Table 4.3.15-7 Estimated jurisdictional losses in wildfire High Hazard areas		
COUNTY	**NUMBER OF IMPACTED BUILDINGS**	**DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS ($)**
Lycoming	55,457	$10,416,509
Mckean	3,504	$640,829
Mifflin	22,555	$4,453,176
Monroe	92,982	$22,120,898
Montgomery	366,737	$127,701,377
Montour	1,955	$822,789
Northampton	71,559	$20,456,956
Northumberland	17,858	$3,716,933
Perry	31,551	$7,440,292
Philadelphia	17,542	$5,721,785
Pike	48,641	$11,878,628
Potter	38,280	$6,625,976
Schuylkill	56,149	$11,654,800
Snyder	15,205	$3,114,066
Somerset	48,522	$9,407,900
Sullivan	24,267	$4,320,707
Susquehanna	13,504	$2,608,801
Tioga	12,880	$2,199,234
Union	30,651	$6,067,339
Venango	20,926	$3,663,769
Warren	31,166	$5,799,808
Washington	11,493	$2,323,382
Wayne	23,196	$5,079,273
Westmoreland	50,905	$11,214,851
Wyoming	19,631	$3,666,036
York	96,189	$23,154,898
Grand Total	***3,304,698***	***$866,027,399***

4.3.15.9. State Facility Loss Estimation

The estimated replacement cost of all State Critical Facilities located in High Hazard jurisdictions is $9,464,720,342. The exact losses will depend on the construction material of each facility, its location in relation to wooded areas, and the size and intensity of the wildfire event itself.

4.3.16. Winter Storm

4.3.16.1. Location and Extent

Winter storms are regional events. An event most often impacts a large swath or all of Pennsylvania. In many cases, surrounding states and even the larger northeastern U.S. region are affected.

