8.0 OTHER NATURAL HAZARDS

Previous chapters have addressed the natural hazards which pose the greatest risks for the South Whidbey School District's facilities and people. In addition to these hazards, there are other natural hazards which pose less risk to the District. This chapter addresses these other natural hazards.

8.1 Flood

Flood risk exists at a low level at two sites, Bayview School and Langley Middle School. both reside within 0.5 miles of a FEMA flood zone. Both sites are at good elevations and have no flood events recorded in the past 20 years. Apart from storm water management, no action items are planned for this hazard.

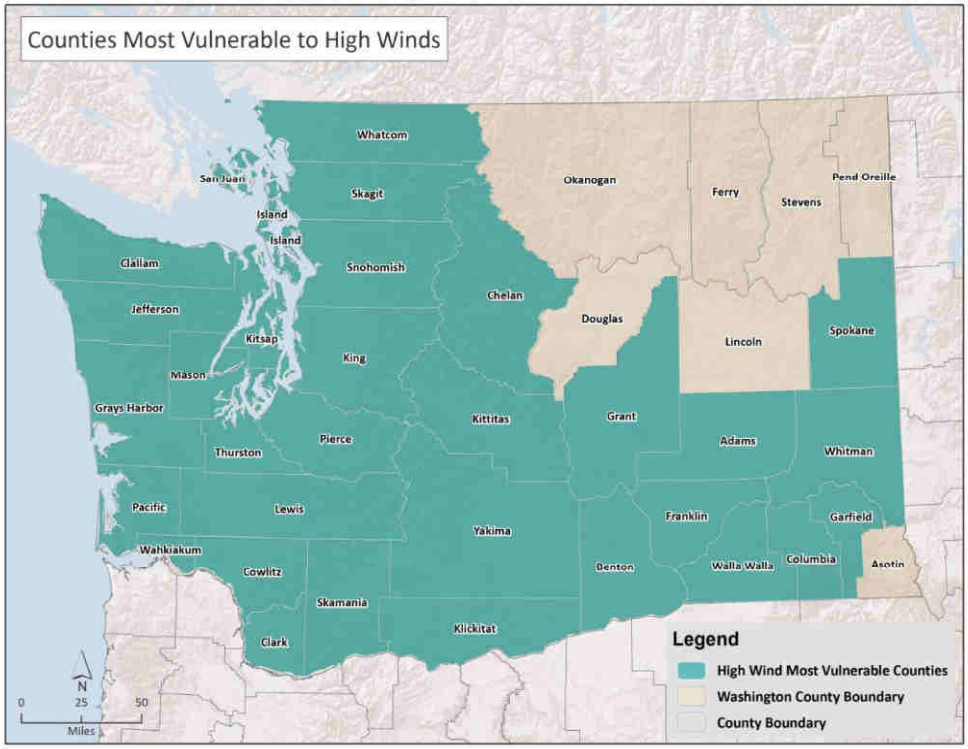
8.2 Severe Weather

Severe weather events are possible throughout Washington State, including: high winds, snow storms, ice storms, thunderstorms, hail and tornadoes. Most such events have relatively minor impacts on K–12 facilities although more severe events may result in significant damages. Of these types of weather hazards, high winds pose the greatest risk to K–12 facilities, although the level of risk for most facilities is much lower than for facilities at high risk from the major hazards addressed in previous chapters.

High Winds

High wind events can occur anywhere in Washington, but the most severe events have occurred on the Pacific Coast and in the Cascades. The following map (Figure 7.1) from the 2013 Washington State Enhanced Hazard Mitigation plan shows that nearly all counties in the state are deemed at significant risk from high wind events.

Figure 8.1
Counties Most Vulnerable to High Winds[1]



The most common impacts from high wind events are loss of electric power from downed overhead power lines due to tree falls or from direct wind forces on power lines. Damage to buildings can range from limited roof damage to major structural damage from wind or from tree falls onto buildings.

More severe events such as the 1962 Columbus Day windstorm result in more widespread damage to vulnerable buildings. Most K–12 facilities will suffer little or no damage in minor to moderate windstorms, with higher levels of damage mostly limited to very severe wind events, especially for the most vulnerable buildings, such as portables, that are not adequately tied down.

Snow and Ice Storms

Numerous snow and ice storms occur in Washington State every year. The principal impacts from severe storms are disruption of electric power from downed overhead lines and disruption of transportation. Severe snow or ice storms result in school closures but rarely result in significant damage to school facilities.

In severe storms, with unusually heavy loading of snow and/or ice, a few very vulnerable buildings may collapse. Most school buildings have been designed for snow loads and thus are unlikely to suffer significant damage except for extreme events with snow and/or ice loads well above the design loads. Districts with older buildings, especially large span buildings, in areas with high annual snowfalls may wish to evaluate some buildings for the capacity to withstand snow and ice loads on the roofs.

