

#### **4.4.12 Winter Storm**

*Including Blizzards, Heavy Snow, Ice Storms, and Extreme Cold*

##### **4.4.12.1 Characteristics**

Winter storms take many forms and vary significantly in size, strength, intensity, duration, and impact. The composition of a storm varies with the temperature, wind, and amounts of precipitation. Important factors in winter storms include temperature, wind, wind chill, rain, sleet, snow, and blowing snow. Exceptional winter storms can and do cause problems for the communities, residents, and travelers. Examples of these types of storms include blizzards, ice storms, heavy snow events, and extended extreme cold temperatures. While these types of events may not sound serious, the combinations of cold temperatures, wind, snow, wind chills, ice, and reduced visibility can make these storms very deadly and costly.

The winter season can begin as early as September and last into May. The bulk of North Dakota's winter weather is from mid-November until early April. On average, there are around ten winter storms (ice storms, heavy snow events, winter storms, and blizzards) each year. Three to four of these storms reach blizzard intensity, thus North Dakota typically leads the nation in blizzard frequency. (National Climatic Data Center, 2007; National Weather Service, 2007h)

Other hazards are prolonged periods of cold often associated with high winds, which produce life-threatening situations. Winter weather too often catches people unprepared. Researchers have said that 70 percent of the fatalities related to ice and snow occur in automobiles and about 25 percent are related to people who have been caught off guard out in the storm. Ice storms with wind, or heavy snow without wind, have been extremely dangerous and costly to business, industry, state and local governments, and citizens. Blizzards can last from less than 24 hours (in the fast moving storms) to more than four days (in the slower moving ones).

There are two major winter storm tracks that occur in the United States. The northern track produces the Alberta Low Pressure System, commonly called the "Alberta Clipper." This usually is a fast moving storm producing blizzard conditions for a relatively short period of time. Extremely low temperatures usually follow storms of this nature. Alberta Lows have traveled as fast as 90 mph and have not been known to become stationary systems. The southern track produces the Colorado Low Pressure System. These types of storms move more slowly and more erratically. The Colorado Low has traveled as fast as 60 mph, but has also been known to stop and become stationary for as long as 18 hours. Both of these types of storm systems can become very deadly.

Blizzards, as defined by the National Weather Service, are a combination of sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling or blowing snow for 3 hours or more. A blizzard, by definition, does not indicate heavy amounts of snow, although they can happen together. The falling or blowing snow usually creates large drifts from the strong winds. The reduced visibilities make travel, even on foot, particularly treacherous. The strong winds may also support dangerous wind chills. The National Weather Service issues the following products for blizzards and blowing snow:

- Blizzard Watch: Blizzard watches are issued to give the public 12-48 hours of advance notice of possible blizzard conditions (sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling and/or blowing snow for 3 hours or more).
  - Blizzard Warning: Blizzard warnings are issued when blizzard conditions (sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling and/or blowing snow for 3 hours or more) are occurring, imminent, or have a high probability of occurring.
  - Blowing Snow Advisory: Blowing snow advisories are issued for visibilities intermittently at or below ½ mile because of blowing snow.
- (National Weather Service, 2005)

Blizzard conditions can also exist without a major storm system being near the state. Strong surface winds can blow already fallen snow, which is known as a "ground blizzard." Visibility can be reduced to near zero even though the sun is shining and the tops of power poles and trees are seen easily. These conditions are extremely variable in duration, from hours to even greater than a day. Ground blizzards are usually accompanied by very cold temperatures and wind chill conditions, making them as potentially deadly as a conventional blizzard.

The impact of a severe blizzard with low visibility, heavy snow, and cold temperatures can bring the entire region to a standstill. Utility and communication systems are often interrupted. Road systems are rendered impassable which causes school, workplace, and commercial shutdowns. This in turn magnifies the emergency and medical management needs of the community. Rural residents are especially hard hit if they are not adequately stocked with food and fuel. The livestock industry can be severely impacted. The inability to get feed and water to livestock can become critical quickly. Dehydration of livestock is the major cause of casualties. Cattle can't lick enough snow to satisfy their thirst; they die of lack of water before succumbing to cold or suffocation.

Other hazardous winter storms also exist that do not meet the criteria of a blizzard. The National Weather Service has the ability to issue Winter Storm Watches and Warnings to alert the public of hazardous winter weather. The definitions of such are as follows:

- Winter Storm Watch: Winter storm watches are issued to give the public 12-48 hours of advance notice of the potential for hazardous winter weather that may threaten life or property.
- Winter Weather Advisory: Winter weather advisories are issued when a combination of winter weather elements that may cause significant inconveniences are occurring, imminent, or have a high probability of occurring.
- Winter Storm Warning: Winter storm warnings are generally issued when a combination of dangerous winter weather elements that may threaten life or property are occurring, imminent, or have a high probability of occurring.

(National Weather Service, 2005)

Ice storms develop when a layer of warm (above freezing), moist air aloft coincides with a shallow cold (below freezing) pool of air at the surface. As snow falls into a warm layer of air, it melts to rain, and then freezes on contact when hitting the frozen ground or cold objects at the surface, creating a smooth layer of ice. This phenomenon is called freezing rain. Similarly, sleet occurs when the rain in the warm layer subsequently freezes into pellets while falling through a cold layer of air at or near the Earth's surface.

Extended periods of freezing rain can lead to accumulations of ice on roadways, walkways, power lines, trees, and buildings. Almost any accumulation can make driving and walking hazardous. Thick accumulations can bring down trees and power lines. In addition to Winter Storm Watches and Warnings, the National Weather Service issues the following products for ice storms:

- Freezing Rain Advisory: Freezing rain advisories are issued when an accumulation of ice will make roads and sidewalks slippery, but significant and damaging accumulations of ice are not expected.
- Ice Storm Warning: Ice storm warnings are issued when a significant and damaging accumulation of ice is occurring, imminent, or has a high probability of occurring.