4.3.16.2. Range of Magnitude

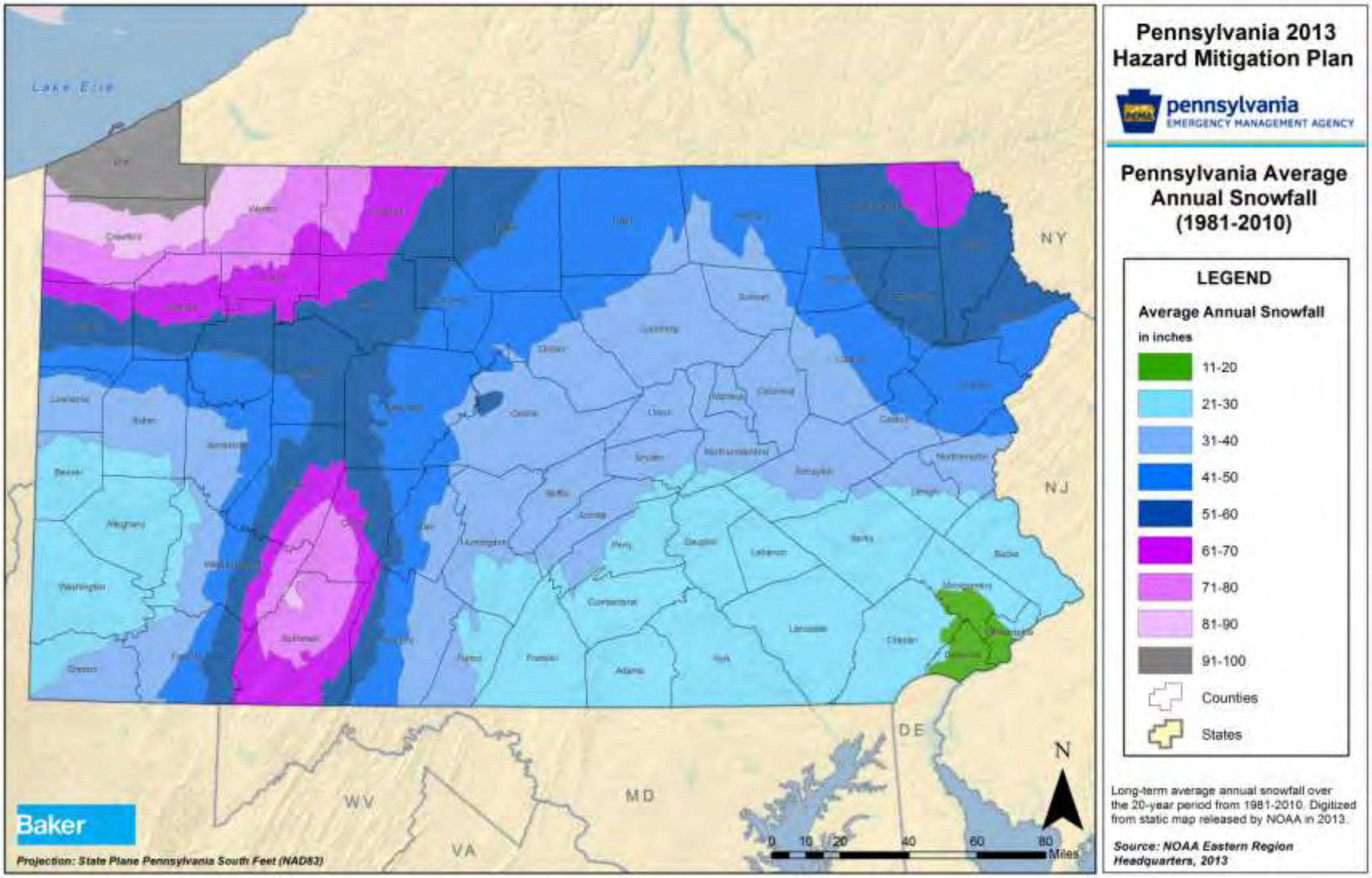
Winter storms consist of cold temperatures, heavy snow or ice and sometimes strong winds. They begin as low-pressure systems that move through Pennsylvania usually following the jet stream. Due to their regular occurrence, these storms are considered hazards only when they result in damage to specific structures or cause disruption to traffic, communications, electric power, or other utilities.

A winter storm can adversely affect roadways, utilities, business activities, and can cause loss of life, frostbite and freezing conditions. They can result in the closing of secondary roads, particularly in rural locations, loss of utility services and depletion of oil heating supplies. These storms typically fall into one of the following categories:

- **Heavy Snowstorm:** Accumulations of four inches or more in a six-hour period, or six inches or more in a twelve-hour period.
- **Sleet Storm:** Significant accumulations of solid pellets which form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces posing hazards to pedestrians and motorists.
- **Ice Storm:** Significant accumulations of rain or drizzle freezing on objects (trees, power lines, roadways, etc.) as it strikes them, causing slippery surfaces and damage from the sheer weight of ice accumulation.
- **Blizzard:** Wind velocity of 35 miles per hour or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period of time.
- **Severe Blizzard:** Wind velocity of 45 miles per hour, temperatures of 10 degrees Fahrenheit or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period time.

Average annual snowfall across Pennsylvania ranges from 11 inches in the southeast to over 100inches inches in the northwest (see Table 4.3.16-1). Storms tracking up the east coast tap into Atlantic moisture, whereas the Great Lakes supply the moisture and instability for heavy snow squalls in the northwest. Orographic lift enhances snowfall over higher elevations (note particularly higher average snowfall in Somerset County in the Allegheny Mountains). The snowfall season is November through April, and amounts are generally below one inch during October and May. The greatest monthly snowfalls occur in March as moisture supply begins to increase with rising temperatures.

Figure 4.3.16-1 Pennsylvania mean annual snowfall (NOAA NWS, 2012).



A summary of the most extreme snowfall events as well as the greatest snowfall depth recorded in Pennsylvania is provided in Table 4.3.16-1.

