

5.1 METHODOLOGY AND TOOLS

This section describes the methodology and tools used to support the risk assessment process.

Methodology

The risk assessment process used for this Plan is consistent with the process and steps presented in FEMA 386-2, State and Local Mitigation Planning How-to-Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA, 2001). This process identifies and profiles the hazards of concern and assesses the vulnerability of assets (population, structures, critical facilities and the economy) at risk in the community. A risk assessment provides a foundation for the community’s decision makers to evaluate mitigation measures that can help reduce the impacts of a hazard when one occurs (Section 9 of this plan).

Step 1: The first step of the risk assessment process is to identify the hazards of concern. FEMA’s current regulations only require an evaluation of natural hazards. Natural hazards are natural events that threaten lives, property, and many other assets. Often, natural hazards can be predicted, where they tend to occur repeatedly in the same geographical locations because they are related to weather patterns or physical characteristics of an area.

Step 2: The next step of the risk assessment is to prepare a profile for each hazard of concern. These profiles assist communities in evaluating and comparing the hazards that can impact their area. Each type of hazard has unique characteristics that vary from event to event. That is, the impacts associated with a specific hazard can vary depending on the magnitude and location of each event (a hazard event is a specific, uninterrupted occurrence of a particular type of hazard). Further, the probability of occurrence of a hazard in a given location impacts the priority assigned to that hazard. Finally, each hazard will impact different communities in different ways, based on geography, local development, population distribution, age of buildings, and mitigation measures already implemented.

Steps 3 and 4: To understand risk, a community must evaluate what assets it possesses and which assets are exposed or vulnerable to the identified hazards of concern. Hazard profile information combined with data regarding population, demographics, general building stock, and critical facilities at risk, located in Section 4, prepares the community to develop risk scenarios and estimate potential damages and losses for each hazard.

Tools

To address the requirements of DMA 2000 and better understand potential vulnerability and losses associated with hazards of concern, Broome County used standardized tools, combined with local, state, and federal data and expertise to conduct the risk assessment. Our standardized tools used to support the risk assessment are described below.

Hazards U.S. – Multi-Hazard (HAZUS-MH)

In 1997, FEMA developed a standardized model for estimating losses caused by earthquakes, known as Hazards U.S. or HAZUS. HAZUS was developed in response to the need for more effective national-, state-, and community-level planning and the need to identify areas that face the highest risk and potential for loss. HAZUS was expanded into a multi-hazard methodology, HAZUS-MH with new models for estimating potential losses from wind (hurricanes) and flood (riverine and coastal) hazards. HAZUS-MH is a Geographic Information System (GIS)-based software tool that applies engineering and scientific risk calculations that have been developed by hazard and information technology experts to provide defensible

damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

HAZUS-MH uses GIS technology to produce detailed maps and analytical reports that estimate a community's direct physical damage to building stock, critical facilities, transportation systems and utility systems. To generate this information, HAZUS-MH uses default HAZUS-MH provided data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. Damage reports can include induced damage (inundation, fire, threats posed by hazardous materials and debris) and direct economic and social losses (casualties, shelter requirements, and economic impact) depending on the hazard and available local data. HAZUS-MH's open data architecture can be used to manage community GIS data in a central location. The use of this software also promotes consistency of data output now and in the future and standardization of data collection and storage. The guidance *Using HAZUS-MH for Risk Assessment: How-to Guide (FEMA 433)* was used to support the application of HAZUS-MH for this risk assessment and plan. More information on HAZUS-MH is available at <http://www.fema.gov/plan/prevent/hazus/index.shtm>.

In general, probabilistic analyses were performed to develop estimates of long-term average losses (annualized losses) as well as an expected/estimated distribution of losses (mean return period losses) for the earthquake, flood and wind hazards. The probabilistic hazard generates estimates of damage and loss for specified return periods (e.g., 100- and 500-year). For annualized losses, HAZUS-MH version 2.1 calculates the maximum potential annual dollar loss resulting from various return periods averaged on a "per year" basis. It is the summation of all HAZUS-supplied return periods (e.g., 10, 50, 100, 200, 500) multiplied by the return period probability (as a weighted calculation). In summary, the estimated cost of a hazard each year is calculated.

Custom methodologies in HAZUS-MH version 2.1 (HAZUS-MH) were used to assess potential exposure and losses associated with hazards of concern for Broome County:

- **Inventory**: The default demographic data in HAZUS-MH 2.1, based on the 2000 U.S. Census, was used for analysis. However, the 2010 U.S. Census data was used to estimate hazard exposure at the municipal level.

