi and Sidney were inundated with record flooding. Numerous streams and creeks flooding homes, businesses, roads and bridges. Additional rain on June 28th brought an additional five to 10 inches of rain, bringing the total rainfall to eight to 15 inches in Delaware County. The additional rainfall caused catastrophic flooding in the County. In the Village of Walton, the business district was flooded with six to seven feet of water and at least 200 structures were damaged. Several small streams and the Susquehanna River caused major flooding in the Village of Sidney. Some homes in the Village had up to six of water. The flooding caused Interstate 88 to collapse near the Town of Unadilla, killing two people. Amphenol Corporation in the Town of Sidney was flooded and had $40 M in damages. Overall, the County experienced approximately $275.5 M in total damages, with $189 M in damages just to roads. At least 1,000 homes were either damaged or destroyed; hundreds of businesses were flooded; and over 500 people were evacuated. At the height of the flooding, all roads were closed in Delaware	FEMA, NOAA-NCDC, SHELDUS

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				County and a state of emergency was declared.	
November 16-17, 2006	Severe Storm and Flooding	DR-1670 (PA)	Yes	Strong thunderstorms brought heavy rainfall and 45 to 74 mph winds across central NYS. Between one and four inches of rain fell within a three-hour period, causing significant flash flooding. The flash floods caused mudslides, road washouts, highway closings and flooded parking lots. In Delaware County, roads were flooded in the western portion. In the Town of Walton, Route 206 was flooded and closed. In the Town of Hancock, a state of emergency was declared due to flooding and damage public infrastructure and private properties. People were evacuated along Sands Creek Road. The County had approximately $51,000 in damages.	FEMA, NOAA-NCDC, SHELDUS
June 19-20, 2007	Severe Storm and Flooding	DR-1710 (PA)	Yes	The area along the border of Delaware and Sullivan Counties received between eight and 11 inches of rain in two to three hours. One bridge was washed out and several other bridges and roads were damaged. Land line and cellular communications were destroyed and homes were ripped from their foundations. Three people were killed when their homes washed away and one was killed in their car. Overall, 37 homes were destroyed and 16 homes suffered major damages throughout the County. A section of Route 206/Route 7 was destroyed between the hamlets of Rockland and Downsville. Total damages in the County was over $30 M.	FEMA, NOAA-NCDC, SHELDUS
July 23, 2008	Severe Storms and Flooding	N/A	N/A	Thunderstorms brought heavy rain to the County, causing significant flash flooding. All roads in the Towns of Andes, Stamford, and Middletown were closed. A state of emergency was declared for Delaware County. Roads and bridges were damaged. Damages totaled approximately $10 M.	NOAA-NCDC, SHELDUS
September 30 - October 1, 2010	Flash Flood	N/A	N/A	Remnants of Tropical Storm Nicole brought three to six inches of rain across central New York State. The heavy rain caused flash floods and flooding along main stem rivers. Higher amounts of rain fell across Delaware County, with amounts ranging between six and eight inches. The heavy rains produced flooding in the County, causing approximately $2.1 M in damages.	NOAA-NCDC, SHELDUS
April 26 – May 8, 2011	Severe Storm, Flooding, Straight-Line Winds	DR-1993	Yes	Showers and thunderstorms brought heavy rain and strong winds to parts of New York State. In Delaware County, heavy rain caused flash flooding and damage to roadways. The Towns of Hamden and Deposit were amount the harder hit	FEMA, NOAA-NCDC

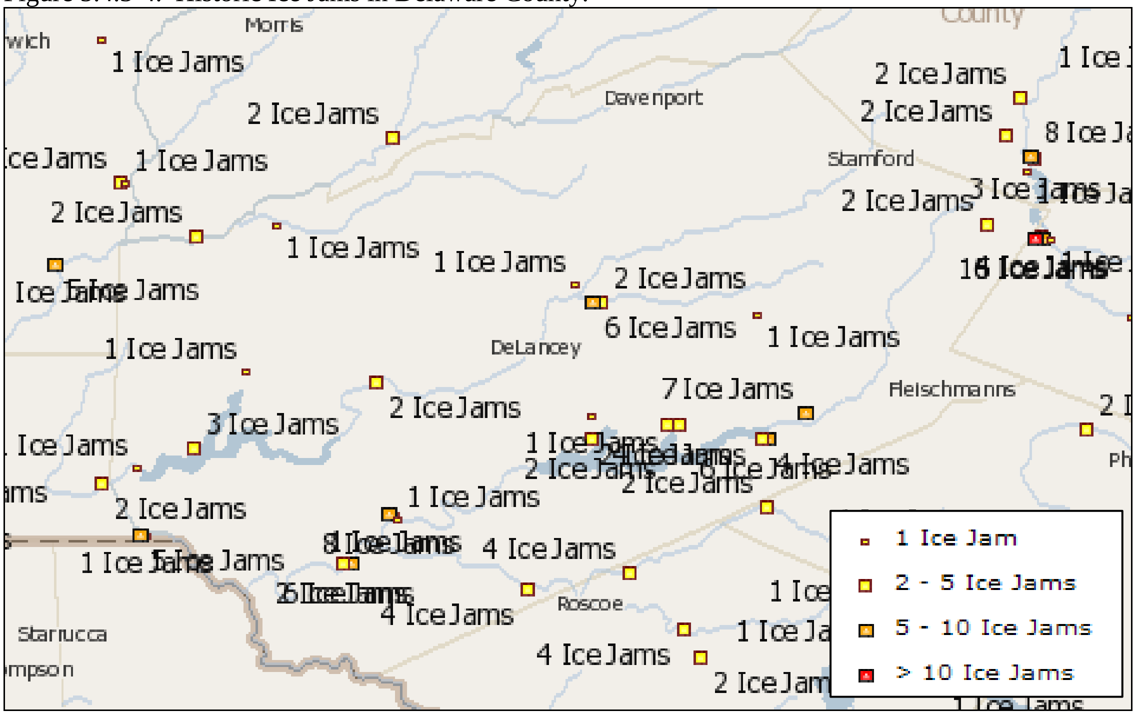
Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				areas, with bridge damage in Hamden. The County experienced approximately $650,000 in damages.	
August 25 – September 5, 2011	Hurricane Irene	EM-3328 / DR-4020 (PA and IA)	Yes	Hurricane Irene brought heavy rains to the Catskill Mountains of New York State. The heavy rains and strong winds knocked down numerous trees and power lines across Broome, Delaware, Sullivan, and Otsego Counties. During the height of the storm, over 40,000 people were without power, some without power for a week. In Delaware County, between four and eight inches of rain fell, causing catastrophic flooding in the areas along the East Branch of the Delaware River. The flooding of the East Branch of the Delaware River caused evacuations of approximately 100 homes and major flooding on roadways and bridges. Major flooding was reported in the Villages of Margaretville and Fleischmanns, where over 200 people were evacuated in this area. In the Village of Fleischmanns, homes were washed off their foundations. One woman was killed when her building collapsed. The County experienced over $10 M in damages.	FEMA, NOAA-NCDC
September 7 -11, 2011	Remnants of Tropical Storm Lee	EM-3341 / DR-4031 (PA and IA)	Yes	The Remnants of Tropical Storm Lee brought strong winds and heavy rains to the area. Between six and eight inches of rain fell within a 48-hour period. The heavy rain caused massive, record breaking flooding on small streams, creeks, and along the Susquehanna River and its tributaries. In Delaware County, moderate flooding occurred along the West Branch of the Delaware River, near Hale Eddy. The River crested at 14.71 feet. Near the Town of Walton, the River crested at 14.4 feet. Near the Town of Harvard, the River crested at 14.71 feet. Delaware County had approximately $6 M in property damage.	FEMA, NOAA-NCDC

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.

DR	Federal Disaster Declaration
EM	Federal Emergency Declaration
FEMA	Federal Emergency Management Agency
FSA	Farm Service Agency
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
PA	Public Assistance
SHELDUS	Spatial Hazard Events and Losses Database for the U.S.

According to the CRREL database, ice jams have historically formed at various points along the East and West Branches of the Delaware River, the Little Delaware River, Beaver Kill, Trout Creek, Terry Clove Kill, Coles Clove Kill, Oquaga Creek, Coulter Brook, and Tremper Kill (Ice Engineering Research Group, 2011). Locations of historical ice jam events are indicated in Figure 5.4.3-4 below.

Figure 5.4.3-4. Historic Ice Jams in Delaware County.



Source: CRREL, 2012

Based on review of the CRREL Database, Table 5.4.3-2 lists the ice jam events that have occurred in Delaware County between 1900 and 2012. Information regarding losses associated with these reported ice jams was limited.

Table 5.4.3-2. Ice Jam Events in Delaware County between 1900 and 2011

Event Date	River / Location	Description	Source(s)
February 16, 1939	West Branch Delaware River at Hale Eddy	maximum annual gage height of 15.24 feet, affected by backwater from ice	CRREL
March 7, 1941	Little Delaware River at Delhi	maximum annual gage height of 5.73 feet, affected by backwater from ice	CRREL
March 9, 1942	Little Delaware River at Delhi	maximum annual gage height of 7.40 feet, affected by backwater from ice	CRREL
February 22, 1943	Little Delaware River at Delhi	maximum annual gage height of 7.45 feet, affected by backwater from ice	CRREL
March 5, 1934	Beaver Kill at Cooks Falls	maximum annual gage height of 8.50 feet, affected by backwater from ice	CRREL
March 5, 1934	West Branch Delaware River at Hale Eddy	maximum annual gage height of 11.43 feet, affected by backwater from ice, discharge 13,000 cfs.	CRREL
March 16, 1944	Little Delaware River at Delhi	maximum annual gage height of 7.01 feet, affected by backwater from ice	CRREL
March 17, 1944	Beaver Kill at Cooks Falls	maximum annual gage height of 11.66 feet, affected by backwater	CRREL