Table 4.3.16-1 Summary of Pennsylvania snowfall and snow depth extremes (NCDC, 2010)

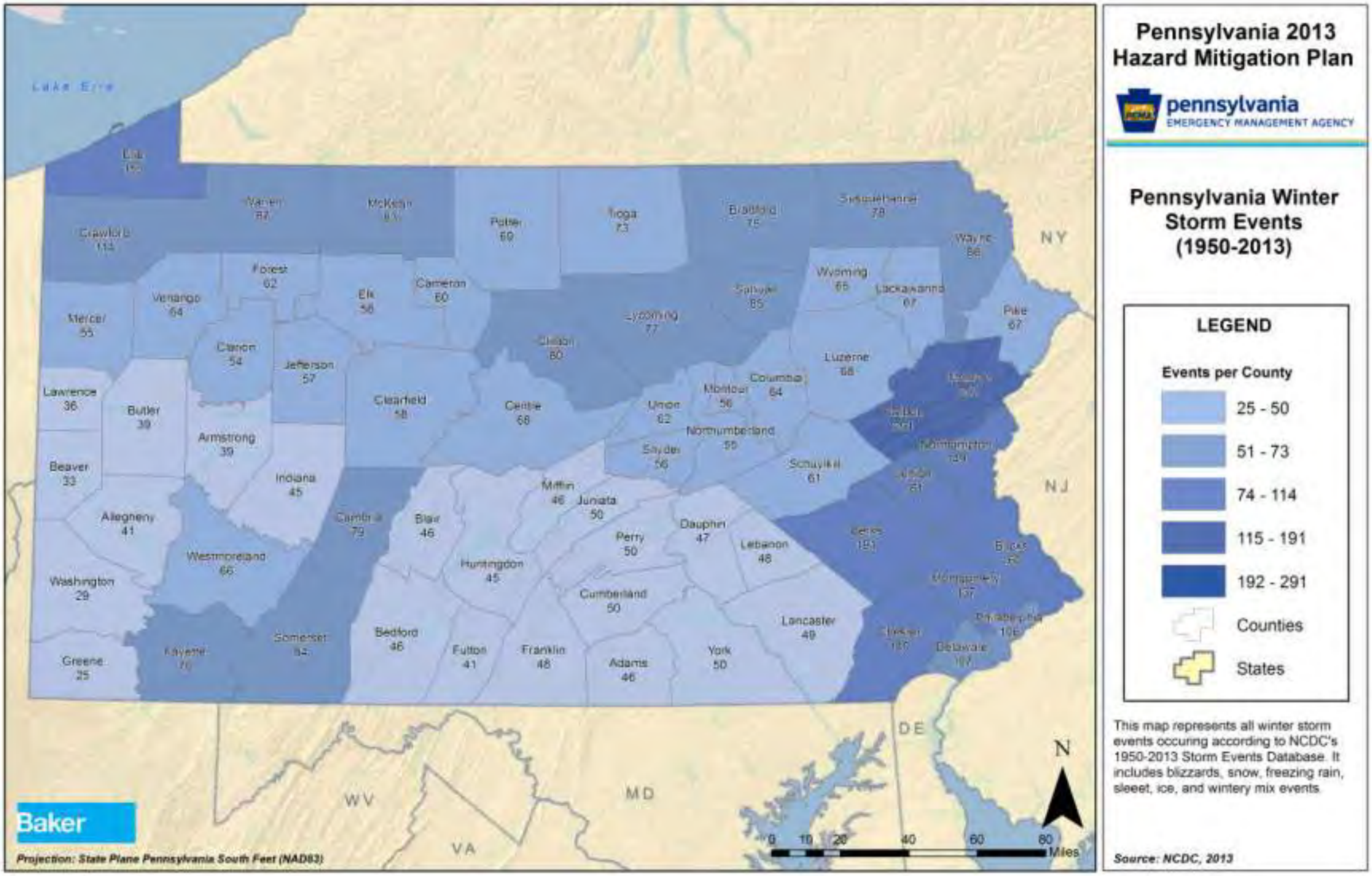
CATEGORY	SNOW AMOUNT (INCHES)	STATION LOCATION	ENDING DATE
Greatest daily snowfall	38	Morgantown	3/20/1958
Greatest 2-day snowfall (snowed both days)	45.3	Coatesville 1 SW	2/14/1899
Greatest 3-day snowfall (snowed all 3 days)	52.4	Coatesville 1 SW	2/14/1899
Greatest 4-day snowfall (snowed all 4 days)	53	Coatesville 1 SW	2/14/899
Greatest 5-day snowfall (snowed all 5 days)	43	Emporium 1 E	12/29/1944
Greatest 6-day snowfall (snowed all 6 days)	50	Emporium 1 E	12/29/1944
Greatest 7-day snowfall (snowed all 7 days)	57	Emporium 1 E	12/29/1944
Greatest monthly snowfall total	84.4	Ebensburg Sewage Plant	January 1978
Greatest Aug-July snowfall total	186.1	Ebensburg Sewage Plant	1978
Greatest daily snow depth	55	Beavertown 1 NE	1/13/1996

