



4.4 HAZARD RANKING

A comprehensive range of hazards that pose a significant risk to Burlington County were selected and considered during the development of this plan. Each community has differing levels of exposure and vulnerability to each of these hazards. It is important for each community participating in this plan to recognize the 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. To this end, a hazard risk ranking process was conducted using the method described below.

4.4.1 Hazard Ranking Methodology

Estimates of hazard risk for Burlington County were developed using methodologies promoted by FEMA's hazard mitigation planning guidance, results from FEMA's Hazus risk assessment tool, and input from Burlington County and participating jurisdictions. The ranking method includes four risk assessment categories—probability of occurrence, impact (population, property, and economy), adaptive capacity, and changing future conditions (i.e., climate change). Each was 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.

As described in Section 4.1 (Methodology and Tools), three levels of analysis were used to estimate potential impacts: 1) historic loss/qualitative analysis; 2) exposure analysis; and 3) loss estimation. All three levels of analysis are suitable for planning purposes; however, with any risk analysis, there is underlying uncertainty resulting from assumptions used to describe and assess vulnerability and the methodologies available to model impacts.

The hazard ranking methodology for some hazards of concern is based on a scenario event with mapping of hazard areas, while the methodology for others is based on their potential risk to the Planning Area as a whole. In order to account for these differences, the quantitative hazard ranking methodology was adjusted using professional judgement. Although the scenarios do not all have the same likelihood of occurrence, there is value in summarizing and comparing the hazards using a standardized approach to evaluate relative risk.

The following categories were considered when evaluating the relative risk of the hazards of concern:

- **Probability of Occurrence**—The probability of occurrence of the scenario evaluated was estimated by examining the historical record and/or calculating the likelihood of annual occurrence. When no scenario was assessed, an examination of the historical record and judgement was used to estimate the probability of occurrence of an event that will impact the County.
- **Impact**—Three hazard impact subcategories were considered: impact on people; impact on buildings; and impact on the economy. The results of the risk assessment and/or professional judgment were used to assign numeric values for of these subcategories. A factor was applied to each subcategory, giving impact on population the greatest weight:



- Population—Numeric value x 3
- Buildings—Numeric value x 2
- Economy—Numeric value x 1
- **Adaptive Capacity**—Adaptive capacity describes a jurisdiction’s current ability to protect from or withstand a hazard event. This includes capabilities and capacity in the following areas: administrative, technical, planning/regulatory, and financial. Mitigation measures already in place increase a jurisdiction’s capacity to withstand and rebound from events (e.g., codes/ordinances with higher standards to withstand hazards due to design or location; deployable resources; or plans and procedures for responding to an event). The following ratings were assigned using the results of the core capability assessment with subject-matter input from each jurisdiction:
 - “Weak” means the jurisdiction does not have the capability to effectively respond, which increases vulnerability.
 - “Moderate” means the jurisdiction has a reasonable capability to effectively respond.
 - “Strong” means the jurisdiction has above-average capability to effectively respond, which decreases vulnerability.
- **Changing Future Conditions (Climate Change)**—Current climate change projections were considered as part of the hazard ranking to ensure that the ranking accounts for the potential for an increase in severity or frequency of the hazard. This is important because the hazard ranking helps guide and prioritize the development of a mitigation strategy, which should have a long-term future vision to mitigate the hazards of concern. The potential impacts that climate change may have on each hazard of concern are discussed in the individual hazard profile sections. The benchmark values in the methodology are similar to confidence levels outlined in the National Climate Assessment 2017.

Weighting factors were assigned to each of the categories above to represent its relative importance:

- Probability of occurrence: Weighting factor = 0.3 (30 percent)
- Impacts: Weighting factor = 0.3 (30 percent)
- Adaptive capacity: Weighting factor = 0.3 (30 percent)
- Climate change: Weighting factor = 0.1 (10 percent)

Based on the category scores and weights as described above, the risk ranking for each hazard is calculated as follows:

Risk Ranking Equation

$$[\text{Probability of Occurrence} \times 0.3] + [(\text{Impact on Population} \times 3) + (\text{Impact on Property} \times 2) + (\text{Impact on Economy} \times 1) \times 0.3] + [\text{Adaptive Capacity} \times 0.3] + [\text{Climate Change} \times 0.1]$$

Table 4.4-1 summarizes the categories, benchmark values, and weights used to calculate the risk factor for each hazard. Using the weighting applied, the highest possible risk factor value is 6.9. The higher the



number, the greater the relative risk. 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.

