4.1.5. Risk Ranking Methodology and Risk Factor Analysis

At the conclusion of the risk assessment, all 33 hazards were ranked in terms of their overall impact on Pennsylvania. Ranking hazards helps the Commonwealth set goals and mitigation priorities. A Risk Factor (RF) is a tool used to measure the degree of risk for identified hazards in a particular planning area. The RF can also be used to assist officials in ranking and prioritizing hazards that pose the most significant threat to Pennsylvania based on a variety of factors deemed important by the SPT and other stakeholders involved in the hazard mitigation planning process.

The RF system relies mainly on historical data, local knowledge, general consensus opinions from the SPT and information collected through development of the hazard profiles and vulnerability assessments included in Section 4.3. The RF approach produces numerical values that allow identified hazards to be ranked against one another; the higher the RF value, the greater the hazard risk.

The risk assessment categories and corresponding matrix shown in Table 4.1-10 are based on FEMA's Comprehensive Preparedness Guide (CPG) 101 (see pg. 3-11 of CPG-101). Similar matrices have been used in other states for hazard mitigation and emergency management planning. For example, the Arizona Emergency Management advocates using this approach, found online at: http://www.maricopa.gov/Emerg_Mgt/pdf/cpri%20guidance.pdf. Additionally, Pointe Coupee Parish, Louisiana, Lyon County, Kansas, Yucaipa County, California, Phelps County, Missouri, and the Commonwealth of Massachusetts use similar priority risk indices, which include the same *Probability* and *Impact* descriptions used since the Pennsylvania 2010 SSAHMP.

This approach compliments more quantitative analysis by capturing participants' qualitative analysis and providing a value to summarize and compare hazards. Pennsylvania recognizes limitations to this approach. There are numerous examples where risk levels may not be entirely compatible with all-hazard scenarios or events and particular indices may not reflect certain unique hazard classifications. There may also be differences in how hazards are scored in dense urban areas versus rural areas. Nonetheless, the method serves as a useful tool for providing systematic and consistent prioritization of qualitative hazard information. It is particularly helpful when evaluating hazards for which there have not been conclusive scientific studies of risk and probability.

RF values were obtained by assigning varying degrees of risk to five categories for each of the 33 hazards profiled in the 2018 SHMP. Those categories include: *probability*, *impact*, *spatial extent*, *warning time* and *duration*. Probability ranges from unlikely to highly likely, which gives an indication of how frequently a given hazard event will occur. They may not be catastrophic in scope; for example, floods of some magnitude occur each year in the Commonwealth. Similarly, winter storms, utility interruptions, wildfires, and transportation accidents are expected each year. Impact looks at the systemic loss of life, property, and economic well-being induced in a given hazard event. Spatial extent indicates the geographic area a given hazard event will cover and whether a hazard event is expected to be statewide, regional, or extremely localized. Warning time evaluates how far in advance a community will know of an impending hazard

event, taking into account hazard-specific warning systems. Finally, duration indicates the length of time the hazard event will last, be it a multi-day winter storm event or a two-hour tornado. Each degree of risk was assigned a value ranging from 1 to 4. The weighting factor derived from a review of best practice plans and agreed upon by the SPT is shown in the blue box below. To calculate the RF value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the example equation:

Risk Factor Value = [(Probability x .30) + (Impact x .30) + (Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

Table 4.1.7-2 summarizes each of the five categories used for calculating a RF for each hazard. According to the weighting scheme applied, the highest possible RF value is 4.0.

Table 4.1.5-1 Summary of Risk Factor approach used to rank hazard risk.

RISK ASSESSMENT CATEGORY	DEGREE OF RISK			WEIGHT VALUE
	LEVEL	CRITERIA	INDEX	
PROBABILITY *What is the likelihood of a hazard event occurring in a given year?*	**UNLIKELY**	LESS THAN 1% ANNUAL PROBABILITY	1	30%
	POSSIBLE	BETWEEN 1 & 49.9% ANNUAL PROBABILITY	2	
	LIKELY	BETWEEN 50 & 90% ANNUAL PROBABILITY	3	
	HIGHLY LIKELY	GREATER THAN 90% ANNUAL PROBABILTY	4	
IMPACT *In terms of injuries, damage, death, and economic impact, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	**MINOR**	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	1	30%
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY.	2	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK.	3	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE.	4	
SPATIAL EXTENT *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	**NEGLIGIBLE**	LESS THAN 1% OF AREA AFFECTED	1	20%
	SMALL	BETWEEN 1 & 10% OF AREA AFFECTED	2	
	MODERATE	BETWEEN 10 & 50% OF AREA AFFECTED	3	
	LARGE	BETWEEN 50 & 100% OF AREA AFFECTED	4	
WARNING TIME *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	**MORE THAN 24 HRS**	SELF-DEFINED *(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	1	10%
	12 TO 24 HRS	SELF-DEFINED	2	
	6 TO 12 HRS	SELF-DEFINED	3	
	LESS THAN 6 HRS	SELF-DEFINED	4	
DURATION *How long does the hazard event usually last?*	**LESS THAN 6 HRS**	SELF-DEFINED *(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	1	10%
	LESS THAN 24 HRS	SELF-DEFINED	2	
	LESS THAN 1 WEEK	SELF-DEFINED	3	
	MORE THAN 1 WEEK	SELF-DEFINED	4	

Using this methodology, Table 4.1.7-3 lists the Risk Factor calculated for each of the 33 potential hazards from high to low identified in the 2018 SHMP.