The worst winter storm on record occurred on March 12-13, 1993. This blizzard, often called the *Storm of the Century*, stretched from Canada to the Gulf of Mexico but was worst in the Eastern United States, including all of Pennsylvania. This storm caused widespread blackout conditions; snowfall totals ranged from twelve inches in Philadelphia to 20 inches in Harrisburg and Scranton to 24 inches in the Pittsburgh area. This event garnered a Presidential Emergency Declaration; the overall damage estimate for all states in this event was $6.6 billion.

4.3.16.3. Past Occurrence

Pennsylvania has a long history of severe winter weather. Six of the 59 Presidential Disaster and Emergency Declarations issued in Pennsylvania have been in response to winter storm events (see Table 4.2.1-1). Figure 4.3.16-2 shows the number of winter storm events by county across Pennsylvania between 1950 and 2013. While this map implies that certain areas have experienced significantly more events than others, the true distribution of past events throughout the Commonwealth is likely more uniform.

Figure 4.3.16-2 Map showing the number of winter storm events by county across Pennsylvania (NCDC, 2013).



In the winter of 1993-1994, the Commonwealth was hit by a series of protracted winter storms. The severity and nature of these storms combined with accompanying record-breaking frigid temperatures posed a major threat to the lives, safety and well-being of Commonwealth residents and caused major disruptions to the activities of schools, businesses, hospitals and nursing homes.

The first of these devastating winter storms occurred in early January, 1994 with record snowfall depths in excess of 33 inches across southwest and south-central portions of the Commonwealth, strong winds and sleet/freezing rains. Numerous storm-related power outages were reported and as many as 600,000 residents were without electricity, in some cases for several days at a time. A ravaging ice storm followed, affecting the southeastern portion of the Commonwealth, which closed major arterial roads and downed trees and power lines. Utility crews from a five-state area were called to assist in power restoration repairs. Officials from PP&L stated that this was the worst winter storm in the history of the company; related damage-repair costs exceeded $5,000,000.

Serious power supply shortages continued through mid-January because of record cold temperatures at many places, causing sporadic power generation outages across the Commonwealth. The entire Pennsylvania-New Jersey-Maryland grid and its partners in the District of Columbia, New York and Virginia experienced 15-30 minute rolling blackouts, threatening the lives of people and the safety of the facilities in which they resided. Power and fuel shortages affecting Pennsylvania and the East Coast power grid system required the Governor to recommend power conservation measures be taken by all commercial, residential and industrial power consumers.