4.4.2 Hazard Ranking Results

Using the process described above, the ranking for the identified hazards of concern was determined for the entire County as shown in Table 4.4-2 and Table 4.4-3. The County and the participating jurisdictions all applied the same methodology to develop risk rankings to ensure consistency in the overall ranking of risk. However, the ranking for the entire planning area may not reflect the highest risk for any of the participating jurisdictions. The ranks for each municipality indicate the differing degrees of risk exposure and vulnerability. Jurisdictions had the ability to alter rankings based on local knowledge and experience in handling each hazard. Hazard rankings for individual planning partners are in the jurisdictional annexes in Volume II of this plan. The results support the appropriate selection and prioritization of initiatives to reduce the highest levels of risk for each municipality.

4.4.3 Confidence Level

To evaluate the confidence level of the input utilized to populate the hazard ranking, a gradient of certainty was developed. A certainty factor of high, medium, or low was selected and assigned to each hazard to provide a level of transparency and increased understanding of the data utilized to support the resulting ranking. The following scale was used to assign a certainty factor to each hazard:

- High—Defined scenario/event to evaluate; probability calculated; evidenced-based/quantitative assessment to estimate potential impacts through hazard modeling.
- Moderate—Defined scenario/event or only a hazard area to evaluate; estimated probability; combination of quantitative (exposure analysis, no hazard modeling) and qualitative data to estimate potential impacts.
- Low—Scenario or hazard area is undefined; there is a degree of uncertainty regarding event probability; majority of potential impacts are qualitative.



Table 4.4-1. 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 has 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 the 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 the 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 the 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 the community.	1	
		Medium	Property exposure is 15% to 29% of the total number of structures for the community.	2	
		High	Property exposure is 30% or more of the total number of structures for the community.	3	
	Economy (Numeric Value x 1)	Low	Loss estimate is 9% or less of the total replacement cost for the community.	1	
		Medium	Loss estimate is 10% to 19% of the total replacement cost for the community.	2	
		High	Loss estimate is 20% or more of the total replacement cost for the community.	3	
Adaptive Capacity		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, meeting minimum requirements; mitigation strategies identified but not implemented on a widespread scale; jurisdiction can recover but needs outside resources; moderate jurisdiction capabilities.	0	
		Strong	Plans, policies, codes/ordinances in place that exceed minimum requirements; mitigation/protective measures in place; 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 projections 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	

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 estimated loss for economy. For non-natural hazards, although they may occur anywhere in the Planning Area, an event will not likely cause countywide impacts; therefore, impact to population was scored using an event-specific scenario.



Table 4.4-2. Ranking for Hazards of Concern for Burlington County

Hazard of Concern	Probability		Impact										Adaptive Capacity	Climate Change
			Population			Property			Economy			Total Impact Value		
	Category	Numeric Value	Impact	Numeric Value	Weighted Value (x3)	Impact	Numeric Value	Weighted Value (x2)	Impact	Numeric Value	Weighted Value (x1)			
Dam/Levee Failure	Rare	1	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Medium	2	2 x 1 = 2	13	Moderate	High
Disease Outbreak	Occasional	2	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Medium	2	2 x 1 = 2	13	Strong	Low
Drought	Rare	1	Medium	2	2 x 3 = 6	Low	1	1 x 2 = 2	Medium	2	2 x 1 = 2	10	Moderate	High
Earthquake	Unlikely	0	Low	1	1 x 3 = 3	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	6	Moderate	Low
Extreme Temperature	Frequent	3	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	12	Strong	High
Flood	Frequent	3	Low	1	1 x 3 = 3	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	6	Moderate	High
Severe Weather	Frequent	3	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	12	Moderate	High
Severe Winter Weather	Frequent	3	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	12	Strong	Medium
Wildfire	Occasional	2	Medium	2	2 x 3 = 6	Medium	2	2 x 2 = 4	Low	1	1 x 1 = 1	11	Moderate	High

Table 4.4-3. Total Hazard Ranking Values for the Hazards of Concern for Burlington County

Hazard of Concern	Probability x 30%	Total Impact x 30%	Adaptive Capacity x 30%	Changing Future Conditions x 10%	Total Hazard Ranking Value
Dam/Levee Failure	0.3	3.9	0	0.3	4.5
Disease Outbreak	0.6	3.9	-0.3	0.1	4.3
Drought	0.3	3.0	0	0.3	3.6
Earthquake	0.0	1.8	0	0.1	1.9
Extreme Temperature	0.9	3.6	-0.3	0.3	4.5
Flood	0.9	1.8	0	0.3	3.0
Severe Weather	0.9	3.6	0	0.3	4.8
Severe Winter Weather	0.9	3.6	-0.3	0.2	4.4
Wildfire	0.6	3.3	0	0.3	4.2