Event Date	River / Location	Description	Source(s)
		from ice	
February 23, 1944	Trout Creek at Cannonsville	maximum annual gage height of 6.69 feet, affected by backwater from ice, reported at USGS gage Trout Creek at Cannonsville, on February 23, 1944	CRREL
February 22, 1945	Little Delaware River at Delhi	maximum annual gage height of 5.98 feet, affected by backwater from ice, reported at USGS gage Little Delaware River near Delhi, on February 22, 1945	CRREL
February 27, 1945 / March 3, 1945	West Branch Delaware River at Hale Eddy	maximum annual gage height of 13.13 feet, affected by backwater from ice. Additional ice affected gage height of 10.45 feet, reported on March 3; discharge 11,000 cfs.	CRREL
February 27, 1946	Terry Clove Kill near Pepacton	maximum annual gage height of 3.25 feet, affected by backwater from ice	CRREL
February 28, 1946	Trout Creek at Cannonsville	maximum annual gage height of 7.11 feet, affected by backwater from ice	CRREL
February 28, 1946	Coles Clove Kill at Pepacton	maximum annual gage height of 6.62 feet, affected by backwater from ice	CRREL
March 5, 1946	West Branch Delaware River at Hale Eddy	maximum annual gage height of 12.75 feet, affected by backwater from ice	CRREL
March 14, 1947	Little Delaware River at Delhi	maximum annual gage height of 7.44 feet, affected by backwater from ice	CRREL
February 14, 1948	Coles Clove Kill at Pepacton	gage height of 6.00 feet, affected by backwater from ice	CRREL
March 9, 1950	West Branch Delaware River at Delhi	Maximum annual gage height of 6.20 feet, affected by backwater from ice, discharge 2,800 cfs.	CRREL
March 9, 1950	West Branch Delaware River at Hale Eddy	maximum annual gage height of 15.15 feet, affected by backwater from ice	CRREL
January 27, 1954	Beaver Kill at Cooks Falls	maximum annual gage height of 9.63 feet, affected by backwater from ice	CRREL
February 11, 1955	Oquaga Creek at Deposit	gage height of 5.70 feet, affected by backwater from ice	CRREL
February 11, 1955	Trout Creek at Cannonsville	maximum annual gage height of 7.01 feet, affected by backwater from ice	CRREL
January 22, 1957	Oquaga Creek at Deposit	maximum annual gage height of 6.25 feet, affected by backwater from ice	CRREL
January 23, 1957	Beaver Kill at Cooks Falls	maximum annual gage height of 8.09 feet, affected by backwater from ice	CRREL
January 21, 1959	Ouleout Creek at East Sidney	maximum annual gage height of 4.12 feet, affected by backwater from ice	CRREL
February 20, 1961	West Branch Delaware River at Stilesville	maximum annual gage height of 7.74 feet, affected by backwater from ice	CRREL
January 26, 1976	Tremper Kill at Andes	Maximum gage height of 7.92 ft	CRREL
January 21, 1979	Tremper Kill at Andes	The water discharge was 220 cubic feet per second.	CRREL
February 2, 1981	West Branch Delaware River at Walton	A gage height of 11.07 ft and a discharge of 2,800 cfs as a result of an ice jam	CRREL

Event Date	River / Location	Description	Source(s)
February 11, 1981	Tremper Kill at Andes	The maximum annual gage height of 6.13 ft and maximum annual discharge of about 1,800 cfs occurred as a result of backwater from ice jam.	CRREL
February 4, 1982	West Branch Delaware River at Walton	The maximum annual gage height of 11.23 ft occurred as a result of an ice jam.	CRREL
February 4, 1982	West Branch Delaware River at Hale Eddy	The maximum annual gage height of 8.74 ft occurred as a result of an ice jam.	CRREL
February 4, 1994	Tremper Kill at Andes	Maximum annual gage height of 4.89 ft. on February 4, 1994. The daily mean discharge was estimated to be 48 cfs.	CRREL
February 28, 2000	Little Delaware River at Delhi	An ice jam resulted in the maximum annual gage height of 5.50 ft. with a maximum annual discharge of about 1,300 cfs.	CRREL
January 1, 2001	Little Delaware River at Delhi	An ice jam caused a maximum annual gage height of 8.55 ft. This was also the maximum gage height since January 1997. The daily mean discharge was estimated to be 64 cfs	CRREL
March 4, 2003	Coulter Brook at Bovina Center	Annual maximum gage height of 1.77ft due to an ice jam. The average daily discharge was 0.78cfs	CRREL

Source: CRREL, 2012
Note: Although many events were reported for Delaware County, information pertaining to every event was not easily ascertainable; therefore this table may not represent all ice jams in the County.

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 Delaware County is presented further in Table 5.4.3-14 in the Vulnerability Assessment section of this profile.

As an additional component of NFIP, the Community Rating System (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, 2012). According to FEMA, no jurisdictions within the County participate in the CRS; therefore specific repetitive loss areas other than those identified by FEMA are not available for Delaware County (FEMA, 2011).

Probability of Future Events

Given the history of flood events that have impacted Delaware 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 the county in the past suggests that many people and properties are at risk from the flood hazard in the future.

It is estimated that Delaware County will continue to experience direct and indirect impacts of floods annually. Table 5.4.3-3 summarizes the occurrences of winter storm events and their annual occurrence (on average).

Table 5.4.3-3. Occurrences of Flood Events in Delaware County, 1993 - 2011

Event Type	Total Number of Occurrences	Annual Number of Events (average)
Flash Flood	39	2.2
Urban Flood	1	0.05
Flood	52	2.9
Total:	**92**	**5.1**

Source: NOAA-NCDC, 2011
Note: On average, Delaware County experiences 5.1 flood events each year.

In Section 5.3, the identified hazards of concern for Delaware 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 the 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. Delaware County is part of Region 2, Catskill Mountains and West Hudson River Valley. Some of the issues in this region, affected by climate change, include: the watershed for New York City's water supply, spruce/fir forests disappear from mountains, decline in popular apple varieties, winter recreation declines/summer opportunities increase, Hemlock wooly adelgid destroys trees, and native brook trout decline and replaced by bass (NYSERDA, 2011).

Temperatures are expected to increase throughout the state, by 1.5 to 3ºF by the 2020s, 3 to 5.5ºF by the 2050s and 4 to 9ºF 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 5.4.3-4 displays the projected seasonal precipitation change for the Catskill Mountains and West Hudson River Valley ClimAID Region (NYSERDA, 2011).

Table 5.4.3-4. Projected Seasonal Precipitation Change in Region 2, 2050s (% change)

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

Source: NYSERDA, 2011

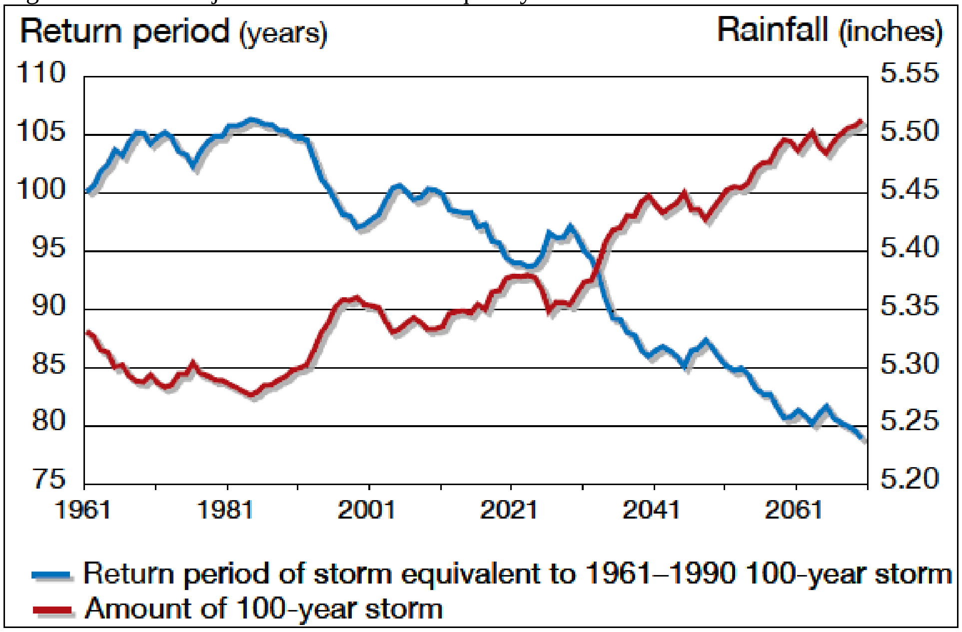
The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. The increase in heavy downpours has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways and transportation hugs; and increase delays and hazards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

Figure 5.4.3-5 displays the project rainfall and frequency of extreme storms in New York State. The amount of rain fall in a 1% annual chance (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 5.4.3-5. 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% (100- and 500-year) floodplains. The following text evaluates and estimates the potential impact of flooding in Delaware 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
- Further data collections that will assist understanding of this hazard over time
- Overall vulnerability conclusion

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 major concern for Delaware County. To assess vulnerability, potential losses were calculated for the County for riverine flooding for 1% (100-year) and 0.2% (500-year) 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.

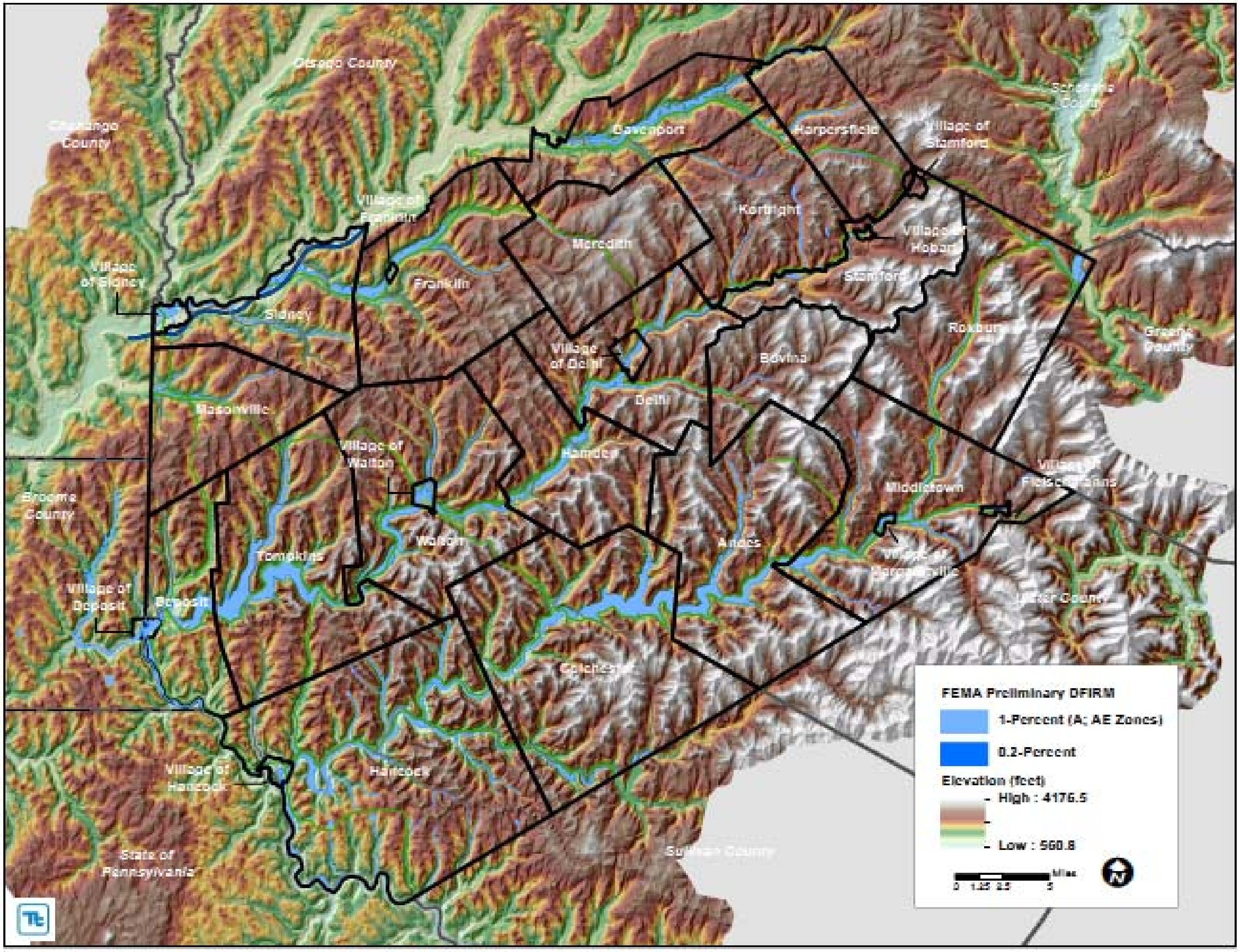
Data and Methodology

The 1% and 0.2% (100- and 500-year) annual chance flood events were examined to evaluate Delaware 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.