For this update, the default general building stock in HAZUS-MH was updated and replaced with a custom inventory. The building inventory (9,286 buildings) generated by FEMA and described in the *Flood Risk Report* (February 2011) for the City of Binghamton, Village of Endicott, Village of Johnson City, Town of Union, and Town of Vestal was used. Tetra Tech updated the replacement cost values (structure and contents) using RSMMeans 2011 data. The building inventory for the remainder of the County was developed using parcels and 911 address points provided by the Broome County GIS Department. The updated building inventory (76,634 buildings) was incorporated into HAZUS-MH at the structure and aggregate level.

The critical facility inventory (essential facilities, utilities, transportation features and user-defined facilities) was updated for the earthquake, flood and wind hazard models. This comprehensive inventory was developed by gathering input from numerous sources including Broome County and input from the Planning Committee.

- **Earthquake**: A Level 2 HAZUS-MH analysis using a probabilistic scenario was performed to analyze the earthquake hazard losses for Broome County (annualized losses and 100-, 500- and 2,500-year mean return period [MRP] losses). Default demographic data in HAZUS-MH was used for the

earthquake analysis. However, as described above, updated building and critical facility inventories were used. Additionally, a local soil map provided by NYSOEM was entered into HAZUS-MH to replace default soil conditions. HAZUS-MH uses the seismic soil type classes recommended by the National Earthquake Hazard Reduction Program (NEHRP). The NEHRP soils classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses (NYSOEM, 2004; NYCEM, 2003). When a Level 1 HAZUS-MH earthquake analysis is conducted, the NEHRP soil classification type “D” is used as the soil type across the entire study region. For this HMP, a local soil map with Broome County’s NEHRP soil types provided by NYSOEM was entered into HAZUS-MH and used for all analyses.

- **Flood:** The 1- and 0.2-percent annual chance flood events were examined to evaluate Broome 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.

The HAZUS-MH riverine flood model was used to estimate Broome County’s estimated potential losses. For this update, the default general building stock in HAZUS-MH was updated and replaced with a custom inventory at the structure and aggregate level, as mentioned above. The updated building inventory (76,634 buildings) was incorporated into the HAZUS-MH flood model as individual buildings. Examining risk at the individual building level versus running the model and reporting results at the aggregate level (Census block level as per the analysis provided in the original Broome 2007 Hazard Mitigation Plan) provides more accurate potential loss estimates. An updated critical facility inventory was used in place of the HAZUS-MH defaults for essential facilities and utilities.

Broome County’s 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 3-meter Digital Elevation Model (DEM) and the preliminary DFIRM database, both provided by the County, were used to develop the estimated 1-percent and 0.2-percent annual chance depth grids. The depth grids were integrated into HAZUS-MH and the model was run to estimate potential losses.

- **Hurricane/Wind:** A HAZUS-MH probabilistic analysis was performed to analyze the wind hazard losses for Broome County. The probabilistic hurricane hazard activates a database of thousands of potential storms that have tracks and intensities reflecting the full spectrum of Atlantic hurricanes observed since 1886 and identifies those with tracks associated with the County. Annualized losses and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. Default demographic data in HAZUS-MH and updated building and critical facility data were used for the analysis.
- **Other Hazards:** HAZUS-MH support was used to evaluate other hazards, as feasible. For many of the hazards evaluated in this risk assessment, historic data are not adequate to model future losses at this time. However, HAZUS-MH can map hazard areas and calculate exposures if geographic information on the locations of the hazards and inventory data are available. For some of the other hazards of concern, areas and inventory susceptible to specific hazards were mapped and exposure was evaluated to help guide mitigation efforts discussed in Section 9. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment.

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For this risk assessment, the loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- 1) Approximations and simplifications necessary to conduct such a study
- 2) Incomplete or dated inventory, demographic, or economic parameter data
- 3) The unique nature, geographic extent, and severity of each hazard
- 4) Mitigation measures already employed by Broome County and the amount of advance notice residents have to prepare for a specific hazard event

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, Broome County will collect additional data to assist in developing refined estimates of vulnerabilities to natural hazards.