(National Weather Service, 2005)

Large quantities of snow may fall during winter storms. Six inches or more in 12 hours or eight inches or more in 24 hours constitutes conditions that may significantly hamper travel or create hazardous conditions. The National Weather Service issues warnings for such events. Smaller amounts can also make travel hazardous, but in most cases, only results in minor inconveniences. Heavy wet snow before the leaves fall from the trees in autumn or after the trees have leafed out in the spring may cause problems with broken tree branches and power outages. In addition to Winter Storm Watches and Warnings, the National Weather Service issues the following products for heavy snow events:

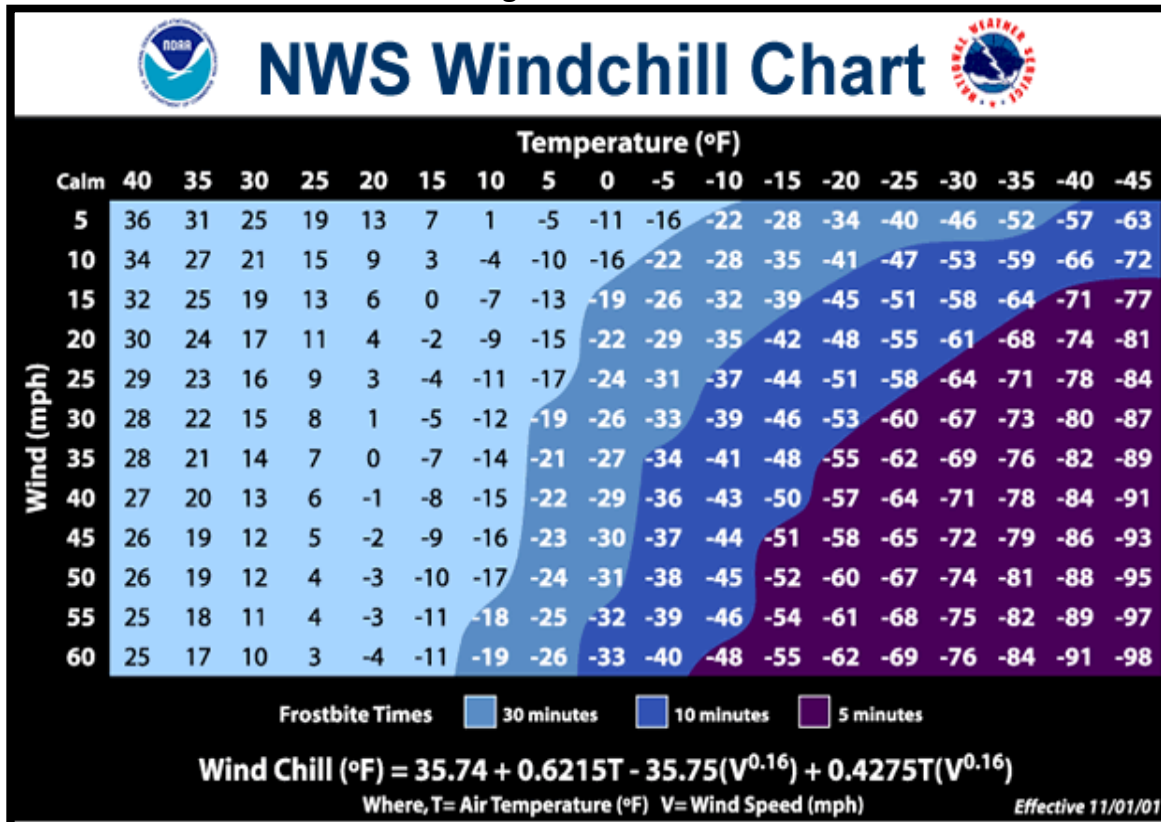
- Snow Advisory: Snow advisories are issued when snow accumulations of 3-5 inches are expected.
- Sleet Advisory: Sleet advisories are issued when sleet accumulations causing hazardous conditions are expected.
- Heavy Snow Warning: Heavy snow warnings are issued when snow accumulations of 6 inches or more in 12 hours or 8 inches or more in 24 hours are expected.

(National Weather Service, 2005)

Extended periods of cold temperatures frequently occur throughout the winter months in North Dakota. Heating systems compensate for the cold outside. Most people limit their time outside during extreme cold conditions, but common complaints usually include pipes freezing and cars refusing to start. When cold temperatures and wind combine, dangerous wind chills can develop.

Wind chill is how cold it feels when outside. Wind chill is based on the rate of heat loss on exposed skin from wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature, and eventually, internal body temperature. Therefore, the wind makes it feel much colder than the actual temperature. For example, if the temperature is 0°F and the wind is blowing at 15 mph, the wind chill is -19°F. At this wind chill, exposed skin can freeze in 30 minutes. Wind chill does not affect inanimate objects. (National Weather Service, 2007f) Figure 4.4.12.1A shows the current wind chill chart. The wind chill index changed in 2001 to better reflect the conditions felt by humans. This chart depicts the new, more accurate representation.

Figure 4.4.12.1A



Source: National Weather Service, 2007f.

The National Weather Service issues the following products for significant wind chills:

- **Wind Chill Watch:** Wind chill watches are issued to give the public 12-48 hours advanced notice of the potential for wind chills of -40°F or colder with a wind speed of 10 mph or higher.
- **Wind Chill Advisory:** Wind chill advisories are issued when wind chills of -20°F to -39°F with a wind speed of 10 mph or higher are expected.
- **Wind Chill Warning:** Wind chill warnings are issued when wind chills of -40°F or colder with a wind speed of 10 mph or higher are expected.