Delaware and Broome Counties' Flood Insurance Rate Maps (FIRMs) are currently being updated and the latest versions are considered preliminary. Their preliminary Digital FIRMS (DFIRMs), considered the best available data, were used for analysis. A modified Level 1 HAZUS-MH analysis was performed to analyze the risk and vulnerability to Delaware County. The model uses 2000 U.S. Census data at the block level and default general building stock data (RSMeans 2006), which has a level of accuracy acceptable for planning purposes. Where possible, the HAZUS-MH default data was enhanced using local GIS data from the county, state and federal sources and updated 2010 U.S. Census data was used for the exposure analysis.

The hydrology and hydraulics for the selected river reaches in the County was run in HAZUS and the flood-depth grid and flood boundary for the specified return periods (100- and 500-year mean return period [MRP]) were generated. To estimate exposure, the preliminary DFIRM flood boundaries were used. HAZUS-MH 2.0 calculated the estimated damages to the general building stock and critical facilities based on the depth grid generated and the default HAZUS damage functions in the flood model. Figure 5.4.3-6 illustrates the flood boundaries used for this vulnerability assessment.

Figure 5.4.3-6. Floodplains in Delaware County



Source: FEMA, 2011

Please note the preliminary DFIRMs were used to generate this figure and are not considered regulatory at this time.

Impact on Life, Health and Safety

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

To estimate the population exposed to the 1% and 0.2% annual chance (100- and 500-year) flood events, the preliminary FEMA DFIRM floodplain boundaries were overlaid upon the 2010 Census population data in GIS (U.S. Census 2010). Census blocks do not follow the boundaries of the floodplain. The Census blocks with their centroid in the flood boundaries were used to calculate the estimated population exposed to this hazard. Using this approach, it is estimated that 5, 863 people are within the 1% (100-year) floodplain or 11.6% of the total County population (population total 50,402 including the entire Village of Deposit), and 6,559 people are within the 0.2% (500-year) floodplain (13.0% of the total County population of 50,402 people). Table 5.4.3-5 lists the estimated population located within these flood zones by municipality.

Table 5.4.3-5. Estimated Delaware County Population Vulnerable to the 1% and 0.2% (100-Year and 500-Year MRP) Flood Hazard

Municipality	Population in the 1% annual chance event (100- Year) Flood Boundary	Population in the 0.2% annual chance (500-Year) Flood Boundary
Andes (T)	65	65
Bovina (T)	29	29
Colchester (T)	330	338
Davenport (T)	453	458
Delhi (T)	217	226
Delhi (V)	117	173
Deposit (T)	74	74
Deposit (V)	767	853
Fleischmanns (V)	82	82
Franklin (T)	115	115
Franklin (V)	0	0
Hamden (T)	137	137
Hancock (T)	284	299
Hancock (V)	48	126
Harpersfield (T)	36	36
Hobart (V)	76	76
Kortright (T)	85	85
Margaretville (V)	282	282
Masonville (T)	1	1
Meredith (T)	5	5
Middletown (T)	317	317
Roxbury (T)	70	70
Sidney (T)	120	129

Municipality	Population in the 1% annual chance event (100- Year) Flood Boundary	Population in the 0.2% annual chance (500-Year) Flood Boundary
Sidney (V)	1,176	1512
Stamford (T)	121	121
Stamford (V)	0	0
Tompkins (T)	10	10
Walton (T)	76	76
Walton (V)	770	864
Delaware County	**5,863**	**6,559**

Source: Census, 2010; FEMA, 2011
Notes: The exposed population for the Village of Deposit represents the entire Village; area in both Delaware and Broome Counties.

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 to due isolation during a flood event and they may have more difficulty evacuating.

HAZUS-MH 2.0 estimates the potential sheltering needs as a result of a 1% and 0.2% annual chance (100- and 500-year MRP) flood events. For the 1% (100-year) event, HAZUS-MH 2.0 estimates 6,317 people will be displaced and 3,699 people will seek short-term sheltering, representing 12.9% and 7.5% of the County population, respectively. For the 0.2% (500-year) event, HAZUS-MH 2.0 estimates 6,904 people will be displaced and 4,119 people will seek short-term sheltering, representing 14.1% and 8.4% of the County population, respectively. Refer to Table 5.4.3-6.

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 5.4.3-6. Estimated Delaware County Population Displaced or Seeking Short-Term Shelter from the 1% and 0.2% Annual Chance (100-Year and 500-Year MRP) Flood Events

Municipality	1% Annual Chance (100 Year)				0.2% Annual Chance (500 Year)			
	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter
Andes (T)	76	5.6	25	1.8	84	6.2	28	2.1
Bovina (T)	9	1.4	0	0.0	10	1.5	0	0.0
Colchester (T)	235	11.5	115	5.6	272	13.3	135	6.6
Davenport (T)	289	10.4	60	2.2	308	11.1	74	2.7
Delhi (T)	119	5.8	44	2.2	133	6.5	50	2.4
Delhi (V)	97	3.8	49	1.9	111	4.3	58	2.2
Deposit (T)	106	13.2	45	5.6	110	13.7	48	6.0
Deposit (V)	587	30.3	417	21.5	647	33.4	465	24.0
Fleischmanns (V)	75	24.4	19	6.2	84	27.3	29	9.4
Franklin (T)	109	4.9	15	0.7	119	5.4	23	1.0
Franklin (V)	28	7.0	9	2.2	33	8.2	11	2.7
Hamden (T)	68	5.3	15	1.2	78	6.1	22	1.7
Hancock (T)	349	15.7	53	2.4	428	19.3	94	4.2
Hancock (V)	289	23.7	213	17.5	343	28.2	252	20.7
Harpersfield (T)	31	3.0	1	0.1	35	3.3	1	0.1
Hobart (V)	32	11.0	4	1.4	39	13.4	7	2.4
Kortright (T)	98	6.0	4	0.2	108	6.6	6	0.4
Margaretville (V)	174	32.5	136	25.4	186	34.7	155	28.9
Masonville (T)	49	3.5	1	0.1	58	4.1	3	0.2
Meredith (T)	34	2.1	1	0.1	36	2.3	1	0.1
Middletown (T)	212	6.6	86	2.7	228	7.1	95	3.0
Roxbury (T)	263	10.5	149	5.9	278	11.1	166	6.6
Sidney (T)	171	8.2	14	0.7	208	10.0	18	0.9
Sidney (V)	1,717	42.2	1,524	37.5	1,826	44.9	1,635	40.2
Stamford (T)	103	6.2	13	0.8	119	7.2	15	0.9
Stamford (V)	63	11.3	9	1.6	73	13.1	14	2.5

Municipality	1% Annual Chance (100 Year)				0.2% Annual Chance (500 Year)			
	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter
Tompkins (T)	13	1.2	0	0.0	22	2.0	0	0.0
Walton (T)	120	4.7	15	0.6	120	4.7	17	0.7
Walton (V)	801	26.1	663	21.6	808	26.3	697	22.7
Delaware County	**6,317**	**12.9**	**3,699**	**7.5**	**6,904**	**14.1**	**4,119**	**8.4**

Source: HAZUS-MH 2.0

Note: The percent of the population displaced and seeking shelter was calculated using the 2000 U.S. Census data for Delaware County including the portion of the Village of Deposit in Broome County (population of 49,130).

Impact on General Building Stock

After considering the population exposed to the flood hazard, developed land, the HAZUS-MH 2.0 default value of general building stock exposed to, and damaged by, the 1% and 0.2% (100- and 500-year MRP) annual chance flood events was evaluated. Exposure in the flood zone 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 HAZUS-MH 2.0 flood model does not estimate general building stock exposure to the flood hazard. To provide a general estimate of number of properties and structural/content replacement value exposure, the preliminary FEMA DFIRM flood boundaries, Delaware County parcel GIS shapefile, July 2011 Real Property assessed values and HAZUS-MH 2.0 general building stock inventory were used. The FEMA preliminary DFIRM 1% and 0.2% (100- and 500-year) flood zones were overlaid upon the County parcel layer and the Real Property layers provided for each municipality. The polygons that cross the 1% and 0.2% flood zones were totaled for each municipality to approximate the number of properties and assessed values (total, building and land) located in the flood zone. Although it is unknown where on each parcel/property a structure may/may not be located, a portion of each property is within the flood zone and is inundated by flood waters.

The HAZUS-MH 2.0 Census blocks with their centroid in the FEMA preliminary DFIRM flood zones were used to estimate the building replacement cost value exposed to this hazard (Table 5.4.3-7).

In summary, there are approximately 54 and 56 square miles of land in Delaware County located in the preliminary DFIRM 1% and 0.2% (100-year and 500-year) floodplains, respectively. Approximately 4.7 miles and 5.3 miles (or 9- to 10-percent) of this land is developed land and located within the 1% and 0.2% preliminary DFIRM floodplains and thus exposed to the flood hazard (FEMA, 2011; USGS, 2011). Refer to Table 5.4.3-8 below.

There are 5,879 parcels and 6,165 parcels exposed to the 1% and 0.2% annual chance (100- and 500-year) events, respectively (refer to Table 5.4.3-9 below). This closely agrees with the Real Property exposure analysis conducted. There are 5,871 properties and greater than $775K in total assessed value (building and land) exposed to the 1% (100-year) flood. In addition, there are 6,203 properties and nearly $800K in total assessed value exposed to the 0.2% (500-year) flood. For more detailed information per municipality, please refer to Tables 5.4.3-10 and 5.4.3-11 below.

According to the HAZUS Census block analysis (blocks with the centroid located in the flood zones), there is approximately $795 million of building/contents exposed to the 1% (100-year) flood in Delaware County. This represents approximately 12-percent of the County's total general building stock replacement value inventory (approximately $6.5 billion; see Section 4). For the 0.2% (500-year) event, it is estimated there is nearly $960 million of buildings/contents exposed in Delaware County or nearly 15-percent (Table 5.4.3-12).

HAZUS-MH 2.0 estimates the potential damage to the general building stock inventory associated with the 1% (100-year) flood is approximately $317 million or 4.8-percent of the County's general building stock inventory. For the 0.2% (500-year) event, the HAZUS-MH 2.0 potential damage estimate is approximately $377 million (structure and contents) or 5.8-percent of the County's general building stock inventory. HAZUS-MH damage assessments for Delaware County are displayed in Table 5.4.3-13.