5.2 IDENTIFICATION OF NATURAL HAZARDS OF CONCERN

To provide a strong foundation for mitigation strategies considered in Sections 6 and 9, Broome County considered a full range of natural hazards that could impact the area, and then identified and ranked those hazards that presented the greatest concern. The natural hazard of concern identification process incorporated input from the County and participating jurisdictions; review of the 2011 New York State Hazard Mitigation Plan (NYS HMP) and previous hazard identification efforts; research and local, state, and federal information on the frequency, magnitude, and costs associated with the various hazards that have previously, or could feasibly, impact the region; and qualitative or anecdotal information regarding natural hazards and the perceived vulnerability of the study area’s assets to them. Table 5.2-1 documents the process of identifying the natural hazards of concern for further profiling and evaluation.

Hazards of Concern is defined as those hazards that are considered most likely to impact a community. These are identified using available data and local knowledge.

For the purposes of this planning effort, the Planning Committee chose to group some natural hazards together, based on the similarity of hazard events, their typical concurrence or their impacts, consideration of how hazards have been grouped in Federal Emergency Management Agency (FEMA) guidance documents (FEMA 386-1, “Understanding Your Risks, Identifying Hazards and Estimating Losses; FEMA’s “Multi-Hazard Identification and Risk Assessment – The Cornerstone of the National Mitigation Strategy”), and consideration of hazard grouping in the NYS HMP.

The “Flood” hazard includes riverine, flash, ice jam, saturated land failure, and dam break flooding. Other types of flooding such as coastal or urban drainage do not generally occur within the County; therefore, they were not further considered for inclusion within this HMP. Inclusion of the various forms of flooding under a general “Flood” hazard is consistent with that used in FEMA’s “Multi-Hazard Identification and Risk Assessment” guidance.

The “Severe Storm” hazard includes windstorms that often entail a variety of other influencing weather conditions including thunderstorms, hail, lightning and tornadoes. Since tropical disturbances are identified as a type of severe storm event, this hazard also includes tropical cyclone events (hurricanes, tropical storms and tropical depressions). Tropical cyclones were not grouped as a separate hazard, because the County felt that these types of events do not directly impact the County on a frequent basis and that exposure and risk of such events are minimal in comparison to communities along the New York coastline.

The “Severe Winter Storm” hazard includes heavy snowfall, blizzards, freezing rain/sleet, ice storms and extra-tropical cyclones (Nor’Easters and severe winter low-pressure systems). Extra-tropical events generally occur during winter weather months; therefore, for the purpose of this HMP, all such events are to be grouped within this hazard. Although not all extra-tropical events, such as nor’easters, occur during the winter, they will remain grouped within this hazard category to avoid duplication of events in hazard profiles. This grouping is consistent with that used in the NYS HMP, as well as the “Severe Winter Storm” hazard used in FEMA’s “Multi-Hazard Identification and Risk Assessment” guidance.

These groupings do not change the definition of the included specific events/hazards, as defined within FEMA guidance and other risk assessment documents, and does not affect the hazard analysis conducted through the use of HAZUS-MH, either directly or as a risk assessment support tool.

Please note that technological (for example, hazardous material incidents) and man-made hazards (for example, terrorism) are not being addressed in this planning process. The DMA 2000 regulations do not require consideration of such hazards, and the Steering Committee has elected to focus full attention on

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the natural hazards, particularly flooding, that clearly pose the greatest risk to the County. Further, the risks of man-made and technological hazards are generally mitigated and/or managed through other regulatory programs and plans.

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Table 5.2-1. Identification of Natural Hazards of Concern for Broome County, New York

Hazard	Step 1	Step 2	Step 3	
	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?	Source(s)
Avalanche	No	No	<ul style="list-style-type: none"> The NYS HMP does not identify avalanche as a hazard of concern for New York State. The topography and climate of Broome County does not readily support the occurrence of an avalanche event. New York State in general has a very low occurrence of avalanche events based on statistics provided by National Avalanche Center – American Avalanche Association (NAC-AAA) between 1950 and 2006. 	<ul style="list-style-type: none"> NYSDPC Review of NAC-AAA database between 1950 and 2006
Coastal Erosion / Coastal Storm	No	No	<ul style="list-style-type: none"> Broome County is not bounded by coastal waters; therefore, not directly impacted by coastal storms that result in coastal erosion. 	<ul style="list-style-type: none"> NYSDPC
Drought	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies drought as a hazard of concern for New York State. Broome County is located within the Eastern Plateau Climate Division. Between 1895 and 2002, 27 severe or extreme drought events occurred in this climate division. These events include: <ul style="list-style-type: none"> September – November 1895 November – December 1899 August 1900 – February 1901 November 1908 – January 1909 August 1909 – January 1910 July 1910 – September 1911 August – September 1913 October – December 1914 April – June 1915 November – December 1916 September 1921 – February 1922 November – December 1922 May 1923 – January 1924 August 1930 – June 1931 November – December 1931 May 1923 – January 1924 August 1930 – June 1931 November – December 1931 August 1939 – February 1940 May – June 1941 	<ul style="list-style-type: none"> NYSDPC NOAA-NCDC Drought Impact Reporter SHELDUS

