

5.3 Hazard Ranking

As discussed in Section 5.2 (Identification of Hazards of Concern), a comprehensive range of natural hazards that pose a significant risk to Westchester County were selected and considered during development of this plan; however, each community in Westchester County has differing levels of exposure and vulnerability to each of these hazards. It is important for each community participating in this plan to recognize those hazards that pose the greatest risk to their community and direct their attention and resources accordingly to most effectively and efficiently manage risk and reduce losses. The hazard ranking for the county and each participating jurisdiction can be found in their jurisdictional annexes in Volume II, Section 9 of this plan.

To this end, a hazard risk ranking process was conducted for Westchester County and its municipalities using the method described below. This method includes four risk assessment categories—probability of occurrence, impact (population, property, and economy), adaptive capacity, and changing future conditions (climate change). Each were assigned a weighting factor to calculate an overall ranking value for each hazard of concern. Depending on the calculation, each hazard was assigned a high, medium, or low ranking. Details regarding each of these categories is described below.

5.3.1 Hazard Ranking Methodology

The methodology used to rank the hazards of concern for Westchester County is described below. Estimates of risk for the county were developed using methodologies promoted by FEMA’s hazard mitigation planning guidance, generated by FEMA’s HAZUS-MH risk assessment tool, and input from Westchester County and participating jurisdictions. The ranking includes a factor to evaluate capacity of the participating jurisdiction regarding ability to address the hazard through plans, policies, and mitigation strategies. For example, a community participating in the CRS has a high capacity to address and mitigation flooding issues, which will be reflected in the ranking benchmark. In addition, a factor addressing the degree of climate change impact is included in the methodology to adjust rankings for hazards expected to be significantly impacted by climate change. Table 5.3-1 shows the four risk assessment categories’ values for each of Westchester County’s hazards. Details for each category are further described below.

Table 5.3-1. Summary of Hazard Ranking Approach

Category		Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
Probability of Occurrence		Unlikely	A hazard event is not likely to occur or is unlikely to occur with less than a 1% annual chance probability.	0	30%
		Rare	Between 1 and 10% annual probability of a hazard event occurring.	1	
		Occasional	Between 10 and 100% annual probability of a hazard event occurring.	2	
		Frequent	100% annual probability; a hazard event may occur multiple times per year.	3	
Impact (Sum of all 3)	Population (Numeric Value x 3)	Low	14% or less of population is exposed to a hazard with potential for measurable life safety impact due to its extent and location.	1	30%
		Medium	15% to 29% of population is exposed to a hazard with potential for measurable life safety impact due to its extent and location.	2	
		High	30% or more of population is exposed to a hazard with potential for measurable life safety impact due to its extent and location.	3	
	Property (Numeric Value x 2)	Low	Property exposure is 14% or less of the total number of structures for community.	1	
		Medium	Property exposure is 15% to 29% of the total number of structures for community.	2	
		High	Property exposure is 30% or more of the total number of structures for community.	3	
	Economy (Numeric Value x 1)	Low	Loss estimate is 9% or less of the total replacement cost for community.	1	
		Medium	Loss estimate is 10% to 19% of the total replacement cost for community.	2	

Category	Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
	High	Loss estimate is 20% or more of the total replacement cost for community.	3	
Capability	Weak	Weak/outdated/inconsistent plans, policies, codes/ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	-1	30%
	Moderate	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; county/jurisdiction can recover but needs outside resources; moderate county/jurisdiction capabilities.	0	
	Strong	Plans, policies, codes/ordinances in place and exceed minimum requirements; mitigation/protective measures in place; county/jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.	1	
Climate Change	Low	No local data is available; modeling projects are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	1	10%
	Medium	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; confidence level is medium to high (suggestive to moderate evidence).	2	
	High	Studies and modeling projections indicate exacerbated conditions/increased future risk due to climate change; very high confidence level (strong evidence, well-documented and acceptable methods).	3	

Probability of Occurrence

The probability of occurrence is the likelihood of a hazard event occurring in any given year. A review of historic events assists with this determination. Each hazard of concern is rated in accordance with the numerical ratings and definitions described in Table 5.3-2. The probability of occurrence is given a weighted value of 30%.