Table 5.4.3-7. Land Use (2006) in the 1% and 0.2% (100- and 500-year) FEMA Preliminary DFIRM Flood Boundaries

Land Use	Total Area (sq. mi.)	1% (100-Year) Area (sq. mi.)	1% (100-Year) Percent of Total	0.2% (500-Year) Area (sq. mi.)	0.2% (500-Year) Percent of Total
Barren	5.7	4.4	77.2	4.4	77.2
Developed	50.1	4.7	9.4	5.3	10.6
Farmland	233.3	14.3	6.1	15.6	6.7
Forested	1,140.1	7.7	0.7	7.9	0.7
Open Water	17	6.4	37.6	6.4	37.6
Wetlands	22.4	7.5	33.5	7.6	33.9
Total	**1,468.6**	**45.0**	**3.1**	**47.2**	**3.2**

Source: FEMA, 2011; USGS, 2011 (2006 National Land Cover Database)
Note: sq. mi. = square miles

Table 5.4.3-8. Area and Estimated Number of Parcels Located in the 1% and 0.2% (100- and 500-year) FEMA Preliminary DFIRM Flood Boundaries

Municipality	Total Area (sq. mi.)	Area Exposed (sq. miles) 1% (100 Year)	Area Exposed (sq. miles) 02.% (500 Year)	Percent Area Exposed 1% (100 Year)	Percent Area Exposed 02.% (500 Year)	Total Number of Parcels	Number of Parcels Exposed 1% (100 Year)	Number of Parcels Exposed 02.% (500 Year)	Percent of Parcels Exposed 1% (100 Year)	Percent of Parcels Exposed 02.% (500 Year)
Andes (T)	112.5	4.1	4.1	3.7	3.7	2,382	158	158	6.6	6.6
Bovina (T)	44.5	0.3	0.3	0.6	0.6	966	59	59	6.1	6.1
Colchester (T)	142.2	7.6	7.8	5.3	5.5	2,927	427	476	14.6	16.3
Davenport (T)	52.5	2.3	2.5	4.4	4.7	1,984	249	229	12.6	11.5
Delhi (T)	64.6	2.5	2.6	3.9	4.1	1,409	194	199	13.8	14.1
Delhi (V)	3.2	0.3	0.3	8.5	9.5	750	181	215	24.1	28.7
Deposit (T)	44.6	2.5	2.8	5.7	6.2	1,192	135	148	11.3	12.4
Deposit (V)*	1.3	0.3	0.3	20.6	24.4	364	114	126	31.3	34.6
Fleischmanns (V)	0.7	0.1	0.1	19.4	19.4	330	128	128	38.8	38.8
Franklin (T)	81.6	1.8	1.8	2.2	2.2	1,942	121	121	6.2	6.2
Franklin (V)	0.4	0.1	0.1	31.4	31.4	200	18	18	9.0	9.0
Hamden (T)	59.9	1.6	1.6	2.7	2.7	1,388	97	101	7.0	7.3
Hancock (T)	161.8	7.6	8.2	4.7	5.1	3,569	1,245	1,316	34.9	36.9
Hancock (V)	1.7	0.3	0.4	19.2	22.8	595	103	140	17.3	23.5
Harpersfield (T)	42.4	1.0	1.0	2.4	2.4	1,189	116	116	9.8	9.8
Hobart (V)	0.5	0.1	0.1	10.4	10.4	258	59	59	22.9	22.9
Kortright (T)	62.7	2.3	2.3	3.7	3.7	1,599	238	238	14.9	14.9
Margaretville (V)	0.7	0.3	0.3	45.7	48.6	380	117	134	30.8	35.3

Municipality	Total Area (sq. mi.)	Area Exposed (sq. miles)		Percent Area Exposed		Total Number of Parcels	Number of Parcels Exposed		Percent of Parcels Exposed	
		1% (100 Year)	02.% (500 Year)	1% (100 Year)	02.% (500 Year)		1% (100 Year)	02.% (500 Year)	1% (100 Year)	02.% (500 Year)
Masonville (T)	54.3	0.4	0.4	0.7	0.7	1,261	85	85	6.7	6.7
Meredith (T)	58.3	0.2	0.2	0.3	0.3	1,295	72	72	5.6	5.6
Middletown (T)	97.3	3.9	3.9	4.1	4.1	3,646	489	490	13.4	13.4
Roxbury (T)	87.6	1.7	1.7	1.9	1.9	3,231	247	247	7.6	7.6
Sidney (T)	50.7	2.4	2.6	4.8	5.2	1,466	226	235	15.4	16.0
Sidney (V)	2.4	0.8	0.9	34.6	39.2	1,686	262	278	15.5	16.5
Stamford (T)	48.5	0.9	0.9	1.8	1.8	1,237	88	88	7.1	7.1
Stamford (V)	1.3	0.1	0.1	4.7	4.7	564	70	70	12.4	12.4
Tompkins (T)	104.5	4.6	4.6	4.4	4.4	1,397	49	49	3.5	3.5
Walton (T)	97.6	3.2	3.3	3.2	3.3	2,063	256	258	12.4	12.5
Walton (V)	1.6	0.5	0.5	28.8	31.3	1,405	276	312	19.6	22.2
Delaware County	**1,481.5**	**53.7**	**55.7**	**3.6**	**3.8**	**42,675**	**5,879**	**6,165**	**13.8**	**14.4**

Source: FEMA, 2011; Delaware County GIS 2010

Notes:

sq.mi. = square miles; T = Town' V = Village

* Please note that the parcel count only includes the parcels located within Delaware County. Therefore, parcels in the Village of Deposit located in Broome County were not available and are not included in the table above.

Table 5.4.3-9. Estimated Assessed Value (Building and Land) Located in the 1% and 0.2% (100- and 500-year) MRP Flood Boundaries

Municipality	Number of Properties		1% (100 Year)			02.% Annual Chance (500 Year)		
	1% (100 Year)	02.% (500 Year)	Land AV	Building AV	Total AV	Land AV	Building AV	Total AV
Andes (T)	161	161	$58,078,468	$42,580,441	$100,658,909	$58,078,468	$42,580,441	$100,658,909
Bovina (T)	61	61	$1,056,801	$3,021,310	$4,078,111	$1,056,801	$3,021,310	$4,078,111
Colchester (T)	420	469	$406,925	$18,945,200	$19,352,125	$445,287	$19,067,300	$19,512,587
Davenport (T)	232	253	$10,488,433	$22,381,342	$32,869,775	$11,090,557	$24,046,703	$35,137,260
Delhi (T)	194	199	$6,144,448	$24,862,459	$31,006,907	$6,221,848	$25,071,489	$31,293,337
Delhi (V)	179	215	$4,518,937	$79,177,798	$83,696,735	$5,183,537	$83,119,529	$88,303,066
Deposit (T)	136	150	$338,296	$7,199,396	$7,537,692	$349,256	$7,233,646	$7,582,902
Deposit (V)	115	127	$93,165	$1,364,613	$1,457,778	$99,115	$1,407,863	$1,506,978
Fleischmanns (V)	128	128	$2,266,400	$17,530,000	$19,796,400	$2,266,400	$17,530,000	$19,796,400
Franklin (T)	123	123	$5,698,999	$16,617,001	$22,316,000	$5,698,999	$16,617,001	$22,316,000
Franklin (V)	18	18	$383,000	$8,778,000	$9,161,000	$383,000	$8,778,000	$9,161,000
Hamden (T)	99	103	$960,689	$2,549,537	$3,510,226	$972,489	$2,583,037	$3,555,526
Hancock (T)	1,245	1,316	$8,315,061	$12,751,090	$21,066,151	$8,703,845	$13,494,383	$22,198,228
Hancock (V)	103	140	$360,800	$1,572,873	$1,933,673	$471,650	$2,232,473	$2,704,123
Harpersfield (T)	116	116	$2,257,195	$6,015,499	$8,272,694	$2,257,195	$6,015,499	$8,272,694
Hobart (V)	60	60	$80,600	$990,500	$1,071,100	$80,600	$990,500	$1,071,100
Kortright (T)	234	234	$17,774,100	$36,243,500	$54,017,600	$17,774,100	$36,243,500	$54,017,600
Margaretville (V)	117	134	$3,254,800	$59,830,100	$63,084,900	$3,559,900	$62,568,200	$66,128,100
Masonville (T)	85	85	$3,559,560	$6,646,100	$10,205,660	$3,559,560	$6,646,100	$10,205,660
Meredith (T)	73	73	$4,860,700	$5,391,600	$10,252,300	$4,860,700	$5,391,600	$10,252,300
Middletown (T)	492	493	$60,702,100	$52,689,814	$113,391,914	$60,751,100	$52,876,514	$113,627,614
Roxbury (T)	247	247	$4,204,966	$25,351,409	$29,556,375	$4,204,966	$25,351,409	$29,556,375
Sidney (T)	229	241	$6,332,740	$49,023,667	$55,356,407	$6,479,340	$49,641,327	$56,120,667
Sidney (V)	262	278	$4,772,870	$26,291,040	$31,063,910	$5,079,770	$27,660,110	$32,739,880
Stamford (T)	90	90	$955,797	$2,150,640	$3,106,437	$955,797	$2,150,640	$3,106,437
Stamford (V)	71	71	$311,726	$2,502,400	$2,814,126	$311,726	$2,502,400	$2,814,126
Tompkins (T)	49	49	$3,263,647	$84,900	$3,348,547	$3,263,647	$84,900	$3,348,547
Walton (T)	256	258	$3,921,238	$16,745,578	$20,666,816	$3,931,462	$16,797,270	$20,728,732
Walton (V)	276	311	$1,352,300	$12,844,498	$14,196,798	$1,440,476	$13,731,464	$15,171,940

Municipality	Number of Properties		1% (100 Year)			02.% Annual Chance (500 Year)		
	1% (100 Year)	02.% (500 Year)	Land AV	Building AV	Total AV	Land AV	Building AV	Total AV
Delaware County	**5,871**	**6,203**	**$216,714,761**	**$562,132,305**	**$778,847,066**	**$219,531,591**	**$575,434,608**	**$794,966,199**

Source: Real Property Data (July 2011) provided by Delaware County
Notes:
1. This analysis was conducted using the preliminary DFIRM for Delaware County.
2. Building assessed value (AV) was calculated by subtracting the land AV from the total AV.
3. Please note that the Real Property GIS shapefile for the Village of Deposit only includes the properties located within Delaware County. Therefore, property in the Village of Deposit located in Broome County was not available and are not included in the table above.