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Hazard	Step 1	Step 2	Step 3	
	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?	Source(s)
			<ul style="list-style-type: none"> o September 1941 – April 1942 o August 1964 – February 1966 o July – August 1966 o October – November 1966 o January – February 1967 o August – September 1995 o November 2001 – January 2002 • Various sources indicated that many drought events or periods impacted large regions of the State, including Broome County. Such events include: <ul style="list-style-type: none"> o September 1995 – A drought warning was issued for the Catskills and mid-Hudson Valley and was expanded to include the Southern Tier. o April 1999 – This was the second driest April on record. Rainfall amounts were short of normal. Low rainfall and frequent gusty winds turned the underbrush into very dry tinder. This led to numerous brush fires during the month. o August 1999 – This was the peak of the long term drought across eastern New York State that began in July 1998. Precipitation totals were only at 80% normal. August ended the drought. Many wells went completely dry. Most communities implemented voluntary or mandatory water restrictions. 	
Earthquake	Yes	Yes	<ul style="list-style-type: none"> • The NYS HMP identifies earthquake as a hazard of concern for New York State. Areas within the State with a higher seismic risk include; The North and Northeast third (1/3) of the State (The North Country/Adirondack Region including a portion of the Greater Albany-Saratoga region), the Southeast corner (including the greater New York City area and western Long Island), and the Northwest corner (including the City of Buffalo and vicinity) of the State, in that order from higher to lower. • According to the USGS online seismic hazard maps, the peak ground acceleration with a 10% probability of exceedance over 50 years for Broome County is between 2 and 3% g. FEMA guidance recommends earthquakes are evaluated further if an area has a 3% g peak acceleration or more. 	<ul style="list-style-type: none"> • NYSDPC • USGS
Expansive Soils	No	No	<ul style="list-style-type: none"> • The NYS HMP identifies expansive soils as a hazard of concern for New York State. • USGS indicated that Broome County's soils consist of clay having slight to moderate swelling potential 	<ul style="list-style-type: none"> • NYSDPC • USGS



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Hazard	Step 1	Step 2	Step 3	
	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?	Source(s)
			<ul style="list-style-type: none"> Due to the fact that this hazard has no known historical occurrences, the County decided not to analyze the expansive soils hazard for the purpose of this Plan. 	
Extreme Temperature	Yes	Yes	<ul style="list-style-type: none"> Extreme temperature was not identified as a hazard in the NYS Plan. NOAA's NCDC storm events database indicates that Broome County was impacted by approximately 64 extreme events between 1950 and 2012. However, most events are of a regional extent rather than localized to just one county or community. 	<ul style="list-style-type: none"> NYSDPC NOAA-NCDC
Flood (Riverine, Flash, Ice Jam Dam Flooding)	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies flooding as the main hazard of concern for New York State. Broome County has been issued nine FEMA Disaster Declarations for flood-related events, each event resulting in extensive damages. <ul style="list-style-type: none"> FEMA-DR-290 – 1970 – Severe storm and flooding FEMA-DR-487 – 1975 – Severe storms, heavy rain, landslides, flooding FEMA-DR-515 – 1976 – Severe storms and flooding FEMA-DR-1095 – 1996 – Severe storms and flooding FEMA-DR-1564 – 2004 – Severe storms and flooding FEMA-DR-1589 – 2005 – Severe storms and flooding FEMA-DR-1650 – 2006 – Severe storms and flooding FEMA-DR-1670 – 2006 – Severe storms and flooding FEMA-DR-1993 – 2011 – Severe storms, flooding, tornadoes, and straight-line winds NOAA's NCDC storm events database indicates that Broome County was impacted by approximately 132 flood events between 1950 and 2012. This includes flash flooding. The 2011 NYS HMP indicated that Broome County has been ranked as the 6th most flood vulnerable county in New York State based on potential flood exposure and vulnerability to loss. NFIP identifies that there are over 3,000 NFIP policyholders in Broome County, with over \$642.6 million in claims (structure and contents) paid as of 6/30/2012. Ice Jams are mentioned separately in this Table but are grouped with the Flood hazard in this plan (see below). 	<ul style="list-style-type: none"> NYSDPC NYSOEM FEMA SHELDUS NOAA-NCDC NFIP
Hailstorm	Yes	Yes	Please see Severe Storm	



