

# SEVERE LOCAL STORM

## DEFINITIONS:

**Blizzard** – sustained wind or frequent gusts to 35 mph or greater and considerable falling and /or blowing snow that frequently reduces visibility to less than a quarter-mile.

**El Nino** – a major warming of the equatorial waters in the Eastern Pacific Ocean that occur every three to seven years and are characterized by shifts in the “normal” world-wide weather patterns.

**Front** – a transition zone between two differing air masses.

**Funnel Cloud** – a rotating, funnel-shaped cloud that is not in contact with the ground extending downward from a thunderstorm base.

**Heavy Snow** – accumulations of 4 inches or more of snow in 12 hours or 6 inches or more of snow in 24 hours in non-mountainous areas; accumulations of 8 inches or more of snow in 12 hours **or** 12 inches or more of snow in 24 hours in mountainous areas.

**High Wind** – sustained wind at greater than 40 miles per hour and/or gusts to greater than 58 miles per hour.

**Jet Stream** – strong winds concentrated within a narrow band in the atmosphere between 25,000 and 35,000 feet above the Earth’s surface; the jet stream often “steers” fronts and low pressure systems.

**La Nina** – the phase of the El Nino Southern Oscillation (ENSO) where sea surface temperatures in the Central Equatorial Pacific are cooler than average.

**Severe Local Storm** – an atmospheric disturbance manifested in strong winds, tornadoes, rain, snow, or other precipitation (hail, sleet, ice), and often accompanied by thunder or lightning.

**Severe Thunderstorm** – a storm that produces hail  $\frac{3}{4}$  inch in diameter or larger and/or wind gusts of 58 miles per hour or more.



**Storm Surge** – the abnormal rise in water level caused by onshore wind and pressure forces.

**Surface flooding** – localized flooding that typically occurs in urban areas where existing storm water disposal systems are unable to deal with heavy amounts of rainfall and/or snowmelt and thereby cause flooding of streets, parking lots, and low-lying urban areas.

**Tidal flooding** – localized flooding that can occur in low-lying coastal areas during periods of extreme high tides that occur simultaneously with very low atmospheric pressure and/or high wind events.

**Thunderstorm** – a local storm usually with gusty winds, heavy rain, and sometimes hail and accompanied by lightening.

**Tornado** – a violently rotating column of air attached to a thunderstorm and in contact with the ground.

**Waterspout** – a violently rotating column of air in contact with a body of water and extending from a cumulonimbus cloud; a tornado over water.

### **BACKGROUND INFORMATION:**

The climate of Washington State (as well as Skagit County) is regulated by two primary factors:

1. The strength of the Pacific westerlies, also know as the *jet stream* or the *storm track*.
2. The degree to which mountain barriers influence the flow of maritime and continental air masses.

The westerlies affect the weather of Washington State much of the year, growing stronger as autumn progresses, reaching maximum strength in winter, and subsiding again in spring. In summer, the westerlies are usually very weak and are displaced to the north over Alaska and Canada. Rainfall in the summer is infrequent and temperatures across the state are determined by the extent of marine air mass intrusions from the coast. Typical summer rainfall consists of showers and associated thunderstorms – especially over the Cascades and into Eastern Washington. The amount of shower activity is dependent upon the degree to which hot air masses with *monsoon* moisture work their way north from the desert southwest.

The strength, position, and orientation of the westerlies can change from year to year. This is the reason some winters are mild and comparatively dry, while others are cold and wet. The semi-permanent winter low-pressure system in the Gulf of Alaska and the westerlies are also influenced by factors such as El Nino and La Nina. Winter rains can begin early in the autumn of last well into spring depending upon how the Pacific storm track behaves. When the westerlies “sag” south of Washington State, cold, dry wintertime continental air masses can sometimes affect the entire state. It is during the transition period between cold, dry weather patterns and milder, wetter weather patterns when the lowlands of Western Washington experience snow.

Skagit County can experience all types of severe weather except hurricanes, although on occasion, winter windstorms exceed hurricane force winds. While there have not been any documented tornado sightings in Skagit County, there have been five tornado sightings in Snohomish County since 1970. In 1997, there were 14 documented tornado sightings in Washington State. On average, Skagit County experiences less than 10 thunderstorm days each year.

Most storms move into Skagit County from the Pacific Ocean with a southwest to northeast airflow. On occasion however, wind and snow events move into the county from the north accompanied by cold, arctic air. Windstorms with sustained winds of 50 miles per hour or greater occur with some regularity and are powerful enough to cause significant damage. Most of these storms cause transportation-related problems and damage to utilities. On occasion, homes and other structures are damaged either by high winds or falling trees.