Table 5.4.3-10. Estimated HAZUS General Building Stock Replacement Value (Structure and Contents) Located in the 1% and 0.2% (100- and 500-year) Flood Boundaries

Municipality	Total Buildings (All Occupancy Classes)				Residential Buildings		Commercial Buildings		Industrial Buildings	
	1% (100 Year)	% Total	0.2% (500 Year)	% Total	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)
Andes (T)	$9,585,000	3.8	$9,585,000	3.8	$6,781,000	$6,781,000	$2,240,000	$2,240,000	$224,000	$224,000
Bovina (T)	$3,602,000	2.9	$3,602,000	2.9	$3,602,000	$3,602,000	$0	$0	$0	$0
Colchester (T)	$27,407,000	8.8	$28,042,000	9.0	$25,589,000	$26,224,000	$926,000	$926,000	$102,000	$102,000
Davenport (T)	$26,146,000	10.1	$26,720,000	10.3	$9,547,000	$9,547,000	$9,993,000	$10,567,000	$1,392,000	$1,392,000
Delhi (T)	$10,490,000	4.1	$10,738,000	4.2	$9,258,000	$9,506,000	$1,106,000	$1,106,000	$126,000	$126,000
Delhi (V)	$67,431,000	16.0	$67,431,000	16.0	$19,526,000	$19,526,000	$33,164,000	$33,164,000	$1,611,000	$1,611,000
Deposit (T)	$5,475,000	6.3	$7,311,000	8.4	$5,327,000	$7,163,000	$148,000	$148,000	$0	$0
Deposit (V)	$86,005,000	30.4	$108,248,000	38.3	$49,163,000	$54,673,000	$19,752,000	$34,845,000	$1,474,000	$1,672,000
Fleischmanns (V)	$16,128,000	24.0	$16,128,000	24.0	$9,420,000	$9,420,000	$5,972,000	$5,972,000	$0	$0
Franklin (T)	$7,401,000	3.2	$7,401,000	3.2	$6,162,000	$6,162,000	$0	$0	$563,000	$563,000
Franklin (V)	$9,994,000	22.7	$9,994,000	22.7	$7,142,000	$7,142,000	$618,000	$618,000	$0	$0
Hamden (T)	$12,449,000	7.4	$12,449,000	7.4	$11,547,000	$11,547,000	$470,000	$470,000	$0	$0
Hancock (T)	$29,799,000	10.4	$30,912,000	10.7	$21,897,000	$23,010,000	$4,764,000	$4,764,000	$268,000	$268,000
Hancock (V)	$3,382,000	1.9	$34,419,000	19.6	$3,382,000	$11,283,000	$0	$16,036,000	$0	$6,350,000
Harpersfield (T)	$2,998,000	3.0	$2,998,000	3.0	$2,896,000	$2,896,000	$0	$0	$102,000	$102,000
Hobart (V)	$2,166,000	6.2	$2,166,000	6.2	$2,166,000	$2,166,000	$0	$0	$0	$0
Kortright (T)	$9,293,000	4.8	$9,293,000	4.8	$7,185,000	$7,185,000	$1,686,000	$1,686,000	$0	$0
Margaretville (V)	$49,535,000	53.8	$49,535,000	53.8	$26,078,000	$26,078,000	$13,597,000	$13,597,000	$696,000	$696,000
Masonville (T)	$0	0.0	$0	0.0	$0	$0	$0	$0	$0	$0
Meredith (T)	$353,000	0.2	$353,000	0.2	$353,000	$353,000	$0	$0	$0	$0
Middletown (T)	$24,128,000	5.1	$24,128,000	5.1	$20,282,000	$20,282,000	$1,348,000	$1,348,000	$2,266,000	$2,266,000
Roxbury (T)	$17,870,000	4.2	$17,870,000	4.2	$15,090,000	$15,090,000	$732,000	$732,000	$864,000	$864,000
Sidney (T)	$9,493,000	5.2	$12,589,000	6.7	$8,367,000	$11,187,000	$876,000	$1,152,000	$250,000	$250,000
Sidney (V)	$228,534,000	39.6	$289,423,000	50.1	$92,300,000	$116,704,000	$84,584,000	$114,200,000	$26,647,000	$27,440,000
Stamford (T)	$7,131,000	2.4	$7,131,000	2.4	$7,131,000	$7,131,000	$0	$0	$0	$0
Stamford (V)	$7,673,000	8.4	$7,673,000	8.4	$3,245,000	$3,245,000	$902,000	$902,000	$3,526,000	$3,526,000
Tompkins (T)	$1,384,000	1.1	$1,384,000	1.1	$127,000	$127,000	$0	$0	$1,257,000	$1,257,000
Walton (T)	$13,258,000	5.7	$13,258,000	5.7	$9,392,000	$9,392,000	$2,820,000	$2,820,000	$436,000	$436,000

Municipality	Total Buildings (All Occupancy Classes)				Residential Buildings		Commercial Buildings		Industrial Buildings	
	1% (100 Year)	% Total	0.2% (500 Year)	% Total	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)
Walton (V)	$104,315,000	25.0	$146,670,000	35.2	$52,268,000	$72,084,000	$35,600,000	$52,114,000	$5,345,000	$6,904,000
Delaware County	**$794,551,000**	**12.1**	**$958,577,000**	**14.6**	**$436,349,000**	**$500,632,000**	**$221,298,000**	**$299,407,000**	**$47,149,000**	**$56,049,000**

Source: HAZUS-MH 2.0

Notes:

1. Values represent replacement values (RV) for building structure and contents.
2. The general building stock valuations provided in HAZUS-MH 2.0 are Replacement Cost Value from RSMeans as of 2006.
3. RV represents the entire Village of Deposit; area in both Delaware and Broome Counties.

Table 5.4.3-11. Estimated General Building Stock Replacement Value (Structure and Contents) Located in the 1% and 0.2% (100- and 500-year) Flood Boundaries

Municipality	Agricultural Buildings		Religious Buildings		Government Buildings		Educational Buildings	
	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)
Andes (T)	$0	$0	$0	$0	$0	$0	$340,000	$340,000
Bovina (T)	$0	$0	$0	$0	$0	$0	$0	$0
Colchester (T)	$0	$0	$790,000	$790,000	$0	$0	$0	$0
Davenport (T)	$1,792,000	$1,792,000	$0	$0	$66,000	$66,000	$3,356,000	$3,356,000
Delhi (T)	$0	$0	$0	$0	$0	$0	$0	$0
Delhi (V)	$0	$0	$3,678,000	$3,678,000	$9,452,000	$9,452,000	$0	$0
Deposit (T)	$0	$0	$0	$0	$0	$0	$0	$0
Deposit (V)	$608,000	$608,000	$5,314,000	$6,756,000	$842,000	$842,000	$8,852,000	$8,852,000
Fleischmanns (V)	$0	$0	$736,000	$736,000	$0	$0	$0	$0
Franklin (T)	$0	$0	$0	$0	$676,000	$676,000	$0	$0
Franklin (V)	$0	$0	$2,234,000	$2,234,000	$0	$0	$0	$0
Hamden (T)	$432,000	$432,000	$0	$0	$0	$0	$0	$0
Hancock (T)	$150,000	$150,000	$0	$0	$0	$0	$2,720,000	$2,720,000
Hancock (V)	$0	$508,000	$0	$242,000	$0	$0	$0	$0
Harpersfield (T)	$0	$0	$0	$0	$0	$0	$0	$0
Hobart (V)	$0	$0	$0	$0	$0	$0	$0	$0
Kortright (T)	$0	$0	$0	$0	$422,000	$422,000	$0	$0
Margaretville (V)	$0	$0	$5,130,000	$5,130,000	$272,000	$272,000	$3,762,000	$3,762,000
Masonville (T)	$0	$0	$0	$0	$0	$0	$0	$0
Meredith (T)	$0	$0	$0	$0	$0	$0	$0	$0
Middletown (T)	$0	$0	$0	$0	$232,000	$232,000	$0	$0
Roxbury (T)	$448,000	$448,000	$736,000	$736,000	$0	$0	$0	$0
Sidney (T)	$0	$0	$0	$0	$0	$0	$0	$0
Sidney (V)	$690,000	$1,034,000	$10,544,000	$16,074,000	$11,005,000	$11,207,000	$2,764,000	$2,764,000
Stamford (T)	$0	$0	$0	$0	$0	$0	$0	$0
Stamford (V)	$0	$0	$0	$0	$0	$0	$0	$0
Tompkins (T)	$0	$0	$0	$0	$0	$0	$0	$0
Walton (T)	$610,000	$610,000	$0	$0	$0	$0	$0	$0
Walton (V)	$298,000	$464,000	$6,422,000	$7,158,000	$3,362,000	$3,616,000	$1,020,000	$4,330,000

Municipality	Agricultural Buildings		Religious Buildings		Government Buildings		Educational Buildings	
	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)
Delaware County	**$5,028,000**	**$6,046,000**	**$35,584,000**	**$43,534,000**	**$26,329,000**	**$26,785,000**	**$22,814,000**	**$26,124,000**

Source: HAZUS-MH 2.0

Notes:

1. Values represent replacement values (RV) for building structure and contents.
2. The general building stock valuations provided in HAZUS-MH 2.0 are Replacement Cost Value from RSMeans as of 2006.
3. RV represents the entire Village of Deposit; area in both Delaware and Broome Counties.

Table 5.4.3-12. Estimated Potential General Building Stock Loss (Structure and Contents) by the 1% and 0.2% (100- and 500-year) Flood Events

Municipality	Total Buildings (All Occupancies)		Percentage of Total Building Value		Residential Buildings		Commercial Buildings		Industrial Buildings	
	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)
Andes (T)	$3,124,000	$3,514,000	1.2	1.4	$1,054,000	$1,185,000	$1,348,000	$1,505,000	$119,000	$119,000
Bovina (T)	$276,000	$340,000	0.2	0.3	$273,000	$335,000	$1,000	$2,000	$0	$0
Colchester (T)	$10,947,000	$13,808,000	3.5	4.4	$7,895,000	$10,001,000	$787,000	$938,000	$1,695,000	$2,172,000
Davenport (T)	$13,039,000	$15,187,000	5.0	5.9	$5,105,000	$6,043,000	$5,376,000	$6,162,000	$1,700,000	$1,979,000
Delhi (T)	$3,723,000	$4,804,000	1.5	1.9	$2,902,000	$3,538,000	$746,000	$1,137,000	$75,000	$101,000
Delhi (V)	$11,105,000	$13,610,000	2.6	3.2	$3,442,000	$3,854,000	$6,076,000	$6,766,000	$309,000	$352,000
Deposit (T)	$1,577,000	$1,975,000	1.8	2.3	$1,611,000	$1,906,000	$36,000	$55,000	$0	$0
Deposit (V)	$13,000,000	$17,561,000	4.6	6.2	$8,435,000	$12,488,000	$2,894,000	$4,064,000	$587,000	$726,000
Fleischmanns (V)	$4,507,000	$5,244,000	6.7	7.8	$2,118,000	$2,728,000	$1,998,000	$2,096,000	$0	$0
Franklin (T)	$2,483,000	$2,991,000	1.1	1.3	$1,980,000	$1,606,000	$23,000	$28,000	$236,000	$0
Franklin (V)	$1,001,000	$1,177,000	2.3	2.7	$682,000	$815,000	$60,000	$69,000	$0	$263,000
Hamden (T)	$2,179,000	$2,755,000	1.3	1.6	$1,913,000	$2,462,000	$115,000	$134,000	$14,000	$17,000
Hancock (T)	$16,687,000	$22,274,000	5.8	7.7	$11,488,000	$15,399,000	$3,646,000	$4,524,000	$1,127,000	$1,399,000
Hancock (V)	$21,048,000	$23,752,000	12.0	13.5	$7,670,000	$8,862,000	$10,059,000	$11,274,000	$2,104,000	$2,197,000
Harpersfield (T)	$409,000	$510,000	0.4	0.5	$291,000	$365,000	$92,000	$115,000	$17,000	$20,000
Hobart (V)	$782,000	$990,000	2.2	2.8	$679,000	$828,000	$72,000	$117,000	$12,000	$17,000
Kortright (T)	$2,372,000	$2,851,000	1.2	1.5	$1,440,000	$1,699,000	$363,000	$427,000	$23,000	$25,000
Margaretville (V)	$13,070,000	$15,156,000	14.2	16.5	$5,269,000	$6,276,000	$5,566,000	$6,306,000	$291,000	$332,000
Masonville (T)	$1,017,000	$1,250,000	0.7	0.9	$436,000	$582,000	$1,000	$1,000	$54,000	$70,000
Meredith (T)	$650,000	$762,000	0.4	0.4	$544,000	$647,000	$66,000	$72,000	$27,000	$26,000
Middletown (T)	$7,758,000	$9,558,000	1.6	2.0	$5,347,000	$6,756,000	$860,000	$1,023,000	$1,277,000	$1,476,000
Roxbury (T)	$6,128,000	$7,557,000	1.4	1.8	$4,229,000	$5,340,000	$764,000	$989,000	$462,000	$562,000
Sidney (T)	$7,626,000	$9,312,000	3.7	4.6	$5,160,000	$6,947,000	$1,580,000	$1,812,000	$796,000	$1,037,000
Sidney (V)	$129,241,000	$154,905,000	22.4	26.8	$60,459,000	$70,895,000	$49,114,000	$61,877,000	$6,494,000	$5,833,000
Stamford (T)	$2,864,000	$3,434,000	1.0	1.1	$1,097,000	$1,423,000	$973,000	$1,090,000	$277,000	$274,000
Stamford (V)	$1,905,000	$2,396,000	2.1	2.6	$526,000	$711,000	$180,000	$217,000	$1,073,000	$1,316,000