(National Weather Service, 2005)

Wind chill conditions become very relevant when human tissue is exposed to the outside air. This can occur when people become stranded in a blizzard and attempt to walk to safety and become lost. Overexertion due to winter activities can and does cause heart attacks. Lowering of the body core temperature leads to the condition known as "hypothermia." The lack of adherence to simple but important and necessary precautions or even apathy can result in loss of property, injury, and even death.

Hypothermia has often been called "the killer of the unprepared." It also claims the lives of many outdoor sports enthusiasts. This condition occurs when the body or "core temperature" is lowered. The blood is cooled, thereby reducing the amount of oxygen which is carried to the brain, thus dulling the senses. The victim becomes fatigued, delirious, and loses dexterity and control of arms and legs. If the body core temperature continues to drop and nears 85°F, the victim eventually slips into unconsciousness. If

treatment is not started immediately, the result is arrest of the circulatory and respiratory systems and death.

Winter storms can often be associated with other hazards. The most common hazards thought of during winter weather events are transportation accidents. Roadways become hazardous quickly during snow, blowing snow, and ice events. Most accidents involve passenger vehicles; however, an accident involving a commercial vehicle transporting hazardous materials is also possible.

Strong winds and ice or snow accumulations can take down utility lines. A long-term utility outage becomes more significant during extended cold periods as sheltering and cold weather exposure becomes more challenging. Accessing those in rural areas following heavy snow events to deliver supplies or provide emergency services can be difficult; the need for such services would be compounded by any long-term utility outage.

Heavy snow can alleviate drought conditions, improve agricultural conditions, and decrease the wildfire threat, but in doing so, can often increase the probability of flooding come spring.

#### **4.4.12.2 History**

North Dakota has winter storms several times per year. Records show that only three to four severe, widespread blizzards occur each decade. The winter of 1996 with incredible levels of snow almost statewide and the blizzard and rapid thaw of April 1997 produced conditions of such dramatic proportions that records were not available to compare the magnitude of the total loss which occurred. A summary of some of the more significant winter weather events across the state follow:

*1886-1887 Winter* – A severe winter in the western part of the Dakota Territory put an end to open range ranching.

*January 1888 Blizzard* – Also called the Schoolhouse Blizzard, the blizzard of 1888 swept the Dakota Territory during the afternoon of January 12. The day started off with relatively warm temperatures and caught many people off guard. Reportedly, the temperature dropped from 32°F to -20°F in five minutes and the wind blew so strong that people were knocked off their feet. Many children, sent home from school, did not make it home. The blizzard was so withering that people lost their sense of direction and wandered about until they died of hypothermia. Thousands of head of livestock and wild animals perished. Many buildings were covered with snow or destroyed, and all transportation stopped. Although the storm lasted less than one day, an estimated 400 people died through the Dakotas.

*March 1920 Blizzard* – The blizzard lasting three days with winds to 70 mph killed 34 people. In front of the Oliver County Courthouse, this storm is remembered by a statue of Hazel Miner, killed on her way home from school near Center.

*March 1941 Blizzard* – The Red River Valley blizzard killed 39 people in North Dakota.

*March 1966 Blizzard* – This remarkable blizzard hit the Northern Plains and is noted for its long duration. Bismarck had near zero visibility for 42 consecutive hours with 22.4 inches of snow. The livestock losses were extreme; over 100,000 head of livestock were lost in the Dakotas. One farm in eastern North Dakota lost 7,000 turkeys. An estimated 15 people died in this storm.

*January 1975 Blizzard* – A blizzard with 60-70 mph winds and -20°F temperatures resulted in the deaths of 12 North Dakotans and countless cattle.

*February 1984 Blizzard* – The sudden onset of the blizzard that struck eastern North Dakota claimed six lives in North Dakota, including four people that died at the Fargo 19<sup>th</sup> Avenue North underpass of carbon monoxide poisoning.

*1996-1997 Winter* - The heavy snows of late 1996, accompanied by severe winds in early January 1997, resulted in near statewide disruption of transportation with major road blockage as well as rail and local airport disruptions. The January 9, 1997 blizzard left cumulative snow amounts across the state from 13 to 65 inches. Wind chills of 80 degrees below zero were recorded. Interstates 1-29 and 1-94 were closed for four days. Nine storm-related deaths occurred, several of which were due to cold exposure. Snow and ice-blocked vents preventing adequate air circulation and resulted in numerous residents being treated for carbon monoxide poisoning in Mandan. A rapid spring thaw created flooding in west central and southwestern North Dakota in mid to late March. Another blizzard moved into western North Dakota on April 4th and 5th, leaving an additional 10 to 24 inches of snow throughout the state. The life threatening conditions caused massive power outages and shut down road systems throughout the state. Freezing rain, combined with high winds, toppled government and commercial radio and television towers, leaving many without access to emergency information. Reports from ten electric power cooperatives stated that hundreds of transmission towers and about 4,300 power poles toppled. Propane and food shortages were reported by some rural residents. Many farm buildings collapsed under the weight of the snow. Snow blocked roadways compounded many problems. At least 100,000 cattle were lost. Damages were estimated at \$317 million with at least 8 deaths and 91 injuries.

*April 1999 Ice Storm* – The eastern part of North Dakota experienced ice and snow that collected on power lines and resulted in widespread power outages. Thousands were without power and city foresters spent weeks hauling away downed tree branches.



**Figure 4.4.12.2A** The March 1966 blizzard nearly buried utility poles. This photo was taken by Bill Koch of the North Dakota State Highway Department near Jamestown. Source: National Oceanic and Atmospheric Administration, 2007.

*November 2000 Winter Storm and Ice Storm* – Early season heavy snowfall in north-central and western North Dakota, up to 18 inches, closed roads and caused numerous accidents, injuring 7 seriously in a bus accident. In the northwest part of the state, at least 500 power poles were damaged at a cost of about \$1 million. In Cavalier and Ramsey Counties, ice accumulations caused power outages of up to 12 hours for some.