Table 5.3-2. Probability of Occurrence Ranking Factors

Numeric Value	Probability Category	Definition
0	Unlikely	A hazard event is not likely to occur or is unlikely to occur with less than a 1% annual chance probability.
1	Rare	Between 1 and 10% annual probability of a hazard event occurring.
2	Occasional	Between 10 and 100% annual probability of a hazard event occurring.
3	Frequent	100% annual probability; a hazard event may occur multiple times per year.

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 individual assessments by each participating municipality, 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: 3 for population, 2 for property, and 1 for economy. This gives the impact on population the greatest weight in evaluating the impact of a hazard. The total of each category is assigned a weighted value of 30%. Table 5.3-3 presents the numerical rating, weighted factor, and description for each impact category.

Table 5.3-3. Numerical Values and Definitions for Impacts on Population, Property and Economy

Category	Weighted Value	Low Impact* (1)	Medium Impact (2)	High Impact (3)
Population	3	14% or less of population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	15% to 29% of population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	30% or more of population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.
Property	2	Property exposure is 14% or less of the total number of structures for community.	Property exposure is 15% to 29% of the total number of structures for community.	Property exposure is 30% or more of the total number of structures for community.
Economy	1	Loss estimate is 9% or less of the total replacement cost for community.	Loss estimate is 10% to 19% of the total replacement cost for community.	Loss estimate is 20% or more of the total replacement cost for 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.

Additional Impacts

Along with impacts on population, property, and economy, the overall risk ranking looks at two additional impacts that impact the county’s vulnerability: capability and climate change. Table 5.3-4 presents the numerical rating and description for each category.

Capability

Capability refers to a jurisdiction’s ability to protect the community from or withstand a hazard event. Mitigation measures are already in place, including codes/ordinances, plans, and procedures to withstand hazards due to design or location, deployable resources, or plans and procedures in place to respond to an event. The capability category has a weighted factor of 30%.

Table 5.3-4. Numerical Values and Definitions for Adaptive Capability and Changing Future Conditions

Category	Weak	Moderate	Strong
Capability	Weak/outdated/inconsistent plans, policies, codes/ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; county/jurisdiction can recover but needs outside resources; moderate county/jurisdiction capabilities.	Plans, policies, codes/ordinances in place and exceed minimum requirements; mitigation/protective measures in place; county/jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.

Climate Change

Climate change refers to the impact that climate change projections have on increasing or decreasing the severity and frequency of a hazard. The climate change category has a weighted factor of 10%.

Table 5.3-5. Numerical Values and Definitions for Changing Future Conditions

Category	Low Impact	Medium Impact	High Impact
Climate Change	No local data is available; modeling projects are uncertain on whether there is increased future risk;	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change;	Studies and modeling projections indicate exacerbated conditions/increased future risk due to climate change; very high confidence

Category	Low Impact	Medium Impact	High Impact
	confidence level is low (inconclusive evidence).	confidence level is medium to high (suggestive to moderate evidence).	level (strong evidence, well-documented and acceptable methods).

Risk Ranking Value

Each impact was then weighted and the risk ranking for each hazard is then calculated using the following formula:

Example Risk Ranking Equation

$$\text{Risk Ranking} = [(\text{Impact on Population} \times 3) + (\text{Impact on Property} \times 2) + (\text{Impact on Economy} \times 1) \times .30] + [\text{Capability} \times 30\%] + [\text{Climate Impact} \times 10\%] + [\text{Probability of Occurrence} \times 30\%]$$

Based on the total for each hazard, a priority ranking is assigned to each hazard of concern (high, medium, or low). The rankings were categorized as follows: Low = values less than 3.9; Medium = values between 3.9 and 4.9; High = values greater than 4.9.

5.3.2 Hazard Ranking Results

Using the process described above, the risk ranking for the identified hazards of concern was determined for Westchester County. The hazard ranking for Westchester County is detailed in the subsequent tables that present the step-wise process for the ranking. The countywide risk ranking includes the entire planning area and might not reflect the highest risk indicated for any of the participating jurisdictions. The resulting ranks of each municipality indicate the differing degrees of risk exposure and vulnerability. The results support the appropriate selection and prioritization of initiatives to reduce the highest levels of risk for each municipality. Both the county and the participating jurisdictions have applied the same methodology to develop the countywide risk and local rankings to ensure consistency in the overall ranking of risk; jurisdictions had the ability to alter rankings based on local knowledge and experience in handling each hazard.