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Hazard	Step 1	Step 2	Step 3	
	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?	Source(s)
Hurricane (and other Tropical Cyclones)	Yes	Yes	Please see Severe Storm	
Ice Jams (categorized as a Flood hazard in this HMP)	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies ice jam flooding as a hazard of concern for New York State (grouped as a type of flood). New York State ranks 2nd in the Nation for total number of ice jam events, with over 1,500 incidents documented between 1857 and 2010. The USACE CRREL Ice Jam Database, NYS HMP and various other sources, indicates that 46 reported ice jam events have occurred within Broome County between 1857 and 2011. 	<ul style="list-style-type: none"> NYS DPC Review of USACE CRREL Ice Jam Database
Ice Storm	Yes	Yes	Please see Severe Winter Storm	
Infestation	Yes	No	<ul style="list-style-type: none"> The NYS HMP does not identify infestation as a hazard of concern for New York State. The following have infected Broome County over the last several years: <ul style="list-style-type: none"> Lyme disease Sirex Woodwasp West Nile Virus Hemlock Woolly Adelgid 	<ul style="list-style-type: none"> NYS DPC USGS NYS DEC
Land Subsidence	Yes	No	<ul style="list-style-type: none"> The NYS HMP identifies land subsidence as a hazard of concern for New York State. The NYS HMP indicates that New York State is vulnerable to land subsidence; however, this hazard is “extremely localized” and poses a “very low risk to population and property.” The NYS HMP does not identify Broome County as a County that has experienced land subsidence in the past. According to USGS, Broome County is not made up of unconsolidated aquifer systems, hence it is unlikely that there will be permanent subsidence and related ground failures. Due to the fact that this hazard has a low occurrence of incidents and that the County could not quantify significant losses to the County and/or municipalities from historic events, the land subsidence hazard will not be analyzed for the purposes of this Plan. 	<ul style="list-style-type: none"> NYS DPC USGS
Landslide	Yes	No	<ul style="list-style-type: none"> The NYS HMP identifies landslide as a hazard of concern for New York 	<ul style="list-style-type: none"> NYS DPC



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Hazard	Step 1	Step 2	Step 3	
	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?	Source(s)
			State, with most of Broome County located in a moderate landslide incidence area. The southern portion of the County is located in a moderate susceptibility to landslide/low incidence area. The NYS HMP indicates that Broome County has had seven landslide occurrences from 1837 to 2007. The NYS HMP listed Broome County as the 5th County in the State most threatened by and vulnerable to landslides and landslide losses.	<ul style="list-style-type: none"> USGS
Nor'Easters	Yes	Yes	Please see Severe Winter Storm	
Severe Storm (Windstorms, Thunderstorms, Hail, Lightning, Tornadoes and Hurricanes)	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies all types of severe storms as hazards of concern for New York State. Broome County has experienced seven tornado events. NYS HMP listed Broome County as the 21st County in the State most threatened by and vulnerable to extreme wind and wind losses. The NYS HMP, NYSEMO, FEMA indicate that Broome County has been issued 14 FEMA Disaster Declarations for severe storm events (some also identified as flooding events). <ul style="list-style-type: none"> FEMA-DR-290 – 1970 – Severe storm and flooding FEMA-DR-338 – 1972 – Tropical Storm Agnes FEMA-DR-487 – 1975 – Severe storms, heavy rain, landslides, flooding FEMA-DR-515 – 1976 – Severe storms and flooding FEMA-DR-1095 – 1996 – Severe storm and flooding FEMA-DR-1222 – 1998 – Severe storms, thunderstorms and tornadoes FEMA-DR-1564 – 2004 – Severe storms and flooding FEMA-DR-1565 – 2004 – Severe Storm (remnants of Hurricane Ivan) FEMA-DR-1589 – 2005 – Severe storm and flooding FEMA-DR-1650 – 2006 – Severe storm and flooding FEMA-DR-1670 – 2006 – Severe storm and flooding FEMA-DR-1993 – 2011 – Severe storm, flooding, straight-line wind FEMA-DR-4031 (EM-3341) – 2011 – Remnants of Tropical Storm Lee NOAA's NCDC storm events database indicates that Broome County was impacted by approximately 473 severe storm events between 1950 and 2012. 	<ul style="list-style-type: none"> NYSDPC FEMA National Atlas SHELDUS NOAA-NCDC
Severe Winter Storm (Heavy Snow, Blizzards,	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies all types of severe winter storms as hazards of concern for New York State. The NYS HMP listed Broome County as the 23rd County in the State most threatened by and vulnerable to snow and snow loss, with an annual average snowfall 72.6 inches. Broome County is 	<ul style="list-style-type: none"> NYSDPC NYSOEM FEMA NOAA-NCDC