*January 2004 Winter Storm* – A persistent winter storm brought snow up to 12 inches to northwest and central North Dakota. The storm began as freezing rain before changing to snow. Winds of 15-25 mph caused considerable blowing and drifting snow and wind chills to 30 below zero. Travel was significantly impacted.

*October 2005 Blizzard* – An early season blizzard in western and northern North Dakota dropped up to 22 inches of heavy wet snow, downing power lines and closing many roadways, including 155 miles of Interstate 94. The National Guard was called in to rescue hundreds of stranded motorists. Damages were estimated at \$2.2 million.

*November 2005 Ice Storm* – An accumulation of ice covered trees and power lines in southeastern North Dakota. When the wind picked up, the power lines snapped. Thousands of power poles and a high voltage transmission line snapped and thousands were without power. Airports and interstates in the Fargo area were closed. Power line repairs in the Fargo area exceeded \$3,000,000.

(State Historical Society of North Dakota, 2007; South Dakota Office of Emergency Management, 2007)

The National Climatic Data Center has 231 winter weather events listed for North Dakota from 1992-2006 totaling over \$327 million, 17 deaths, and 129 injuries. An additional 30 extreme cold events were recorded from 1992-2006 resulting in 9 deaths and 2 injuries. (National Climatic Data Center, 2007) Note that some winter weather events in the database may be listed more than once if they occurred over several regions. The total number of distinct winter storms in North Dakota from 1992-April 2007 is about 155, which equates to about 10 per year. (National Weather Service, 2007h)

**Table 4.4.12.2B North Dakota Winter Weather Declared Disasters and Emergencies**

| Declaration | Location                                                                                         | Date                    | Other Information                                                                                                                                                                | Casualties              | Damages                                           |
|-------------|--------------------------------------------------------------------------------------------------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------------------------------------------|
| DR 3061     | North Dakota                                                                                     | 1978                    | For blizzards and snowstorms.                                                                                                                                                    | Unknown                 | Unknown                                           |
| State EO    | North Dakota                                                                                     | 1983                    | For ice storm.                                                                                                                                                                   | Unknown                 | Unknown                                           |
| DR 1157     | All counties in North Dakota                                                                     | January 2-31, 1997      | Public Assistance.<br>For blizzards and severe winter storms.                                                                                                                    | 8 deaths<br>91 injuries | \$14,801,246*<br>\$317,000,000<br>estimated total |
| DR 1279     | 34 counties and 3 tribes in Central and Eastern North Dakota                                     | March 1 – July 19, 1999 | Public Assistance and Individual Assistance.<br>For snow and ice.<br>Also included impacts from severe storms, tornadoes, flooding, ground saturation, landslides, and mudslides | None                    | \$124,391,622*~                                   |
| DR 1353     | Benson, Bowman, Cavalier, Divide, Golden Valley, McKenzie, Ramsey, Towner, and Williams Counties | November 1-20, 2000     | Public Assistance.<br>For winter storms.                                                                                                                                         | 7 injuries              | \$1,202,000<br>estimated total                    |
| State EO    | North Dakota                                                                                     | 2003                    | State Declared Winter Emergency                                                                                                                                                  | Unknown                 | Unknown                                           |
| EM 3196     | Dunn, McHenry, McKenzie, McLean, Mercer, Ward Counties and Fort Berthold Reservation             | January 23-27, 2004     | Public Assistance.<br>For snow.                                                                                                                                                  | None                    | Unknown                                           |
| DR 1616     | 23 counties and 1 tribe in western and north central North Dakota                                | October 4-6, 2005       | Public Assistance.<br>For severe winter storms and record/near record snow.                                                                                                      | None                    | \$2,024,210*<br>\$2,200,000<br>estimated total    |
| DR 1621     | Cass, Ransom, Richland, and Sargent Counties                                                     | November 27-30, 2005    | Public Assistance.<br>For severe winter storms.                                                                                                                                  | None                    | \$2,147,154*<br>\$3,000,000<br>estimated total    |

\* Federal Share (includes Individual and Family Grant, Disaster Housing, Manufactured Housing, Crisis Counseling Immediate and Regular Programs, Disaster Unemployment Assistance, Hazard Mitigation Grant Program, Public Assistance, FEMA Mission Assignments, and SBA Home, Business, and Economic Injury Loans.

~ primarily includes flood impacts.

Sources: Federal Emergency Management Agency, 2007a; North Dakota Department of Emergency Services, 2007b; National Climatic Data Center, 2007; Interagency Hazard Mitigation Team Reports, varied dates; North Dakota Department of Emergency Services, 2007e.

#### 4.4.12.3 Probability and Magnitude

Based on blizzard studies, a typical North Dakota county may experience an average of two blizzards annually, while statewide, about three to four of these extremely dangerous storms occur. (Schwartz, 2000; National Weather Service, 2007h) The National Climatic Data Center data from 1992-April 2007 translates into about 10 winter storm events annually in the state with an annual average of \$20-25 million in