The record cold conditions resulted in numerous water-main breaks and interruptions of service to thousands of municipal and city water customers throughout the Commonwealth. Additionally, the extreme cold in conjunction with accumulations of frozen precipitation resulted in acute shortages of road salt. As a result, trucks were dispatched to haul salt from New York to expedite deliveries to Pennsylvania Department of Transportation storage sites.

During January and February 1994, Pennsylvania experienced at least seventeen regional or statewide winter storms. In January 1996, another series of severe winter storms with 27- and 24-inch accumulated snow depths was followed by 50 to 60 degree temperatures resulting in rapid melting and flooding.

Pennsylvania experienced several significant snowstorms in the winter of 2009-2010 resulting in record season-total snowfalls in many areas. Two of the top snowfall events were recorded in Philadelphia, including a snowfall of 23.2” on December 19-20, 2009 and a snowfall of 28.5” on February 5-6, 2010 (Weather Underground, 2010). These storms crippled many areas of Pennsylvania. Additional notable storms from this record-setting winter occurred on February 9-10, 2010 and February 25-26, 2010.

4.3.16.4. Future Occurrence

Winter storms are a regular, annual occurrence in Pennsylvania and should be considered *highly likely* according to the Risk Factor Methodology (see Section 4.1). Extreme snowfall totals for 10%-, 4%-, 2%-, and 1%-annual probabilities vary by location and can be obtained by weather station or county from the NOAA National Climatic Data Center at: http://vlb.ncdc.noaa.gov/ussc/USSCAppController?action=options&state=36.

4.3.16.5. Environmental Impacts

Environmental impacts often include damage shrubbery and trees due to heavy snow loading, ice build-up and/or high winds which can break limbs or even bring down large trees. An indirect effect of winter storms is the treatment of roadway surfaces with salt, chemicals, and other de-icing materials which can impair adjacent surface and ground waters. This is particularly a concern in highly urban areas such as Philadelphia, Pittsburgh, and Harrisburg. Another important secondary impact for winter storms is building or structure collapses; if there is a heavy snowfall or a significant accumulation over time, the weight of the snow may cause building damage or even collapse.

Winter storms have a positive environmental impact as well; gradual melting of snow and ice provides excellent groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding.

4.3.16.6. Jurisdictional Vulnerability Assessment

As stated in Section 4.2.2, jurisdictional and state critical facility vulnerability assessments were completed by spatially overlaying hazards with census tracts and state critical facility layers in GIS. When spatial analysis determined that the hazard would impact a census tracts within a county or the location of state critical facilities these locations where deemed vulnerable to the hazard. Loss estimates were prepared based on the value of the facilities impacted by census tract and by state critical facility. Each hazard uses a methodology that is specific to the type of risk it may cause; Table 4.2.2-2 includes a complete methodology description for vulnerability assessments and loss estimates for each hazard.

As stated in Section 4.3.16.1, much of the Commonwealth experiences winter storm events. Even areas that do not experience significant yearly snowfall are still vulnerable to the effects of localized snow and ice storms. However, the counties that are most vulnerable to winter storm hazards are those that experience significant snowfalls. For this analysis, jurisdictions experiencing over 70 inches of snow were considered most vulnerable to sustained winter storm hazards; the area of Pennsylvania falling under this category has shrunk from 2010-2013 to only 11 counties. However, 65 counties in Pennsylvania currently identify winter storms as a hazard, displayed in Table 4.3.16-2. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile

Of the 40 counties which currently have calculated risk factor values for winter storm hazards, the average value is 3.0. The calculated state risk factor for winter storms is 3.1, and the

Pennsylvania THIRA ranks winter storms as an 8 of 10. For more details, please see Section 4.1.