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Hazard	Step 1	Step 2	Step 3	
	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?	Source(s)
Freezing Rain/Sleet, Ice Storms, and Nor'Easters)			also listed as the 32nd County in New York State most threatened by and vulnerable to ice storms and ice storm loss. <ul style="list-style-type: none"> The NYS HMP, NYSOEM, FEMA indicate that Broome County has been issued two FEMA Disaster Declarations for winter storm events (some also identified as flooding events). <ul style="list-style-type: none"> FEMA-EM-3173 – 2003 - Snowstorm FEMA-EM-3184 – 2003 – Snowstorm NOAA's NCDC storm events database indicates that Broome County was impacted by approximately 313 winter storm events between 1950 and 2012. However, most events are of a regional extent rather than localized to just one county or community. 	<ul style="list-style-type: none"> SHELDUS
Tornado	Yes	Yes	Please see Severe Storm	
Tsunami	No	No	<ul style="list-style-type: none"> Tsunami is not identified as a hazard of concern in the NYS HMP 	<ul style="list-style-type: none"> NYSDPC
Volcano	No	No	<ul style="list-style-type: none"> Volcanoes are not identified as a hazard of concern in the NYS HMP, because there are no known volcanoes located in the state. 	<ul style="list-style-type: none"> NYSDPC
Wildfire	Yes	No	<ul style="list-style-type: none"> The NYS HMP identifies wildfires as hazards of concern for New York State. GeoMac indicates that portions of Broome County are located within the Wildland-Urban Interface. USGS indicates that no wildfires greater than 250 acres were experienced in Broome County between 1980 and 2003. GeoMAC indicates that no wildfires were experienced in Broome County between 2002 and 2012. Broome County is located in the Leatherstocking Fire Danger Rating Area. 	<ul style="list-style-type: none"> NYSDPC USGS GeoMAC
Windstorm	Yes	Yes	Please see Severe Storm	

CRREL	Cold Regions Research and Engineering Laboratory	NYS	New York State
DPC	Disaster Preparedness Commission	NYSDPC	New York State Disaster Preparedness Commission
DR	Presidential Disaster Declaration Number	NYSOEM	New York State Office of Emergency Management
EM	Presidential Emergency Declaration	SHELDUS	Spatial Hazard Events and Losses Database for the United States
FEMA	Federal Emergency Management Agency	USACE	U.S. Army Corp of Engineers
HMP	Hazard Mitigation Plan	USGS	U.S. Geologic Survey
NCDC	National Climatic Data Center		
NOAA	National Oceanic and Atmospheric Administration		
NYCDEP	New York City Department of Environmental Protection		



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According to input from Broome County, and review of all available resources, a total of six natural hazards of concern were identified as significant hazards affecting the County, to be addressed within this plan:

- Drought
- Earthquake
- Extreme Temperature
- Flooding (riverine, flash, ice jam, and dam)
- Severe Storm (windstorms, thunderstorms, hail, tornadoes and hurricanes/tropical storms)
- Severe Winter Storm (heavy snow, blizzards, ice storms, Nor'Easters)

Other natural hazards of concern have occurred within the County, but typically have a low potential to result in significant impacts. The County deemed other natural hazards as minor in comparison to those bulleted above; therefore, additional natural hazards will not be further addressed within this version of the Plan. However, if deemed necessary by the County, these hazards may be considered in future versions of the Plan.

5.3 HAZARD RISK RANKING

After the hazards of concern were identified for Broome County, the hazard risks were ranked to describe their probability of occurrence and their impact on population, property (general building stock including critical facilities) and the economy. Each participating Town or Village may have differing degrees of risk exposure and vulnerability compared to the County as a whole; therefore each Town/Village ranked the degree of risk to each hazard as it pertains to their community using the same methodology as applied to the County-wide ranking. This assures consistency in the overall ranking of risk process. The hazard risk ranking for each participating Town or Village can be found in their jurisdictional annex in Volume II of this Plan. It is noted that, although the raw rankings are unique for each participant, the overall resulting rankings are consistent with the County hazard risk rankings. This may be due, in part, to the recent flood hazard events (both riverine and flash flooding) that have affected all jurisdictions hence increasing exposure and damages resulting from flooding across the County.