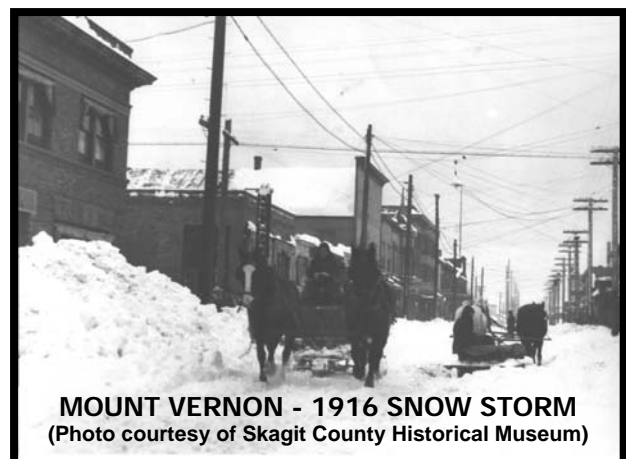
Due to its geographical position between the waters of Puget Sound and the Cascade Range, Skagit County experiences all types of weather events, especially damaging wind and rain events. Furthermore, the Olympic Mountains and the Vancouver Island Range, in addition to local hills and valleys, can generate variable wind patterns and locally accelerated winds. Likewise, the eastern portion of Skagit County can also experience locally accelerated winds due to the narrowing of the river valley and the close proximity to mountain passes. The Cascade Range located to the east, forms a natural barrier to moisture-laden marine air masses resulting in regular rainfall events as these air masses rise in elevation and pass over the mountains.

Recently, there has been much discussion regarding the subject of climate change and the effects the melting of glaciers at the north and south poles and the warming of ocean water may have on costal communities. It is widely accepted that climate change will result in a rise of sea water levels. In October, 2005, The University of Washington Climate Impacts Group published "*CLIMATE CHANGE AND ITS EFFECTS ON PUGET SOUND*" which estimates a possible rise in local sea level of approximately 0.4 meters by 2050 to 2080 as a result of both the warming of ocean waters (which causes thermal expansion) as well as the melting of glaciers, small ice fields, and polar ice sheets. This estimate is supported by research conducted under the sponsorship of the United Nations and published in the Global Environmental Outlook GEO 4 environment for development, United Nations Environment Programme, 2007.

There is currently much debate regarding climate change, especially pertaining to the uncertainty of how soon (and to what extent) climate change will adversely affect shoreline communities. While climate change and the subsequent rise in sea level may someday significantly affect Skagit County, the mitigation strategies contained within this plan do not take future climate change (and its effects) into account.

## **HISTORY:**

While there have been many severe storms that have impacted Skagit County in the past, a few of the most notable storms to affect Skagit County were the 1916 Snowstorm, the 1950 Snowstorm, the 1962 Columbus Day Windstorm, the 1990 Arctic Blast Windstorms, the 1993 Inauguration Day Storm, a series of snowstorm and windstorm events in December 1996 and January 1997, and a series of windstorm events in December 2000. A more complete listing of severe storm events is described below.



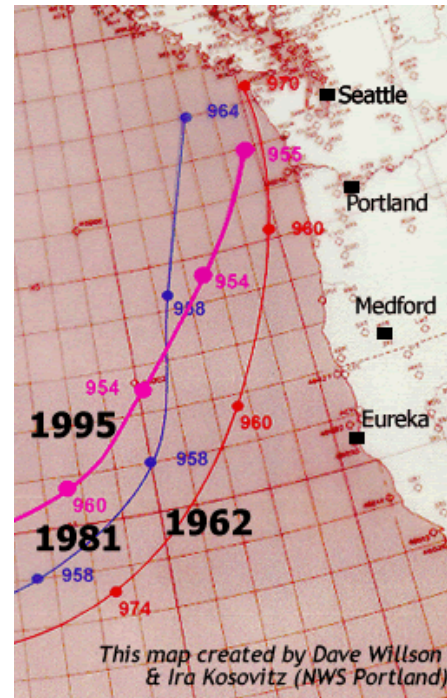
- February 1916 – Snow: Heavy accumulations of snow fell throughout western Washington with accumulations of approximately 4 feet in the western portion of Skagit County. This snow event was followed by very cold temperatures causing many lakes and even the Skagit River to freeze over.



- January 1950 – Snow: Heavy accumulations of snow fell throughout western Washington with accumulations of 3 to 4 feet in the western portion of Skagit County with deeper drifts.
- October 1962 – Wind: Columbus Day Windstorm affected areas from northern California to British Columbia and is the windstorm all others since are compared to. Recorded wind gusts between 88 and 150 miles per hour were recorded in Washington State; damage in Skagit County ranged from broken windows to collapsed barns.