Table 4.3.16-2 Counties profiling winter storm hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.7
Allegheny	X		High	2.7
Armstrong	X		Not Ranked	No RF
Beaver	X		High	3.0
Bedford	X		High	3.3
Berks	X		Not Ranked	No RF
Blair	X		Not Ranked	No RF
Bradford		X		
Bucks	X		High	3.0
Butler	X		High	3.0
Cambria	X		High	3.3
Cameron	X		High	3.2
Carbon	X		High	3.0
Centre	X		High	3.0
Chester	X		Not Ranked	No RF
Clarion	X		Not Ranked	No RF
Clearfield		X	Medium	2.4
Clinton	X		High	3.0
Columbia	X		High	2.9
Crawford	X		High	3.0
Cumberland	X		High	2.7
Dauphin	X		Not Ranked	No RF
Delaware	X		High	3.0
Elk	X		High	3.0
Erie	X		High	3.5
Fayette	X		High	3.0
Forest	X		Not Ranked	No RF
Franklin	X		Not Ranked	No RF
Fulton	X		High	2.5
Greene	X		High	3.0
Huntingdon	X		Not Ranked	No RF

Table 4.3.16-2 Counties profiling winter storm hazards with hazard ranking and risk factor (if available).				
COUNTY	**PROFILED HAZARD**	**DID NOT PROFILE HAZARD**	**RANKING (IF AVAILABLE)**	**RISK FACTOR (IF AVAILABLE)**
Indiana	X		High	3.0
Jefferson	X		High	3.0
Juniata	X		High	3.1
Lackawanna	X		Not Ranked	No RF
Lancaster	X		Medium	2.1
Lawrence	X		High	3.3
Lebanon*	X		Not Ranked	9.5
Lehigh	X		High	2.7
Luzerne	X		Not Ranked	No RF
Lycoming	X		High	3.7
McKean	X		High	3.0
Mercer	X		High	3.0
Mifflin	X		Not Ranked	No RF
Monroe	X		High	3.0
Montgomery	X		High	2.9
Montour*	X		Not Ranked	No RF
Northampton	X		High	2.7
Northumberland	X		High	2.9
Perry*	X		Not Ranked	9.5
Philadelphia**	X		High	A
Pike	X		High	3.1
Potter	X		Not Ranked	No RF
Schuylkill	X		Not Ranked	No RF
Snyder	X		High	3.0
Somerset	X		High	3.7
Sullivan	X		Not Ranked	No RF
Susquehanna	X		High	3.0
Tioga	X		High	3.0
Union	X		Not Ranked	No RF
Venango	X		High	2.7
Warren	X		High	2.7
Washington	X		Not Ranked	No RF
Wayne	X		Not Ranked	No RF

Table 4.3.16-2 Counties profiling winter storm hazards with hazard ranking and risk factor (if available).				
COUNTY	**PROFILED HAZARD**	**DID NOT PROFILE HAZARD**	**RANKING (IF AVAILABLE)**	**RISK FACTOR (IF AVAILABLE)**
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		High	2.7

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

The ten counties most affected by winter storms host a total of 345 state critical facilities (Table 4.3.16-3). Of these counties, Crawford has the most vulnerable critical facilities with a total of 81 vulnerable facilities. Forest County has the fewest with only one state critical facility impacted by winter storms.

Table 4.3.16-3 Number of State Critical Facilities impacted by winter storms in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Cambria	74	McKean	8
Crawford	81	Somerset	52
Erie	66	Venango	7
Forest	1	Warren	42
Indiana	8	Westmoreland	6

4.3.16.7. State Facility Vulnerability Assessment

In winter storm events, state critical facility buildings are vulnerable to widespread utility disruptions, including loss of heat and electricity, as well as building collapse or damage from downed trees. Structure vulnerability frequently depends on the age of the structure in question and its roof pitch; the older the structure, especially the roof, the less snow load it can handle. Similarly, roofs with a more gradual pitch are less able to have snow and ice slide off of them, increasing the weight of snow and ice sitting on top and thus the potential for damage. They could potentially affect all critical facilities, but those located in areas experiencing 70 or more inches of snowfall or more experience the most risk. These facilities are largely concentrated in northwestern Pennsylvania. The critical facilities considered most vulnerable are listed by type in Table 4.3.16-4.