Municipality	Total Buildings (All Occupancies)		Percentage of Total Building Value		Residential Buildings		Commercial Buildings		Industrial Buildings	
	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)
Tompkins (T)	$261,000	$395,000	0.2	0.3	$239,000	$381,000	$5,000	$10,000	$15,000	$18,000
Walton (T)	$5,321,000	$5,381,000	2.3	2.3	$3,462,000	$3,293,000	$1,342,000	$1,510,000	$231,000	$250,000
Walton (V)	$33,001,000	$33,406,000	7.9	8.0	$8,888,000	$9,633,000	$17,017,000	$16,872,000	$2,505,000	$2,375,000
Delaware County	**$317,101,000**	**$376,855,000**	**4.8**	**5.8**	**$154,634,000**	**$186,998,000**	**$111,160,000**	**$131,192,000**	**$21,520,000**	**$22,956,000**

Source: HAZUS-MH 2.0

Notes:

1. Values represent replacement values (RV) for building structure and contents.
2. The general building stock valuations provided in HAZUS-MH 2.0 are Replacement Cost Value from RSMeans as of 2006.
3. RV represents the entire Village of Deposit; portions of the Village are located in Delaware and Broome Counties.

Table 5.4.3-12. Potential Estimated General Building Stock Loss (Structure and Contents) by the 1% and 0.2% (100- and 500-year) Flood Events (Continued)

Municipality	Agriculture Buildings		Religious Buildings		Government Buildings		Education Buildings	
	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)
Andes (T)	$13,000	$15,000	$186,000	$217,000	$1,000	$2,000	$403,000	$471,000
Bovina (T)	$2,000	$3,000	$0	$0	$0	$0	$0	$0
Colchester (T)	$4,000	$6,000	$419,000	$465,000	$146,000	$177,000	$0	$0
Davenport (T)	$423,000	$485,000	$33,000	$37,000	$112,000	$126,000	$290,000	$355,000
Delhi (T)	$13,000	$14,000	$13,000	$31,000	$0	$0	$0	$0
Delhi (V)	$0	$0	$536,000	$606,000	$1,864,000	$2,032,000	$0	$0
Deposit (T)	$1,000	$1,000	$0	$0	$0	$0	$0	$0
Deposit (V)	$40,000	$65,000	$831,000	$1,093,000	$0	$21,000	$213,000	$215,000
Fleischmanns (V)	$30,000	$33,000	$361,000	$386,000	$0	$1,000	$0	$0
Franklin (T)	$51,000	$64,000	$56,000	$61,000	$147,000	$154,000	$69,000	$80,000
Franklin (V)	$0		$259,000	$293,000	$0	$0	$0	$0
Hamden (T)	$121,000	$142,000	$0	$0	$0	$0	$0	$0
Hancock (T)	$34,000	$45,000	$24,000	$28,000	$833,000	$0	$412,000	$714,000
Hancock (V)	$67,000	$75,000	$161,000	$203,000	$0	$922,000	$154,000	$219,000
Harpersfield (T)	$0	$0	$0	$0	$9,000	$10,000	$0	$0
Hobart (V)	$19,000	$28,000	$0	$0	$0	$0	$0	$0
Kortright (T)	$25,000	$32,000	$25,000	$27,000	$188,000	$220,000	$386,000	$423,000
Margaretville (V)	$4,000	$4,000	$1,521,000	$1,757,000	$38,000	$60,000	$381,000	$421,000
Masonville (T)	$0	$0	$1,000	$1,000	$525,000	$613,000	$0	$0
Meredith (T)	$10,000	$12,000	$0	$0	$3,000	$5,000	$0	$0
Middletown (T)	$61,000	$67,000	$78,000	$78,000	$141,000	$158,000	$0	$0
Roxbury (T)	$136,000	$170,000	$522,000	$620,000	$15,000	$19,000	$0	$0
Sidney (T)	$59,000	$79,000	$13,000	$13,000	$10,000	$12,000	$8,000	$10,000
Sidney (V)	$245,000	$278,000	$6,460,000	$8,775,000	$5,569,000	$6,087,000	$900,000	$1,160,000
Stamford (T)	$1,000	$1,000	$236,000	$249,000	$224,000	$332,000	$62,000	$68,000
Stamford (V)	$8,000	$9,000	$78,000	$98,000	$0	$0	$40,000	$45,000
Tompkins (T)	$15,000	$0	$0	$0	$0	$0	$1,000	$1,000
Walton (T)	$99,000	$118,000	$0	$0	$187,000	$210,000	$0	$0

Municipality	Agriculture Buildings		Religious Buildings		Government Buildings		Education Buildings	
	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)	1% (100 Year)	0.2% (500 Year)
Walton (V)	$213,000	$205,000	$1,640,000	$1,884,000	$1,500,000	$1,149,000	$1,238,000	$1,288,000
Delaware County	**$1,694,000**	**$1,951,000**	**$13,453,000**	**$16,922,000**	**$11,512,000**	**$12,310,000**	**$4,557,000**	**$5,470,000**

Source: HAZUS-MH 2.0
Notes:

1. Values represent replacement values (RV) for building structure and contents.
2. The general building stock valuations provided in HAZUS-MH 2.0 are Replacement Cost Value from RSMeans as of 2006.
3. RV represents the entire Village of Deposit; area in both Delaware and Broome Counties.

In addition to total building stock modeling, individual data available on flood policies, claims, 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 NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are two or more losses reported which were paid more than $1,000 for each loss. The two losses must be within 10 years of each other & be as least 10 days apart. Only losses from (*sic* since) 1/1/1978 that are closed are considered."

Severe RLPs (SRL) were then examined in Delaware 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 5.4.3-13 and Figure 5.4.3-7 summarize the NFIP policies, claims and repetitive loss statistics for Delaware County. According to FEMA, using the 'occ01' column of their repetitive loss statistics, there 13 2-4 family residential RL properties; eight (8) assumed condominium buildings; 18 non-residential RL properties; two (2) RL property classified as 'other residential' and 119 single-family residential RL properties in the County. Of the 11 SRL properties in Delaware County, five (5) are residential (FEMA Region 2, 2012). This information is current as of January 31, 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. This data is more current than the properties reported in the New York State HMP and may explain any difference in property count between the two sources.

Table 5.4.3-13. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (1)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Polices in 1% (100-year) Boundary (1,2)	# Polices in 0.2% (500-year) Boundary (1,2)	# Policies Outside the 0.2% (500-year) Flood Hazard (1,2)
Andes (T)	37	25	$233,416	4	0	6	6	31
Bovina (T)	9	5	$151,976	0	0	0	0	9
Colchester (T)	103	108	$1,982,635	12	2	29	38	65
Davenport (T)	21	22	$122,395	1	0	10	11	10
Delhi (T)	13	9	$83,551	2	0	1	1	12
Delhi (V)	36	22	$107,040	2	0	7	11	25
Deposit (T)	27	24	$347,317	3	1	19	20	7
Deposit (V) (3)	0	0	(3)	0	0	0	0	0
Fleischmanns (V)	19	41	$678,417	3	0	3	3	16
Franklin (T)	14	5	$25,719	0	0	0	0	14
Franklin (V)	2	2	$91,818	0	0	0	0	2
Hamden (T)	12	10	$76,008	1	0	0	0	12
Hancock (T)	121	121	$2,001,497	12	2	24	31	90
Hancock (V)	20	6	$64,081	1	0	4	11	9
Harpersfield (T)	2	1	$3,700	0	0	0	0	2
Hobart (V)	6	2	$650	0	0	0	0	6
Kortright (T)	6	1	$0	0	0	0	0	6
Margaretville (V)	71	126	$4,801,670	15	6	30	37	34
Masonville (T)	6	3	$7,816	0	0	0	0	6
Meredith (T)	9	5	$42,861	0	0	0	0	9
Middletown (T)	65	62	$1,184,752	5	0	18	18	47
Roxbury (T)	23	15	$80,666	0	0	9	9	14
Sidney (T)	30	46	$848,066	11	0	16	16	14
Sidney (V)	216	334	$14,608,429	79	0	176	202	14

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (1)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Polices in 1% (100-year) Boundary (1,2)	# Polices in 0.2% (500-year) Boundary (1,2)	# Policies Outside the 0.2% (500-year) Flood Hazard (1,2)
Stamford (T)	5	1	$12,232	0	0	1	1	4
Stamford (V)	8	1	$1,213	0	0	2	2	6
Tompkins (T)	7	7	$38,101	0	0	0	0	7
Walton (T)	24	41	$981,145	2	0	8	9	15
Walton (V)	160	182	$7,283,981	7	0	120	132	28
Delaware County	**1,073**	**1,227**	$35,861,149	**160**	**11**	**483**	**558**	**515**