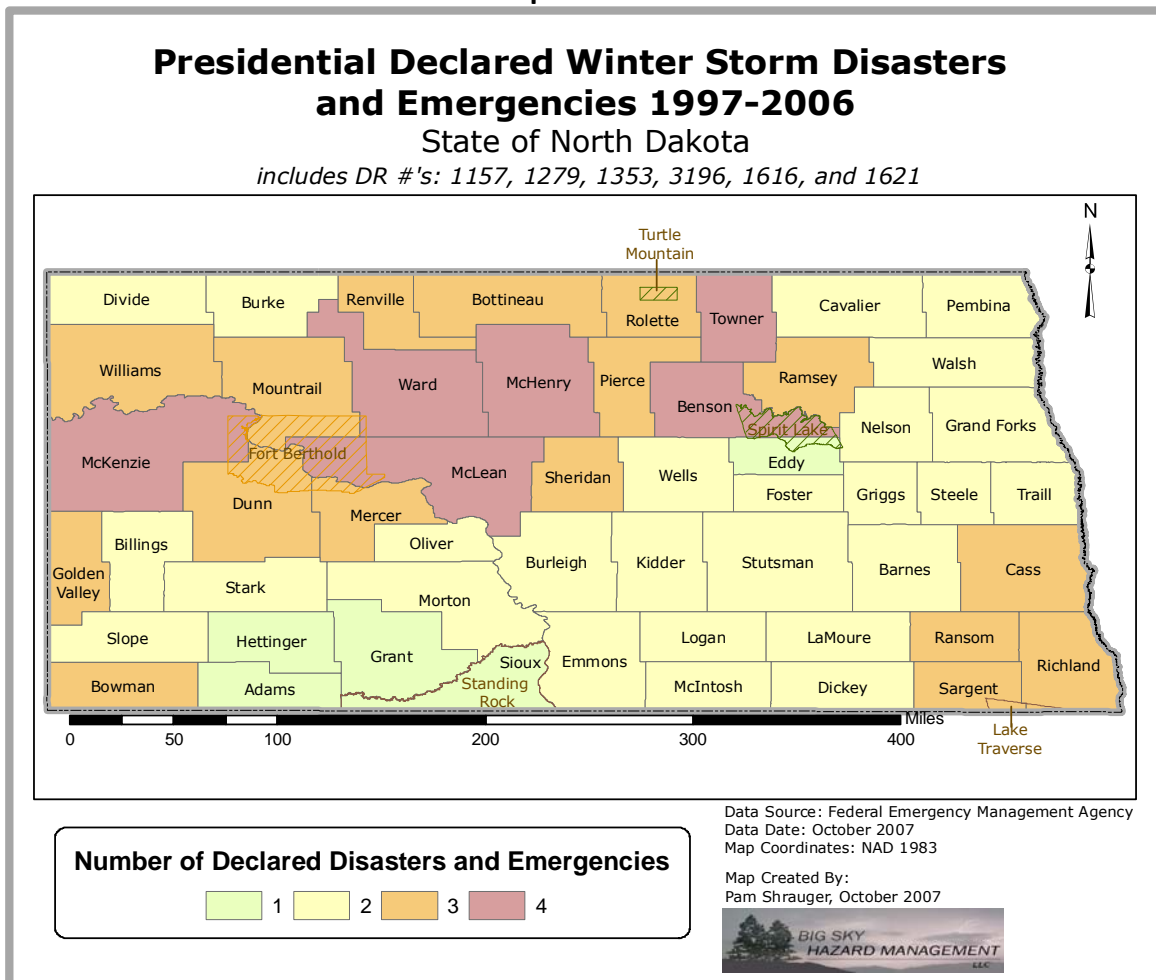
damages, 1-2 deaths, and 5-10 injuries. Extreme cold events, separate from the winter storms, occur about 2 times per year and result in about 1 death or injury annually. (National Climatic Data Center, 2007; National Weather Service, 2007h)

The severe blizzards and winter storms that result in the loss of life, extended road closures, long-term power outages, communication failures, or significant isolation problems represent high magnitude winter storm events for North Dakota. Blizzard conditions continuing for 2 or more days and blocked roadways or power outages for a week or more both represent extreme winter weather conditions that are possible. These types of events present significant transportation, sheltering, and logistical challenges.

**4.4.12.4 Mapping**

The winter storm hazards, such as blizzards, ice storms, heavy snow, and extreme cold, usually occur on a regional or even statewide scale. As the historical record indicates, winter storms are a formidable hazard for all parts of the state. Map 4.4.12.4A shows the number of winter storm Presidential disaster and emergency declarations since 1997 by county.