HAZARD RISK RANKING METHODOLOGY

The methodology used to rank the hazards of concern for Broome County is described below. Estimates of risk for the County were developed using methodologies promoted by FEMA’s hazard mitigation planning guidance and generated by FEMA’s HAZUS-MH risk assessment tool.

Probability of Occurrence

The probability of occurrence is an estimate of how often a hazard event occurs. A review of historic events assists with this determination. Each hazard of concern is rated in accordance with the numerical ratings and definitions in Table 5.3-1.

Table 5.3-1. Probability of Occurrence Ranking Factors

Rating	Probability	Definition
0	None	Hazard event is not likely to occur.
1	Rare	Hazard event is not likely to occur within 100 years.
2	Occasional	Hazard event is likely to occur within 100 years.
3	Frequent	Hazard event is likely to occur within 25 years.

Impact

The impact of each hazard is considered in three categories: impact on population, impact on property (general building stock including critical facilities), and impact on the economy. Based on documented historic losses and a subjective assessment by the Planning Committee, an impact rating of high, medium, or low is assigned with a corresponding numeric value for each hazard of concern. In addition, a weighting factor is assigned to each impact category: three (3) for population, two (2) for property, and one (1) for economy. This gives the impact on population the greatest weight in evaluating the impact of a hazard.

Table 5.3-2 presents the numerical rating, weighted factor and description for each impact category. The impact rating definitions for population and property are consistent with the New York State Hazard

SECTION 5.3: RISK ASSESSMENT - HAZARD RISK RANKING

Mitigation Plan (NYS HMP) ranking methodology with minor modifications. Impact to the economy is also being evaluated.

Table 5.3-2. Numerical Values and Definitions for Impacts on Population, Property and Economy

Category	Weighting Factor	Low Impact (1)	Medium Impact (2)	High Impact (3)
Population*	3	14% or less of your developed land area is exposed to a hazard due to its extent and location	15% to 29% of your developed land area is exposed to a hazard due to its extent and location	30% or more of your developed land area is exposed to a hazard due to its extent and location
Property*	2	Property exposure is 14% or less of the total replacement cost for your community	Property exposure is 15% to 29% of the total replacement for your community	Property exposure is 30% or more of the total replacement cost for your community
Economy	1	Loss estimate is 9% or less of the total replacement cost for your community	Loss estimate is 10% to 19% of the total replacement cost for your community	Loss estimate is 20% or more of the total replacement cost for your community

Note: A numerical value of zero is assigned if there is no impact.

*For the purposes of this exercise, “impacted” means exposed for population and property and loss for economy.

Risk Ranking Value

The risk ranking for each hazard is then calculated by multiplying the numerical value for probability of occurrence by the sum of the numerical values for impact. The equation is as follows: Probability of Occurrence Value (1, 2, or 3) X Impact Value (6 to 18) = Hazard Ranking Value. Based on the total for each hazard, a priority ranking is assigned to each hazard of concern (high, medium, or low).

HAZARD RISK RANKING RESULTS

Using the process described above, the risk ranking for the identified hazards of concern was determined for Broome County. Based on the combined risk values for probability of occurrence and impact to Broome County, a priority ranking of “high”, “medium” or “low” risk was assigned. The hazard ranking for Broome County, from high to low risk, is summarized below:

- Flood
- Severe Winter Storm
- Drought
- Severe Storm
- Earthquake
- Extreme Temperature

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The following tables present the step-wise process for the ranking. Table 5.3-3 shows the probability ranking assigned for likelihood of occurrence for each hazard.

Table 5.3-3. Probability of Occurrence Ranking for Hazards of Concern for Broome County

Hazard of Concern	Probability	Numeric Value
Drought	Frequent	3
Earthquake	Occasional	2
Extreme Temperature	Frequent	3
Flood	Frequent	3
Severe Storm	Frequent	3
Severe Winter Storm	Frequent	3

Table 5.3-4 shows the impact evaluation results for each hazard of concern, including impact on property, structures, and the economy. The weighting factor results and a total impact for each hazard also are summarized.