This hazard ranking exercise serves four purposes: 1) to describe the probability of occurrence for each hazard; 2) to describe the impact each would have on the people, property, and economy; 3) evaluate the capabilities a community has with regards to natural hazards; and 4) to consider changing future conditions (i.e., climate change) in Westchester County. Estimates of risk for Westchester County were developed using methodologies promoted by FEMA’s hazard mitigation planning guidance, generated by FEMA’s HAZUS-MH risk assessment tool and input from the county and participating municipalities.

Table 5.3-6 shows the county-wide probability ranking assigned for likelihood of occurrence for each hazard.

Table 5.3-6. Probability of Occurrence Ranking for Hazards of Concern for Westchester County

Hazard of Concern	Probability	Numeric Value
Disease Outbreak	Occasional	2
Earthquake	Unlikely	0
Extreme Temperature	Occasional	2
Flood	Frequent	3
Severe Storm	Frequent	3
Severe Winter Storm	Frequent	3
Wildfire	Rare	1
CBRN	Rare	1

Table 5.3-7 shows the impact evaluation results for each hazard of concern, including impact on property, structures, and the economy on the county level. It is noted that several hazards that have a high impact on the

local jurisdictional level can have a lower impact when analyzed countywide. Jurisdictional ranking results are presented in each local annex in Section 9 (Jurisdictional Annexes) of this plan. The weighting factor results and a total impact for each hazard also are summarized. Values in red indicate values that were altered by the county based on local knowledge and experience with each hazard.

Table 5.3-7. Impact Ranking for Hazards of Concern for Westchester County

Hazard of Concern	Population			Property			Economy			Total Impact Rating (Population + Property + Economy)
	Impact	Numeric Value	Multiplied by Weighing Factor (3)	Impact	Numeric Value	Multiplied by Weighing Factor (2)	Impact	Numeric Value	Multiplied by Weighing Factor (1)	
Disease Outbreak	Medium	2	6	Low	1	2	Medium	2	2	10
Earthquake	Low	1	3	Low	1	2	Low	1	1	6
Extreme Temperature	Medium	2	6	Low	1	2	Low	1	1	9
Flood	Medium	3	6	High	3	6	Low	1	1	13
Severe Storm	High	3	9	Medium	2	4	Low	1	1	14
Severe Winter Storm	High	3	9	Low	1	2	Low	1	1	12
Wildfire	Low	1	3	Medium	2	4	Medium	2	2	9
CBRN	Medium	3	6	Low	1	2	Medium	2	2	10

Table 5.3-8 shows the additional impact rankings for the hazards of concern. This includes the overall capabilities of the county and municipalities and the consideration of changing future conditions, such as climate change.

Table 5.3-8. Additional Impact Ranking for Hazards of Concern for Westchester County

Hazard of Concern	Capabilities	Numeric Value	Climate Change	Numeric Value
Disease Outbreak	Moderate	0	Medium	2
Earthquake	Moderate	0	Low	1
Extreme Temperature	Moderate	0	High	3
Flood	Moderate	0	High	3
Severe Storm	Moderate	0	High	3
Severe Winter Storm	Strong	1	Medium	2
Wildfire	Moderate	0	High	3
CBRN	Moderate	0	Low	1

Table 5.3-9 presents the total calculations for each hazard ranking value for the hazards of concern.

Table 5.3-9. Total Hazard Ranking Values for the Hazards of Concern for Westchester County

Hazard of Concern	Probability x 30%	Total Impact x 30%	Adaptive Capacity x 30%	Changing Future Conditions x 10%	Total Risk Ranking Value
Disease Outbreak	0.6	3	0	0.2	3.8
Earthquake	0	1.8	0	0.1	1.9
Extreme Temperature	0.6	2.7	0	0.3	3.6
Flood	0.9	3.9	0	0.3	5.1
Severe Storm	0.9	4.2	0	0.3	5.4
Severe Winter Storm	0.9	3.6	0.3	0.2	5
Wildfire	0.3	2.7	0	0.3	3.3
CBRN	0.3	3	0	0.1	3.4

Low = values less than 3.9 (yellow); Medium = values between 3.9 and 4.9 (orange); High = values greater than 4.9 (red).