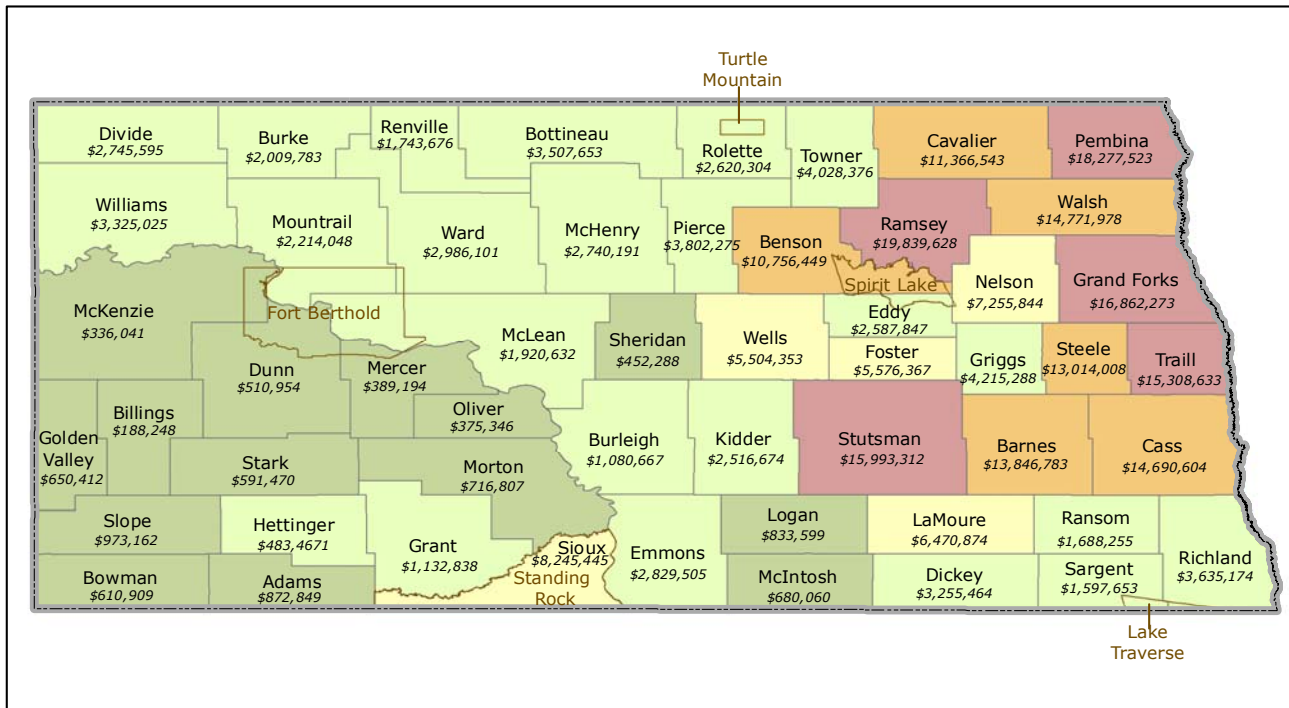
**Map 4.4.12.4A**



Map 4.4.12.4B shows the losses listed through the federal crop insurance program due to frost, freeze, cold winter, and cold wet weather from 1996-2005. The total losses over the 10-year period in the state totaled \$268,979,651, or about \$26.9 million annually. (Risk Management Agency, 2007)

Map 4.4.12.4B

### Crop Losses Paid by Insurance for Frost, Freeze, Cold Winter, and Cold Wet Weather 1996-2005 State of North Dakota



Data Source: Risk Management Agency  
Data Date: 2007  
Map Coordinates: GCS, NAD 1983

**10-Year Winter Storm Crop Losses**

- Less than \$1.0 million
- \$1.0 million - \$4.9 million
- \$5.0 million - \$9.9 million
- \$10.0 million - \$14.9 million
- \$15.0 million and greater

Map Created By:  
Pam Shrauger, November 2007



#### 4.4.12.5 Vulnerabilities of State-Owned Buildings and Property

Most structures usually remain unaffected by winter weather with the primary exceptions being heavy snow loads, frozen pipes, or other utility failure. Should the weight of the snow on the roof of a state-owned building exceed its structural capability, the roof could collapse, as was the case in January 1997

when roof of the Winter Show Building in Valley City collapsed. This type of loss might be generally categorized as a collapse by the North Dakota State Fire and Tornado Fund, along with other buildings that have collapsed for other reasons. Table 4.4.10.5A in the Urban Fire or Structure Collapse Hazard Profile shows the collapse claims paid for state-owned buildings and property. A total of about \$2.7 million has been paid since 1989. State-owned buildings may become inaccessible during periods of heavy snow and drifting, therefore, functional losses may also occur.

#### **4.4.12.6 Vulnerabilities of Critical Facilities and Infrastructure**

The critical facilities themselves generally are not threatened by winter storms. Heavy snow loads on roofs, particularly large span roofs, can cause the roof to leak or even collapse depending on its construction. Table 4.4.10.6B in the Urban Fire or Structure Collapse Hazard Profile shows the collapse claims paid to local governments, universities, and school districts since 1989; a total of \$616,090 in claims have been paid. Extremely cold temperatures may cause pipes to freeze and subsequently burst, causing water damage. Probably the greatest issue for critical facilities during significant winter weather is the inaccessibility of such facilities due to poor roadways, utility outages, or dangerous wind chills. First responders such as fire, law enforcement, and ambulance may have a difficult time responding during poor road conditions or may not be able to provide certain services during electric outages. Those facilities with back-up generators are better equipped to handle a winter storm situation should the power go out.

Winter weather does pose a threat to key infrastructure. Above ground power and telephone lines can be taken out by falling tree branches or thick ice accumulations. Following severe ice storms, power may take weeks to be restored. Water infrastructure may also be threatened by winter weather, particularly rapid freeze and thaw periods that cause underground water mains to burst. This could result in temporary disruptions of running water. The most difficult network to maintain is the road infrastructure. During periods of heavy snow, ice, or blizzards, roads can quickly become impassable, stranding motorists and isolating communities. Long term road closures during an extended cold period may diminish and threaten propane, fuel, and food supplies.

Table 4.4.12.6A shows the critical facilities and infrastructure summary for the counties with a high or very high winter storm rating. See Section 4.3.2 for more details.

**Table 4.4.12.6A Critical Facilities and Infrastructure in High and Very High Winter Storm Hazard Counties**

| County        | Local | State | Hospitals | National Guard | Comms | Energy | Trans. | Univ. | Schools | Special Needs |
|---------------|-------|-------|-----------|----------------|-------|--------|--------|-------|---------|---------------|
| Benson*       | M     | L     | L         | L              | M     | L      | M      | M     | M       | L             |
| Bottineau     | M     | L     | L         | L              | H     | L      | M      | H     | L       | L             |
| Bowman        | M     | L     | L         | L              | M     | M      | M      | L     | L       | L             |
| Cass          | VH    | L     | H         | H              | VH    | L      | VH     | VH    | VH      | L             |
| Dunn*         | L     | L     | L         | L              | H     | H      | L      | M     | L       | L             |
| Golden Valley | L     | L     | L         | L              | M     | M      | H      | L     | L       | L             |
| McHenry       | M     | L     | L         | L              | M     | M      | M      | L     | L       | L             |
| McKenzie*     | M     | L     | L         | L              | H     | H      | L      | L     | L       | L             |
| McLean*       | M     | L     | L         | L              | H     | M      | M      | L     | M       | L             |
| Mercer*       | M     | L     | L         | L              | M     | VH     | M      | L     | M       | L             |
| Mountrail*    | M     | L     | L         | L              | H     | L      | M      | M     | M       | L             |
| Pierce        | M     | L     | L         | L              | M     | L      | M      | L     | L       | L             |
| Ramsey*       | M     | L     | L         | VH             | M     | L      | H      | H     | M       | L             |
| Ransom        | M     | L     | L         | L              | M     | L      | M      | L     | L       | H             |
| Renville      | M     | L     | L         | L              | L     | L      | M      | L     | L       | L             |
| Richland*     | M     | L     | L         | M              | VH    | M      | H      | H     | M       | L             |
| Rolette*      | M     | L     | L         | L              | M     | L      | M      | M     | M       | L             |
| Sargent*      | M     | L     | L         | L              | M     | L      | M      | L     | L       | L             |
| Sheridan      | L     | L     | L         | L              | M     | L      | L      | L     | L       | L             |
| Towner        | M     | L     | L         | L              | L     | L      | M      | L     | L       | L             |
| Ward*         | H     | L     | H         | H              | VH    | L      | H      | H     | H       | L             |
| Williams      | H     | L     | L         | L              | VH    | H      | H      | H     | M       | L             |