Table 4.3.16-4 State Critical Facilities vulnerable to winter storms by Critical Facility Type	
STATE CRITICAL FACILITY TYPE	**NUMBER OF IMPACTED FACILITIES**
Agriculture	4
Banking	1
Commercial Facilities	1
Critical Manufacturing	1
Dams	4
Education	9
Emergency Services	6
Energy	2
Fire Departments (Non-HSIP)	140
Government Facilities	4
Hospital (Non-HSIP)	18
National Monuments & Icons	1
Police (Non-HSIP)	60
School (Non-HSIP)	87
Transportation	1
Water	6
Grand Total	***345***

4.3.16.8. Jurisdictional Loss Estimation

In the jurisdictions affected by 70 or more inches of snowfall per year, 424,799 buildings may be impacted by winter storms. These buildings have a combined loss estimate of $90.1 billion (Table 4.3.16-5). Of the vulnerable jurisdictions, Erie County is the most threatened with 140,915 impacted buildings worth over $32 billion.

Table 4.3.16-5 Estimated jurisdictional losses due to winter storms.		
COUNTY	**NUMBER OF IMPACTED BUILDINGS**	**DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS ($)**
Cambria	57,174	$12,866,002.00
Crawford	69,380	$13,690,978.00
Erie	140,915	$32,417,238.00
Forest	6,717	$1,106,896.00
Indiana	12,952	$2,375,474.00
McKean	8,129	$1,667,663.00
Mercer	5,760	$1,156,082.00
Somerset	44,577	$9,573,203.00
Venango	11,309	$1,969,411.00
Warren	47,584	$9,113,823.00
Westmoreland	20,302	$4,208,113.00
Grand Total	**424,799**	**$90,144,883.00**

4.3.16.9. State Facility Loss Estimation

Winter storm hazards can cause a range of damage to state critical facilities that will depend on the magnitude and duration of storm events. Losses may be as small as lost productivity and wages when workers are unable to travel or as large as sustained roof damage or building collapse. Roof pitch and building age are typical determinants in the vulnerability of an individual structure to snow load or icing during a winter storm. However, if all the critical facilities located in winter storm hazard zones were to be destroyed in a winter storm event, the estimated replacement cost of all State Critical Facilities is $2,675,883,338.

HUMAN-MADE HAZARDS

4.3.17. Civil Disturbance

4.3.17.1. Location and Extent

Civil disturbance is a broad term that is typically used by law enforcement to describe one or more forms of disturbance caused by a group of people. Civil disturbance is typically a symptom of, and a form of protest against, major socio-political problems. Typically the severity of the action coincides with the level of public outrage. In addition to a form of protest against major socio-political problems, civil disturbances can also arise out of union protest, institutional population uprising, or from large celebrations that become disorderly. The scale and scope of civil disturbance events varies widely. However, government facilities, landmarks, prisons, and universities are common sites where crowds and mobs may gather. The concentration of federal buildings in Philadelphia and state government buildings in Harrisburg may be targets of civil disturbance. Additionally, Pennsylvania has 26 state correctional facilities, one motivational boot camp, 14 community corrections centers, 40 contract facilities and a training academy. In addition, Pennsylvania is home to eight federal prison facilities as well as local and private facilities that may be targets for civil unrest.

4.3.17.2. Range of Magnitude

Civil disturbances can take the form of small gatherings or large groups blocking or impeding access to a building, or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full scale riot, in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. Often that which was intended to be a peaceful demonstration to the public and the government can escalate into general chaos. There are two types of large gatherings typically associated with civil disturbances: a crowd and a mob. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four categories (Blumer, 1946):

- **Casual Crowd:** A casual crowd is merely a group of people who happen to be in the same place at the same time. Violent conduct does not occur.
- **Cohesive Crowd:** A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. Although they may have intense internal discipline, they require substantial provocation to arouse to action.
- **Expressive Crowd:** An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are