Table 5.3-10 presents the jurisdictional hazard ranking for each hazard. An evaluation of the total risk ranking score determined ranking categories that were grouped into three categories, low, medium, and high. It also includes input by the municipalities. The rankings were categorized as follows: Low = values less than 3.9 colored yellow; Medium = values between 3.9 and 4.9 colored orange; High = values greater than 4.9 colored red.

These rankings have been used as one of the bases for identifying the jurisdictional hazard mitigation strategies included in Section 9 (Jurisdictional Annexes) of this plan. The summary rankings for the county reflect the results of the vulnerability analysis for each hazard of concern and can vary from the specific results of each jurisdiction. For example, the severe storm hazard may be ranked low in one jurisdiction, but due to the exposure and impact countywide, it is ranked as a high hazard and is addressed in the county mitigation strategy accordingly. The table below represents the initial calculated rankings presented to each jurisdiction. Each jurisdiction was able to review the rankings and adjust as necessary. Refer to Section 9 (Jurisdictional Annexes) for the adjusted rankings.

Table 5.3-10. Summary of Overall Ranking of Natural Hazards by Jurisdiction

Westchester County Municipalities	Disease Outbreak	Earthquake	Extreme Temperature	Flood	Severe Storm	Severe Winter Storm	Wildfire	CBRN
Ardsley (V)	Low	Medium	Low	High	High	Medium	Low	Low
Bedford (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Briarcliff Manor (V)	Low	Low	Low	High	High	Medium	Low	Low
Bronxville (V)	Low	Low	Low	High	High	Medium	Low	Low
Buchanan (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Cortlandt (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Croton-On-Hudson (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Dobbs Ferry (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Eastchester (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Elmsford (V)	Low	Low	Low	High	High	Medium	Low	Low
Greenburgh (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Harrison (V)	Low	Low	Low	High	High	Medium	Low	Low
Hastings-On-Hudson (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Irvington (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Larchmont (V)	Low	Low	Low	High	High	Medium	Low	Low
Lewisboro (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Mamaroneck (T)	Low	Low	Low	High	High	Medium	Low	Low
Mamaroneck (V)	Low	Low	Low	High	High	Medium	Low	Low
Mount Kisco (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Mount Pleasant (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Mount Vernon (C)	Low	Low	Low	Medium	High	Medium	Low	Low
New Castle (T)	High	Low	Medium	High	High	High	Low	Low
New Rochelle (C)	Low	Low	Low	High	High	Medium	Low	Low
North Castle (T)	Low	Low	Low	Medium	High	Medium	Low	Low
North Salem (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Ossining (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Ossining (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Peekskill (C)	Low	Low	Low	Medium	High	Medium	Low	Low
Pelham (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Pelham (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Pelham Manor (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Pleasantville (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Port Chester (V)	Low	Low	Low	High	High	Medium	Low	Low
Pound Ridge (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Rye (C)	Low	Low	Low	High	High	Medium	Low	Low
Rye (T)	Low	Low	Low	Low	High	Medium	Low	Low
Rye Brook (V)	Low	Low	Low	High	High	Medium	Low	Low
Scarsdale (V)	Low	Low	Low	High	High	Medium	Low	Low
Sleepy Hollow (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Somers (T)	Low	Low	Low	Medium	High	Medium	Low	Low

Westchester County Municipalities	Disease Outbreak	Earthquake	Extreme Temperature	Flood	Severe Storm	Severe Winter Storm	Wildfire	CBRN
Tarrytown (V)	Low	Low	Low	Medium	High	Medium	Low	Low
Tuckahoe (V)	Low	Low	Low	Medium	High	Medium	Low	Low
White Plains (C)	Low	Low	Low	Medium	High	Medium	Low	Low
Yonkers (C)	Low	Low	Low	High	High	Medium	Low	Low
Yorktown (T)	Low	Low	Low	Medium	High	Medium	Low	Low
Westchester County	Low	Low	Low	High	High	Medium	Low	Low

Low = Values less than 3.9; Medium = Values between 3.9 and 4.9; High = Values greater than 4.9.