VH=Very High; H=High; M=Moderate; L=Low

\* includes at least part of the reservation

#### 4.4.12.7 Vulnerabilities to Jurisdictions

The population of North Dakota is most threatened by winter storms while driving or when electric service is lost. Transportation accidents are more common during poor road and visibility conditions and may result in injuries or deaths. Property losses are usually covered by insurance. Approximately 29% of North Dakota's population relies on electricity for heat. Many of the counties in eastern and northern North Dakota have electricity as their primary heat source (see Table 4.3.2H and Map 4.3.2I in the Critical Facilities and Infrastructure Section). In addition, those homes and businesses that use natural gas, propane, and fuel oil still often require electricity to run the blowers and heating systems. Therefore, an extended power outage during winter may make many homes and offices unbearably cold. Additionally, during extended winter-time power outages, people often make the mistake of bringing portable generators inside or not venting them properly, leading to carbon monoxide poisoning. With poor road conditions, sheltering residents may present significant logistical challenges with getting people to heated facilities, feeding, and providing medical care. These situations, accompanied by stranded motorists that need to be rescued, represent significant threats to the population. As history has demonstrated, poorly built structures may also experience structural collapses resulting in property losses.

With respect to the economy, agriculture, transportation, and businesses in general may be affected. Winter is not a peak growing season, so agriculture may not be severely affected unless the storms arrive early or late in the growing season. The primary exceptions for agriculture are extreme cold temperatures during calving operations and keeping animals hydrated during blizzards. Ranchers must take precautions not to lose large numbers of calves and livestock during cold and snowy weather. This could have an impact on agricultural profits. Winter storms may slow transportation resulting in business closures and delivery delays. Schools often close temporarily if conditions warrant.

Perhaps the greatest threat to historical values from winter weather is the potential for pipes to freeze and burst during cold weather. Water can easily damage the interiors of structures and their contents, including items of historic value. When roads are impassable, social events may also be postponed or cancelled. Otherwise, ecological values typically remain unaffected.

All jurisdictions in North Dakota are at high risk for winter storm losses. Table 4.4.12.7A shows the relative risk by county based on the number of past federal disasters and emergency declared. Note that because a county or tribe is listed as "low", this does not mean that that community is not at risk from winter storms. The relative hazard of "low" only indicates that a relatively low number of federal disasters have been declared for that particular area. In general, all areas of North Dakota are at similar risk from winter storms.

Table 4.4.12.7A Winter Storm Risk to Jurisdictions

| County                           | Winter Storm Hazard | Hazard Rating in Local/Tribal Plan | Additional Information from Local/Tribal Plan       |
|----------------------------------|---------------------|------------------------------------|-----------------------------------------------------|
| Adams                            | Low                 | A                                  | \$42.6M potential losses                            |
| Barnes                           | Moderate            | A                                  | \$10M potential building collapse and animal losses |
| Benson                           | Very High           | NP                                 |                                                     |
| Billings                         | Moderate            | C                                  |                                                     |
| Bottineau                        | High                | A                                  |                                                     |
| Bowman                           | High                | A                                  | \$12M in potential losses                           |
| Burke                            | Moderate            | A                                  | \$4.4M in potential losses                          |
| Burleigh                         | Moderate            | B                                  |                                                     |
| Cass                             | High                | B                                  |                                                     |
| Cavalier                         | Moderate            | A                                  | \$19M in potential losses                           |
| Dickey                           | Moderate            | B                                  |                                                     |
| Divide                           | Moderate            | NP                                 |                                                     |
| Dunn                             | High                | A                                  |                                                     |
| Eddy                             | Low                 | A                                  | \$30M in potential losses                           |
| Emmons                           | Moderate            | A                                  |                                                     |
| <i>Fort Berthold<sup>^</sup></i> | <i>High</i>         | <i>NP</i>                          |                                                     |
| Foster                           | Moderate            | B                                  |                                                     |
| Golden Valley                    | High                | A                                  |                                                     |
| Grand Forks                      | Moderate            | A                                  |                                                     |
| Grant                            | Low                 | A                                  |                                                     |
| Griggs                           | Moderate            | A                                  | \$4.7M in potential losses                          |
| Hettinger                        | Low                 | A                                  | \$3.9M potential losses                             |
| Kidder                           | Moderate            | A                                  | \$8.1M in potential losses                          |
| <i>Lake Traverse<sup>^</sup></i> | <i>Low</i>          | <i>NP</i>                          |                                                     |
| LaMoure                          | Moderate            | A                                  |                                                     |
| Logan                            | Moderate            | A                                  |                                                     |
| McHenry                          | Very High           | A                                  | \$11M in potential losses                           |
| McIntosh                         | Moderate            | B                                  |                                                     |
| McKenzie                         | Very High           | NP                                 |                                                     |
| McLean                           | Very High           | A                                  |                                                     |
| Mercer                           | High                | A                                  |                                                     |
| Morton                           | Moderate            | A                                  |                                                     |
| Mountrail                        | High                | A                                  | \$5.7M in potential losses                          |
| Nelson                           | Moderate            | A                                  |                                                     |
| Oliver                           | Moderate            | A                                  |                                                     |
| Pembina                          | Moderate            | A                                  | \$81M in potential losses                           |
| Pierce                           | High                | A                                  |                                                     |
| Ramsey                           | High                | A                                  | \$144M in potential losses                          |