- February 1979 – Wind: A series of windstorms caused damage throughout western Washington including Skagit County and in some areas caused more damage than the Columbus Day Windstorm due to sustained winds of 25 to 30 miles per hour over a long period of time.

- December 1990 – Wind: A series of arctic-air windstorms caused damage throughout western Washington including \$12,013,257 in public and private damage in Skagit County (FEMA Disaster #896). Thousands of trees were downed in the western portion of Skagit County, mostly on Samish Island, Guemes Island, and in the Anacortes/Fidalgo Island area and large areas of the county were without electrical power for several days. Several homes and vehicles were damaged due to downed trees and 1 person was killed when a tree hit the vehicle the victim was driving.



THE MAP ABOVE SHOWS THE STORM TRACKS AND STORM PRESSURES OF THREE SEVERE STORMS THAT HAVE STRUCK THE

- January 1993 – Wind: Inauguration Day Windstorm caused damage throughout western Washington including Skagit County. While Skagit County received less damage than other areas, large areas of the county were without electrical power for several days.

- December 1996 & January 1997 – Snow & Wind: Heavy accumulations of snow fell throughout western Washington including Skagit County over several days with depths of 2-3 feet in the western portion of the county and depths of 4-5 feet in the eastern portion of the county followed several days later by high winds and rain. Many roads were impassable and road and street crews worked 24-hour days to plow snow. Damage to barns, other agricultural buildings, and commercial greenhouses exceeded 3 million dollars and many residential carports, unattached garages, and storage buildings were destroyed. Marinas in Skagit County received over 1.7 million dollars in damage to docks and roofs and 30 private boats were damaged due to collapsed marina roof structures. The total amount of public and private damage in Skagit County was \$6,245,145 as a result of these events (FEMA Disaster #1159).
- December 2000 – Wind: A series of windstorms with gusts between 60 and 90 miles per hour in the western portion of the county downing trees and power lines and damaging numerous agricultural buildings and barns.
- February 2006 – Wind: A severe low pressure weather event accompanied by high winds and coinciding with high tide created a 100-year tidal surge event within the Town of La Conner and the Swinomish Indian Tribal Community. This event caused damage to homes and other structures adjacent to shorelines on Fidalgo Island and caused a break in the dike along Sullivan Slough in La Conner (FEMA Disaster #1682).
- November 2006 – Wind: A sustained windstorm with high peak gusts caused significant blow-down of large trees on southeast Fidalgo Island, in the vicinity of the Swinomish Indian Reservation, blocking roads and access within the Reservation for 2-3 days and downing power lines. The combination of loss of power and blocked roads for an extended period forced some temporary relocation of residents to emergency shelters.
- December 2007 – Wind and Snow: A series of windstorms in the western portion of the county caused damage to the Skagit County dock at Sinclair Island. Warming temperatures caused an avalanche in eastern Skagit County damaging a Skagit County bridge on the Cascade River Road (FEMA Disaster #1734).

## **HAZARD IDENTIFICATION:**

The effects upon Skagit County resulting from a severe storm such as a thunderstorm, tornado, windstorm, ice storm, or snowstorm are likely to be similar in nature. Downed trees and power lines, the interruption of transportation routes, and damage to homes, businesses, and governmental buildings are all possible. Fatalities as a result of such events are uncommon in Skagit County, but they can occur.

Electrical power outages are common with almost all types of severe storm events. Possible problems may be loss of heat, refrigeration, light, cooking, computers, cash registers, gasoline pumps, restaurant cooking, milking machines, chicken warmers, and green houses. In addition, persons could be electrocuted by coming in contact with downed electrical lines.

**High Wind:** Possible hazards or problems may be loss of power and phone lines, danger of fire and electrocution. Toppled trees, broken limbs, collapsed barns, damage to residential and

commercial structures as well as damage to cars, trucks and trailers. Shipping and water vessel transportation may be stopped due to high waves; ferry transportation to Guemes Island may also be stopped. Extremely violent wind storms could cause damage to large areas of the industrial forest resulting in economic losses.

**Lightning:** Hazard areas may be sports venues and complexes such as soccer fields, football fields, baseball fields and golf courses that are without adequate shelter for participants and spectators. Lightning may cause electrical transformers to short resulting in power outages and/or fires in trees located near power lines. Boaters and those persons working outdoors are also vulnerable to lightening strikes.

**Snow and/or Ice:** The majority of problems associated with heavy accumulations of snow and/or ice will most likely be transportation related. Vehicle travel on roadways may be stopped or severely limited; essential government services and businesses may be closed because employees are unable to drive to work. Special transportation may need to be provided in order to insure that hospital and emergency services personnel can report to work. There is a danger to the traveling public who may become trapped in their vehicles for an extended period of time. The weight of heavy accumulations of snow and/or ice may cause roofs to collapse and trees to fall causing damage to power lines.