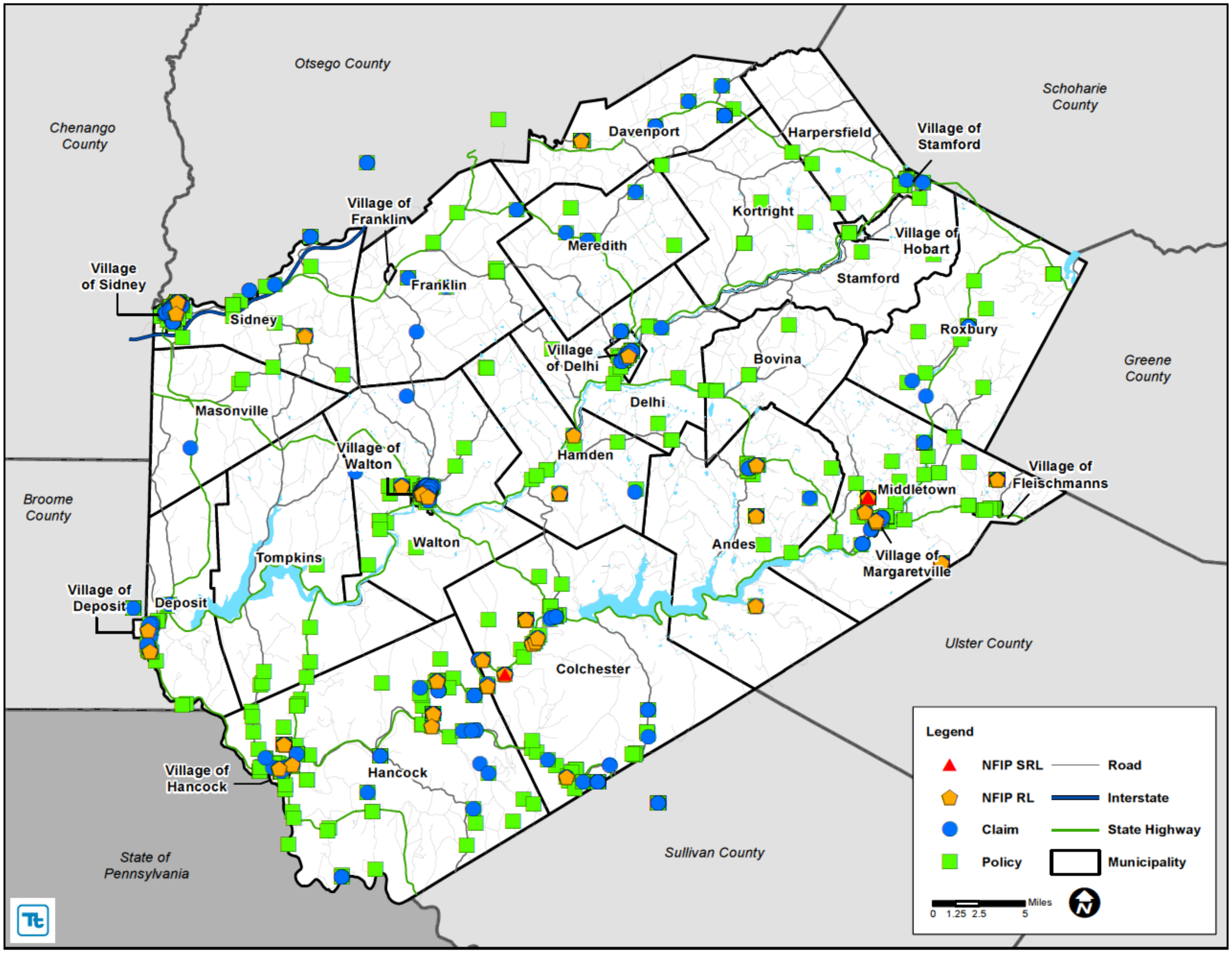
Source: FEMA, 2012

(1) Policies, claims, repetitive loss and severe repetitive loss properties were provided by FEMA Region 2. The total noted is a count using the "Comm_Name". According to FEMA, some properties may have more than one policy in force. The NFIP stats are current as of January 31, 2012. The repetitive loss property count includes the severe repetitive loss property count for that municipality.

(2) FEMA preliminary DFIRMs

(3) There were no policies, claims, repetitive loss or severe repetitive loss properties provided by FEMA Region 2 for the Village of Deposit. This is noted because a portion of the Village is located in Broome County and statistics were only requested/received for Delaware County.

Figure 5.4.3-7. NFIP Policies, Claims, Repetitive Loss and Severe Repetitive Loss Properties in Delaware County



Source: FEMA Region 2, 2012
Note: The NFIP stats are current as of January 31, 2012.

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. Tables 5.4.4-14 and 5.4.4-15 list the critical facilities and utilities located in the FEMA preliminary DFIRM flood zones and the percent damage HAZUS-MH 2.0 estimates to the facility as a result of the 1% and 0.2% annual chance (100- and 500-year) 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.

In terms of infrastructure, according to Delaware County DPW, all bridges that have recently been replaced are designed for 50-year storm events with two-feet of freeboard, or designed to pass 100-year storms with gravity flow (no flow against beams) (Fairbairn, 2011).

Table 5.4.3-14. Critical Facilities Located in the Preliminary DFIRM Flood Boundaries and Estimated Potential Damage from the 1% and 0.2% Annual Chance (100- and 500-year) Events

			Exposure		Potential Loss			
Name	Municipality	Type	1% (100-Year)	0.2% (500-Year)	1% (100-Year) Structure Damage %	1% (100-Year) Content Damage %	0.2% (500-Year) Structure Damage %	0.2% (500-Year) Content Damage %
Andes Central School	Andes (T)	School			12.2	71.2	12.5	71.5
Andes VFD	Andes (T)	Fire	x	x	2.6	2.9	8.5	14.0
Methodist Church	Andes (T)	Shelter	x	x	-	-	5.1	19.3
Downsville Fire Hall	Andes (T)	Shelter		x	-	-	-	-
Town of Bovina DPW	Bovina (T)	User Defined	x	x	-	-	-	-
Amato Mobile Home Park*	Colchester (T)	User Defined	x	x	-	-	-	-
DEP	Colchester (T)	Police	x	x	-	-	-	-
Cooks Falls Fire Hall	Colchester (T)	Shelter	x	x	-	-	-	-
Downsville VFD and EMS	Colchester (T)	Fire		x	-	-	-	-
Cooks Falls VFD	Colchester (T)	Fire	x	x	-	-	-	-
Alcott Chase Mobile Home Park*	Colchester (T)	User Defined	x	x	83.5	82.0	83.1	81.2
Board of Elections - 1 Page Ave	Delhi (V)	County	x	x	-	-	-	-
Cabinet Shop - 1 Page Ave	Delhi (V)	County	x	x	-	-	22%	35%
Salt Shed - 1 Page Ave	Delhi (V)	County	x	x	47%	59%	50%	66%
Pole Barn - 1 Page Ave	Delhi (V)	County	x	x	-	-	-	-
County Garage Wickham Office - 1 Page Ave	Delhi (V)	County	x	x	-	-	-	-
DPW Garages/DPW/DCPD	Delhi (V)	County	x	x	-	-	-	-
99 Main Street – County Building	Delhi (V)	County		x	-	-	-	-
Deposit Village PD	Deposit (V)	Police		x	-	-	-	-
Bryces Trailer Park*	Deposit (V)	User Defined	x	x	79.8	76.8	81.9	78.9

Name	Municipality	Type	Exposure		Potential Loss			
			1% (100-Year)	0.2% (500-Year)	1% (100-Year) Structure Damage %	1% (100-Year) Content Damage %	0.2% (500-Year) Structure Damage %	0.2% (500-Year) Content Damage %
Deposit VFD and EMS	Deposit (V)	Fire	x	x	10.0	20.6	11.1	40.0
EOC	Deposit (V)	EOC	x	x	10.0	20.6	11.1	40.0
Meadow Park Apartments	Deposit (V)	Senior			9.4	55.6	9.4	55.63
Town of Deposit Town Hall	Deposit (V)	User Defined	x	x	11.9	70.7	13.8	81.2
Deposit Central School	Deposit (V)	School/Shelter	x	x	-	-	-	-
DPW Garage	Deposit (V)	User Defined	x	x	12	-	13	-
Bus Garage	Deposit (V)	User Defined	x	x	19	-	19	-
Fleischmanns VFD	Fleischmanns (V)	Fire	x	x	12.3	56.4	16.5	78.0
School Building	Fleischmanns (V)	School			5.6	30.2	8.6	50.1
Delaware Opportunities Inc.	Hamden (T)	School			0.3	1.7	0.5	2.4
East Branch VFD	Hancock (T)	Fire	x	x	10.1	21.4	14.3	66.2
Patrol Garage	Hancock (T)	User Defined	x	x	16.1	79.1	85.0	98.0
New Highway Garage	Hancock (V)	User Defined	x	x	18.1	83.2	13.1	67.3
Torche's Trailer Park*	Hancock (V)	User Defined	x	x	90.8	83.0	94.6	83.0
Dollar General	Margaretville (V)	User Defined	x	x	13.4	40.0	16.7	60.0
Margaretville Central School	Margaretville (V)	School		x	20.8	84.0	28.3	94.3
Mountainside Residential Care Center	Margaretville (V)	User Defined	x	x	9.8	58.8	11.8	65.8
Post 216 Legion Hall	Margaretville (V)	User Defined		x	0.0	0.0	13.8	72.1
Masonville School	Masonville (T)	School			12.3	71.3	12.2	71.2
Head Start	Middletown (T)	User Defined	x	x	6.7	27.8	8.0	31.6
Delaware Cty American Red Cross	Middletown (T)	Shelter	x	x	-	-	-	-
Mountainside Cream	Roxbury (T)	User Defined	x	x	0.0	0.0	1.8	4.5
Roxbury Central School	Roxbury (T)	School			0.0	0.0	3.8	20.5
Sidney Civic Center	Sidney (V)	User Defined	x	x	-	-	-	-
Sidney PD	Sidney (V)	Police	x	x	-	-	-	-
Sidney Training Center	Sidney (V)	Fire	x	x	6.7	7.6	10.4	27.2
Sidney VFD	Sidney (V)	Fire			43.4	100.0	44.4	100.0
Sidney VFD and EMS	Sidney (V)	Fire	x	x	9.2	16.9	11.2	41.3
Tri-Town Regional Hospital	Sidney (V)	Medical			22.0	14.0	41.9	75.7
Head Start School	Sidney (V)	School	x	x	-	-	-	-
Connelly Development Corp.	Stamford (V)	Medical			23.2	16.4	4.3	2.2
DEP (Beerston)	Walton (T)	Police	x	x	0.0	0.0	16.7	79.2
Patrol Garage	Walton (V)	User Defined	x	x	85.0	98.0	15.1	75.3
Townsend Senior Apt	Walton (V)	User Defined			8.1	46.1	7.2	39.5
Village Clerk Office	Walton (V)	User Defined	x	x	11.0	67.9	10.3	66.0
Walton (Townsend) Central School	Walton (V)	School			11.2	70.2	11.5	70.5
Walton Shop	Walton (V)	User Defined	x	x	-	-	-	-

Name	Municipality	Type	Exposure		Potential Loss			
			1% (100-Year)	0.2% (500-Year)	1% (100-Year) Structure Damage %	1% (100-Year) Content Damage %	0.2% (500-Year) Structure Damage %	0.2% (500-Year) Content Damage %
7 Water Street - Walton Shop County Bldg	Walton (V)	User Defined	x	x	-	-	-	-

Source: FEMA, 2011; HAZUS-MH 2.0

Notes:

(1) 'X' indicates the facility location as provided by Delaware County is located in the preliminary DFIRM flood zone.

(2) HAZUS did not calculate potential loss estimates for some facilities located in the preliminary DFIRM flood zone. This is because these facilities are located outside of the flood depth grid generated by HAZUS. The difference between the flood depth grid generated by HAZUS and the preliminary DFIRM flood zones is most likely due to the resolution of the elevation model used (1/3 Arc Second or 10 meters) which differed from the elevation data used to generate the DFIRM itself.

(3) In some cases, HAZUS calculated potential flood loss to structures outside the preliminary FEMA DFIRM. These facilities are located inside the HAZUS flood depth grid.

(4) * Please note the mobile home park was evaluated as a single structure and the results are reported as such.