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Table 5.3-4. Impact Ranking for Hazards of Concern for Broome County

Hazard of Concern	Population			Property			Economy			Total Impact Rating (Population + Property + Economy)
	Impact	Numeric Value	Multiplied by Weighting Factor (3)	Impact	Numeric Value	Multiplied by Weighting Factor (2)	Impact	Numeric Value	Multiplied by Weighting Factor (1)	
Drought	High	3	3	Low	1	2	Low	2	2	7
Earthquake	Low	1	3	High	3	6	Low	1	1	10
Extreme Temperature	Low	1	3	Low	1	2	Low	1	1	6
Flood	High	3	9	Medium	2	4	Low	1	1	14
Severe Storm	Medium	2	6	High	3	6	Low	1	1	13
Severe Winter Storm	Medium	2	6	High	3	6	Low	1	1	13

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Table 5.3-5 presents the total ranking value for each hazard.

Table 5.3-5. Total Risk Ranking Value for Hazards of Concern for Broome County

Hazard of Concern	Probability	Impact	Total = (Probability x Impact)
Drought	3	7	21
Earthquake	2	10	20
Extreme Temperature	3	6	18
Flood	3	14	42
Severe Storm	3	13	39
Severe Winter Storm	3	13	39

Table 5.3-6 presents the hazard ranking category assigned for each hazard of concern. The ranking categories are determined by an evaluation of the total risk ranking score into three categories, low, medium, and high whereby a total score of below 20 is categorized as low, 20 to 30 is medium, and 39 and over is considered a high risk category.

Table 5.3-6. Hazard Ranking Results for Hazards of Concern for Broome County

Hazard of Concern	Ranking Category
Flood	High
Severe Winter Storm	High
Drought	Medium
Severe Storm	Medium
Earthquake	Medium
Extreme Temperature	Low

SUMMARY OF PLANNING AREA RISK RANKING

An overview of the hazard ranking by jurisdiction is provided on the following page. These rankings have been used as a basis for identifying hazard mitigation strategies included in Section 9 of this plan in conjunction with the results of the hazard vulnerability assessments and input from each jurisdiction.

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Municipality	Hazard Ranking					
	Flood	Severe Storm	Severe Winter Storm	Earthquake	Drought	Extreme Temperature
Barker, Town of	High	Medium	High	Low	Low	Low
Binghamton, City of	High	Medium	High	Medium	High	Low
Binghamton, Town of	Medium	Medium	High	Low	High	Low
Chenango, Town of	High	Medium	High	Medium	Low	Low
Colesville, Town of	High	Medium	High	Low	Low	Low
Conklin, Town of	High	Medium	High	Medium	Low	Low
Deposit, Village of	High	Medium	High	Low	Low	Low
Dickinson, Town of	High	Medium	High	Low	Low	Low
Endicott, Village of	High	Medium	High	Medium	Low	Low
Fenton, Town of	High	Medium	High	Low	Low	Low
Johnson City, Village of	High	Medium	Medium	Medium	Low	Low
Kirkwood, Town of	High	Medium	High	Low	Low	Low
Lisle, Town of	High	High	High	Low	Medium	Low
Lisle, Village of	High	High	High	Low	Medium	Medium
Maine, Town of	Medium	Medium	High	Low	Low	Low
Nanticoke, Town of	High	Medium	High	Low	Low	Low
Port Dickinson, Village of	High	Medium	High	Medium	Low	Low
Sanford, Town of	High	Medium	High	Low	Low	Low
Triangle, Town of	Medium	Medium	High	Low	Low	Low
Union, Town of	High	Medium	Medium	Medium	Low	Low
Vestal, Town of	Medium	Medium	High	Medium	Low	Low
Whitney Point, Village of	High	Medium	High	Medium	Low	Low
Windsor, Town of	High	Medium	High	Low	Low	Low
Windsor, Village of	High	Medium	High	Medium	Low	Low
Broome County	High	Medium	High	Medium	Medium	Low

HAZARDS PROFILES AND VULNERABILITY ASSESSMENT

The following sections profile and assess vulnerability for each hazard of concern. For each hazard, the profile includes: the hazard description; its location and extent; previous occurrences and losses; and the probability of future events. The vulnerability assessment for each hazard includes: an overview of vulnerability; the data and methodology used; the impact on life, health and safety; impact on general building stock; impact on critical facilities; impact on the economy; additional data needs and next steps; and the overall vulnerability assessment finding. Hazards are presented as listed above, starting with the flood hazard and ending with the extreme temperature.