**Tidal flooding:** This type of flooding is usually very localized and can occur in low-lying coastal areas during periods of extreme high tides that occur simultaneously with very low atmospheric pressure and/or high wind events. While Skagit County has experienced tidal flooding events in the past, damage is typically very minimal and is usually limited to isolated beachfront areas.

**Surface flooding:** Like tidal flooding, surface flooding is localized and typically occurs in urban areas where existing storm water disposal systems are unable to deal with heavy amounts of rainfall and/or snowmelt and thereby cause flooding of streets, parking lots, and low-lying urban areas. While surface flooding is a minor problem in Skagit County, the potential for surface flooding will increase as more natural watershed areas are converted to business and housing developments.

***For information regarding river flooding, please refer to the FLOOD portion of this Section.***

**The following list is a compilation of comments and suggestions made by various stakeholders and the public regarding possible problems that could result from a severe storm.**

In addition to damaging homes, businesses, property, and the environment, a severe storm event in Skagit County could potentially result in the following:

- Disrupted and/or damaged transportation routes and systems.
- Disruption of service and/or damage to above-ground utilities.

- Emergency response agencies may be delayed in responding to emergency incidents due to downed trees and utility power poles and lines or unusually heavy accumulations of storm water, snow, or ice.
- Unusually heavy rainfall may cause surface flooding in low lying areas.
- Unusually heavy rainfall could cause landslides and/or debris flows on steep or unstable slopes.

### **VULNERABILITY ASSESSMENT:**

**Severe storms, especially severe wind storms are common in Skagit County during the fall and winter months and all areas of Skagit County are vulnerable to the impacts of severe storms.**

Some storms are more severe and require assistance from a variety of governmental agencies or emergency responders such as: public works, fire service, emergency medical services, search and rescue, and law enforcement in addition to utility company personnel. While local electrical power outages frequently occur during severe storm events, the loss of power is usually only an inconvenience causing minor consequences unless the outage continues for an extended period of time or during a period of extremely cold temperature. Extended electrical power outages occurring during winter months may require the opening of emergency shelters, particularly in cold weather.

Livestock can be vulnerable to all types of winter storms although most large dairy herds have at least limited shelter available. A severe snow event followed shortly thereafter by extremely cold temperatures can have an adverse affect on wild animals and birds due to a lack of sufficient food, water and shelter.

While all of Skagit County is vulnerable to severe storm events, certain shoreline areas are more vulnerable to occasional tidal flooding that can occur with extremely high tides accompanied by strong wind events. Historically, these events have occurred during the winter months with winds from the north thereby most affecting low-lying shoreline areas with northerly exposures. The low-lying shoreline areas listed below are especially vulnerable to tidal flooding:

- Portions of the City of Anacortes and other low-lying areas adjoining and adjacent to Burrows Bay, Rosario Strait, Guemes Channel and Fidalgo Bay.
- Portions of the Town of La Conner adjoining and adjacent to Swinomish Channel.
- Portions of the community of Bay View, Samish Island, the community of Edison, and other low-lying areas adjoining and adjacent to Padilla Bay and Bellingham Bay.
- Portions of Fir Island and other low-lying areas adjoining and adjacent to Skagit Bay.

### **PROBABILITY and RISK:**

Based on past events, there is a **High Probability** of a severe storm event occurring in Skagit County. While the probability of such an event is high, there is a **Low to Moderate Risk** associated with this hazard due to the relatively short duration and localized impacts of such events.

## **CONCLUSION:**

**Of all natural hazards, severe local storms ... especially severe wind storms are the most likely to affect Skagit County. These storms have the ability to cause considerable destruction and can impact the lives of large numbers of people.**

Skagit County experiences nearly every type of weather including wind, rain, drought, snow, fog, extreme heat, hail and thunderstorms. When severe weather events occur, they have the ability to significantly impact Skagit County posing a danger to life and property as well as possible causing economic losses.

Due to the frequency and possible destructive nature of severe storm events, individuals, families, and businesses should be aware of the impacts of a severe local storm and take the necessary actions to prepare themselves, their families, and their businesses before such events occur – not after. Citizens and businesses can prepare for severe storm events just as they plan for floods or earthquakes. To be better prepared for severe storm events, citizens should:

- Have a plan
- Stock extra food, water and other supplies
- Trim trees and limbs away from buildings
- Take advantage of Community Emergency Response Team training
- Purchase and use a NOAA Weather Radio