Table 5.4.3-15. Utilities Located in the Preliminary DFIRM Flood Boundaries and Estimated Potential Damage from the 1% and 0.2% Annual Chance (100- and 500-year) Flood Events

Name	Municipality	Type	Exposure		Potential Loss	
			1% (100-Year)	0.2% (500-Year)	1% (100-Year) Damage %	0.2% (500-Year) Damage %
Andes Library Well Treatment System	Andes (T)	Potable Water Facility			1.1	1.1
Andes (V) Library Wastewater Treatment System	Andes (T)	WWTF			9.4	9.4
Corbett Water Company	Colchester (T)	Potable Water Facility			3.4	3.4
Cook Falls Pump House	Colchester (T)	Potable Pump Station	x	x	-	0.6
Drinking Water Treatment Plant	Delhi (V)	Potable Water Facility	x	x	-	35.3
NYSEG	Deposit (V)	Electric Substation	x	x	7.5	10
Pump House #1 Borden Street	Deposit (V)	WW Pump	x	x	40	40
Pump House #2 Borden Street	Deposit (V)	WW Pump	x	x	40	40
Waste Water Pump Station	Deposit (V)	WW Pump	x	x	40	40
Pump House #4 Elm Street	Deposit (V)	WW Pump	x	x	0	40
Waste Water Pump Station	Deposit (V)	WWTF	x	x	40	40
Park Wells	Fleischmanns (V)	Potable Water Well	x	x	35.7	3.4
Religious School and Children's Camp	Fleischmanns (V)	WWTF			9.2	9.2
Town of Hamden WWTF	Hamden (T)	WWTF	x	x	-	-
Johnston & Rhodes Stonemill	Hancock (T)	WWTF	x	x	30.0	40.0
Becton Dickinson	Hancock (T)	WWTF	x	x	40.0	40.0
Beaver-Del Campsites	Hancock (T)	WWTF	x	x	40.0	40.0
Pump station	Hancock (V)	Potable Pump Station	x	x	40.0	40.0
Potable wells	Hancock (V)	Potable Water Well	x	x	40.0	1.1
Hancock (V) Sewage Treatment Plant	Hancock (V)	WWTF		x	30.0	37.9
Lift Station - Firemans Park	Hancock (V)	WW Pump	x	x	40.0	40.0
Water Plant	Kortright (T)	Potable Water Facility	x	x	-	23.0
New BV WWTF	Kortright (T)	WWTF	x	x	-	-
Telephone and Cable	Margaretville (V)	Communication	x	x	NA	NA
Well House	Margaretville (V)	Potable Water Well	x	x	40.0	40.0
Well House	Margaretville (V)	Potable Water Well	x	x	40.0	40.0
Hanah Country Resort	Middletown (T)	WWTF	x	x	-	-
Roxbury Water PH#1	Roxbury (T)	Potable Pump Station	x	x	1.7	40.0
NYC DEP Grand Gorge (H) STP	Roxbury (T)	WWTF	x	x	-	4.9
Roxbury Central School	Roxbury (T)	WWTF			1.0	5.1
Water Treatment Plant	Sidney (V)	Potable Water Facility	x	x	20.8	40.0
Meade Substation	Sidney (V)	Electric Substation		x	NA	NA
NYSEG – Oak Ave	Sidney (V)	Electric Substation	x	x	>30	>30
Radio WCDO	Sidney (V)	Communication		x	NA	NA
Sidney Fire Communication	Sidney (V)	Communication	x	x	NA	NA

Name	Municipality	Type	Exposure 1% (100-Year)	Exposure 0.2% (500-Year)	Potential Loss 1% (100-Year) Damage %	Potential Loss 0.2% (500-Year) Damage %
Well 2-88	Sidney (V)	Potable Water Well	x	x	37.0	40.0
Well 1-46	Sidney (V)	Potable Water Well	x	x	5.8	3.1
Aerospace Operations	Sidney (V)	WWTF	x	x	40.0	40.0
Sidney (V) Water Pollution Control Plant	Sidney (V)	WWTF	x	x	17.1	21.9
Gilbert WW Pump Station	Sidney (V)	WW Pump	x	x	40.0	40.0
Maple Ave Pump Station	Sidney (V)	WW Pump	x	x	-	-
Industrial Park WW Pump Station	Sidney (V)	WW Pump		x	-	-
County Meadow Park	Walton (T)	WWTF	x	x	-	-
Kraft Foods, Inc.	Walton (V)	WWTF	x	x	-	-
Walton (V) Sewage Treatment Plant	Walton (V)	WWTF			-	6.1

Source: FEMA, 2011; HAZUS-MH 2.0

Notes:

(1) 'X' indicates the facility location as provided by Delaware County is located in the preliminary DFIRM flood zone.

(2) Loss estimate calculations for electric and communication facilities are not supported in HAZUS-MH 2.0.

(3) HAZUS did not calculate potential loss estimates for some facilities located in the preliminary DFIRM flood zone. This is because these facilities are located outside of the flood depth grid generated by HAZUS. The difference between the flood depth grid generated by HAZUS and the preliminary DFIRM flood zones is most likely due to the resolution of the elevation model used (1/3 Arc Second or 10 meters) which differed from the elevation data used to generate the DFIRM itself.

(4) In some cases, HAZUS calculated potential flood loss to structures outside the preliminary FEMA DFIRM. These facilities are located inside the HAZUS flood depth grid.

Impact on Economy

For impact on economy, estimated losses from a flood event are considered. Losses include but are not limited to general building stock damages, agricultural losses, business interruption, impacts to tourism and tax base to Delaware 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 washout 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% (100-year) flood is approximately $317 million. This estimated building damage represents approximately 4.8-percent of the County's overall total general building stock inventory exposed to this hazard. For the 0.2% (500-year) event, the potential damage estimate is approximately $377 million (structure and contents), or 5.8-percent of the total exposed building value. These dollar value losses to the County's total building inventory replacement value, in addition to damages to roadways and infrastructure, would greatly impact Delaware's tax base and the local economy.

When a flood occurs, the agricultural industry is at risk in terms of economic impact and damage (i.e., damaged crop, financial loss to the farmer). In 2007, according to the Census of Agriculture, the market value of all agricultural products sold from Delaware County was greater than $55 million with a majority of the value (86-percent) in livestock, poultry and their products. Although the number of farms and the amount of farmland has decreased in Delaware County from 2002 to 2007, agriculture and agricultural products remains a large portion of the local economy (USDA NASS, 2007). As noted in Table 5.4.3-16, approximately six-percent of the farmland in Delaware County is located in the floodplain.

Specific agricultural loss information (monetary losses per agricultural product) was not available at the time this plan was drafted. However, given professional knowledge and historic loss information available, 40-percent and 60-percent loss estimates for crops as a result of major flood events is considered conservative estimates of potential losses for this hazard.

HAZUS-MH estimates the amount of debris generated from the flood events as a result of 1% and 0.2% Annual Chance (100- and 500-year) 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 5.4.3-16 summarizes the debris HAZUS-MH 2.0 estimates for each participating municipality.

Table 5.4.3-16. Estimated Delaware County Debris Generated from the 1% and 0.2% Annual Chance (100- and 500-year) Flood Events

	1% Annual Chance Event (100-Year)				0.2% Annual Chance Event (500-Year)			
Municipality	Total	Finish	Structure	Foundation	Total	Finish	Structure	Foundation
Andes (T)	367	249	57	61	422	278	70	73
Bovina (T)	61	31	16	14	70	36	19	16
Colchester (T)	5,315	1,285	2,150	1,881	6,653	1,583	2,706	2,365
Davenport (T)	3,006	797	1,168	1,042	3,617	927	1,430	1,260
Delhi (T)	1,732	554	629	548	2,147	665	789	693
Delhi (V)	5,458	832	2,603	2,023	5,841	918	2,763	2,160
Deposit (T)	1,131	349	316	466	1,476	433	427	616
Deposit (V)	3,582	1,764	786	1,032	4,595	2,196	1,042	1,358
Fleischmanns (V)	688	465	114	109	839	559	144	136
Franklin (T)	789	396	204	188	965	461	265	238
Franklin (V)	529	146	208	175	655	175	259	222
Hamden (T)	935	280	355	300	1,197	351	456	389
Hancock (T)	9,331	2,305	3,242	3,784	12,196	2,866	4,407	4,923
Hancock (V)	12,442	2,155	4,862	5,425	14,219	2,471	5,541	6,208
Harpersfield (T)	131	82	21	28	158	97	27	34
Hobart (V)	309	110	104	95	373	133	126	114
Kortright (T)	625	249	190	186	773	295	244	234
Margaretville (V)	4,965	1,422	2,049	1,493	6,875	1,692	2,992	2,190
Masonville (T)	155	87	30	38	207	110	45	52
Meredith (T)	152	91	29	33	186	103	40	43
Middletown (T)	1,698	973	379	346	2,330	1,182	617	531
Roxbury (T)	1,140	800	149	191	1,396	958	198	240

Municipality	1% Annual Chance Event (100-Year)				0.2% Annual Chance Event (500-Year)			
	Total	Finish	Structure	Foundation	Total	Finish	Structure	Foundation
Sidney (T)	3,837	851	1,339	1,646	4,732	1,017	1,696	2,018
Sidney (V)	66,188	12,596	30,035	23,557	81,465	15,163	36,606	29,697
Stamford (T)	398	249	73	77	549	311	120	118
Stamford (V)	123	105	8	9	157	135	11	11
Tompkins (T)	83	55	13	15	158	73	43	42
Walton (T)	2,056	525	805	726	1,951	523	749	680
Walton (V)	3,846	2,563	693	589	4,043	2,696	734	613
Delaware County	**131,072**	**32,367**	**52,627**	**46,077**	**160,246**	**38,408**	**64,565**	**57,273**

Source: HAZUS-MH 2.0

Effect of Climate Change on Vulnerability

The potential effects of climate change on Delaware County's vulnerability to flooding shall need to be considered as a greater understanding of regional climate change impacts develop.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by the flood hazard if located within the identified hazard areas. Specific areas of development vulnerable to the flood hazard are also indicated on hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan. Figure 5.4.3-7 illustrates the identified areas of potential new development in relation to the preliminary DFIRM flood boundaries.

Additional Data Needs and Next Steps

A modified Level 1 HAZUS-MH flood analysis was conducted for Delaware County using the default model data, with the exception of the updated critical facility inventory which included user-defined data. For future plan updates, a Level 2 HAZUS analysis can be conducted. A Level 2 analysis provides more accurate exposure and loss estimates by replacing the national default inventories with more accurate local inventories. Updated demographic and general building stock data would be needed to conduct a Level 2 HAZUS-MH analysis. In the future, FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) will be providing the flood depth and analysis grids as part of the DFIRM deliverable. These depth grids can be incorporated into HAZUS and used to calculate the potential losses to the County inventory. The utilization of the RiskMAP depth grids and the updated general building stock inventory on a structural level will provide more accurate flood loss estimates. To estimate exposure and potential loss due to dam breaks, dam break inundation areas can be digitized for future analysis.

Overall Vulnerability Assessment

The flood hazard is evaluated as a significant threat, which was ranked overall as a "high" risk by the Planning Committee with a "frequent" probability of occurrence (see Tables 5.3-3 and 5.3-6 in Section 5.3). This hazard can be managed and planned for through the mitigation strategy and specific activities outlined in Volume II Section 9, which build on efforts already undertaken by these communities.