**Table 4.4.12.7A Winter Storm Risk to Jurisdictions (continued)**

| County                              | Winter Storm Hazard | Hazard Rating in Local/Tribal Plan | Additional Information from Local/Tribal Plan |
|-------------------------------------|---------------------|------------------------------------|-----------------------------------------------|
| Ransom                              | High                | C                                  |                                               |
| Renville                            | High                | A                                  | \$50M in potential losses                     |
| Richland                            | High                | A                                  |                                               |
| Rolette                             | High                | NP                                 |                                               |
| Sargent                             | High                | NP                                 |                                               |
| Sheridan                            | High                | NP                                 |                                               |
| Sioux                               | Low                 | NP                                 |                                               |
| Slope                               | Moderate            | NP                                 |                                               |
| <i>Spirit Lake</i>                  | <i>Low</i>          | <i>NP</i>                          |                                               |
| <i>Standing Rock</i> <sup>^</sup>   | <i>Low</i>          | <i>NP</i>                          |                                               |
| Stark                               | Moderate            | NP                                 |                                               |
| Steele                              | Moderate            | NP                                 |                                               |
| Stutsman                            | Moderate            | B                                  |                                               |
| Towner                              | Very High           | A                                  |                                               |
| Traill                              | Moderate            | A                                  | \$66M in potential losses                     |
| <i>Turtle Mountain</i> <sup>^</sup> | <i>Low</i>          | <i>NP</i>                          |                                               |
| Walsh                               | Moderate            | A                                  |                                               |
| Ward                                | Very High           | NP                                 |                                               |
| Wells                               | Moderate            | B                                  |                                               |
| Williams                            | High                | A                                  |                                               |

NP = no local plan

<sup>^</sup> includes only North Dakota parts of the reservation

**Table 4.4.12.7B Winter Storm Development Concerns**

| County    | Winter Storm Hazard | Building Permits 2004-2006 | Mitigating Factors                                            |
|-----------|---------------------|----------------------------|---------------------------------------------------------------|
| Ward      | Very High           | 470                        | The county and three communities have adopted building codes  |
| McLean    | Very High           | 101                        | Several communities, but not all, have adopted building codes |
| McHenry   | Very High           | 22                         | Three communities have adopted building codes                 |
| McKenzie  | Very High           | 10                         | Two communities have adopted building codes                   |
| Benson    | Very High           | 0                          | Two communities have adopted building codes                   |
| Towner    | Very High           | 0                          | None known                                                    |
| Cass      | High                | 3,076                      | Several communities, but not all, have adopted building codes |
| Williams  | High                | 166                        | Three communities have adopted building codes                 |
| Richland  | High                | 107                        | Several communities, but not all, have adopted building codes |
| Mountrail | High                | 80                         | Two communities have adopted building codes                   |

**Table 4.4.12.7B Winter Storm Development Concerns (continued)**

| County               | Winter Storm Hazard | Building Permits 2004-2006 | Mitigating Factors                                            |
|----------------------|---------------------|----------------------------|---------------------------------------------------------------|
| Sargent              | High                | 34                         | Three communities have adopted building codes                 |
| Mercer               | High                | 21                         | Several communities, but not all, have adopted building codes |
| Ramsey               | High                | 18                         | One community has adopted building codes                      |
| Dunn                 | High                | 16                         | Three communities have adopted building codes                 |
| Sheridan             | High                | 12                         | Two communities have adopted building codes                   |
| Ransom               | High                | 11                         | Two communities have adopted building codes                   |
| Bottineau            | High                | 8                          | One community has adopted building codes                      |
| Pierce               | High                | 7                          | None known                                                    |
| Bowman               | High                | 5                          | None known                                                    |
| Golden Valley        | High                | 5                          | Two communities have adopted building codes                   |
| Renville             | High                | 5                          | Three communities have adopted building codes                 |
| Rolette              | High                | 1                          | None known                                                    |
| <i>Fort Berthold</i> | <i>High</i>         | 0                          | <i>One community has adopted building codes</i>               |

Note 1: Only areas with building permit systems are included. Additional new construction may be occurring in areas lacking building permit regulations. Note 2: 2007 county data is not yet available.

Source: US Census Bureau, 2008.

#### **4.4.12.8 Vulnerabilities to Future Development**

Future development could be impacted by winter storm hazards in those communities lack building codes. Homes and businesses lacking the integrity to hold heavy snow loads could be placed in those areas. Population increases are being seen or are expected in Barnes, Benson, Burleigh, Cass, Grand Forks, Morton, Mountrail, Ransom, Rolette, Sargent, Sioux, and Stark Counties. Rolette and Sioux Counties do not have any jurisdictions that have adopted the state building code. Only small percentages of the populations in Barnes, Benson, Mountrail, and Ransom Counties have adopted the building codes. Future development in those counties that have adopted and enforce the state building code should be better able to withstand extreme winter weather.

#### **4.4.12.9 Data Limitations and Other Key Documents**

Since major winter storms occur frequently in North Dakota, but typically do not always cause significant damages, the biggest data limitation is understanding the magnitude of an event that begins to challenge North Dakota communities. Records outlining the winter weather conditions (snow depth, temperature, wind, snowfall rates, water content, and duration) and the problems (number of accidents, condition of roadways, electric damages, and services needed) would increase the understanding of this hazard. Meteorologists can provide more detail on the atmospheric elements of winter storms.

Other key documents related to the Winter Storm hazard include:

- North Dakota Emergency Operations Plan