Thunderstorms and Hail Storms

Thunderstorms and hail storms occur fairly frequently in Washington State, although the frequency and severity of such events is much lower than in many parts of the United States. Severe thunderstorms may have high enough winds to result in downed overhead electric lines and tree falls with disruptions to utilities and transportation. However, the likelihood of thunderstorms severe enough to result in significant damage to K–12 facilities appears very low.

Hail storms may occur anywhere in Washington but are more common in eastern Washington. Hail storms with large diameter hail may cause significant damage to exposed vehicles and localized damage to some roofs. However, the likelihood of hail storms severe enough to result in significant damage to K–12 facilities appears extremely low.

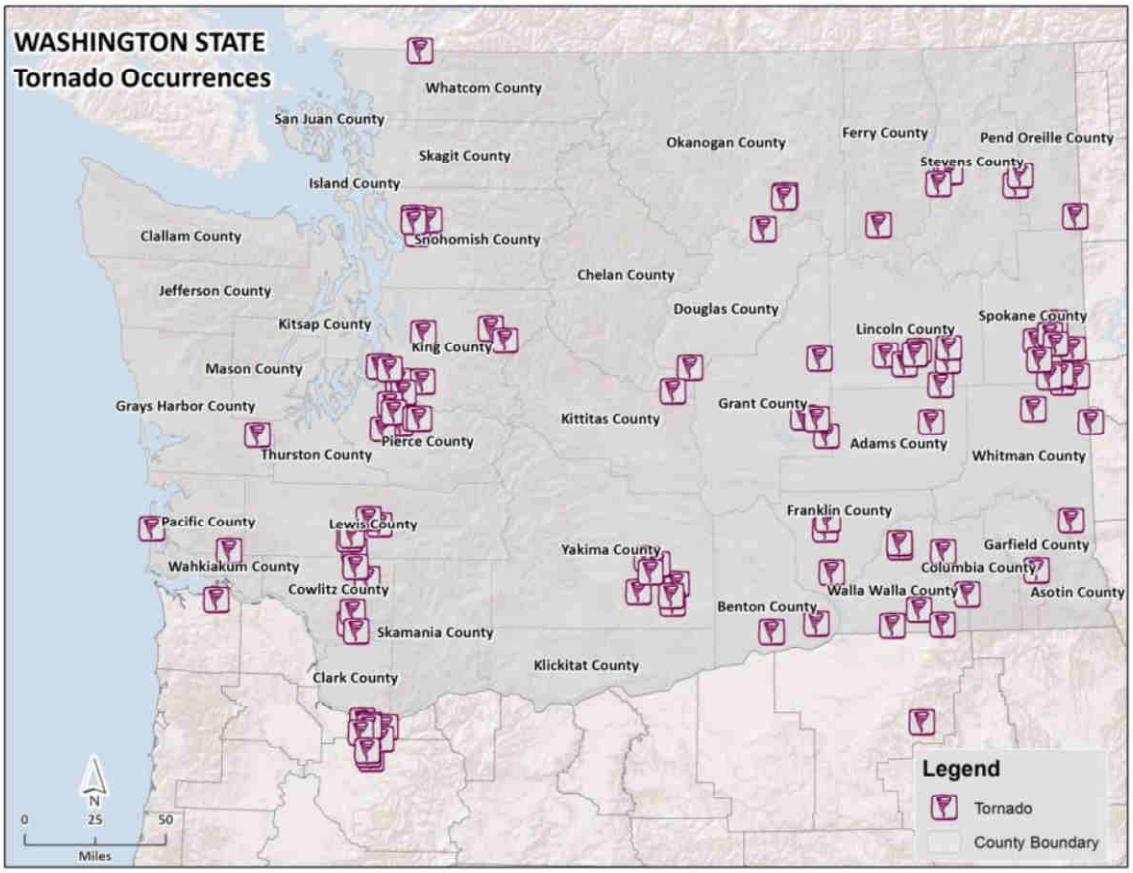
Tornadoes

Between 1954 and 2012, nearly 100 tornadoes have been reported in Washington State, as shown in Figure 7.2 on the following page. The vast majority of these tornadoes were small, F0 or F1, on the Fujita Scale; or, EF-0 or EF-1, on the Enhanced Fujita Scale. Such small tornadoes often result in minor roof damage but do not generally cause significant damage to buildings, and rarely result in significant injuries or deaths.

The most severe tornado outbreak in Washington occurred in April 1972. An F3 tornado hit Vancouver with six deaths, about 300 injuries, and about $50 million in damages. On this same day, there was an F3 near Spokane and an F2 in rural Stevens County.

For K–12 facilities, the risk of significant damage and casualties from tornadoes is very low but not zero. Given the low level of risk, mitigation measures such as building safe rooms are not practical or cost-effective. However, the South Whidbey School District's emergency plan should include identifying the best available safe area in each school if a tornado were to occur. This area should be a small, interior room with the fewest windows, ideally with no windows.

Figure 8.2
Washington State Tornadoes Since 1950[1]



Extreme Temperatures

Extreme cold or extreme heat both pose some risks to students and staff, especially for those that walk or bicycle to/from school. Proactive decisions to close schools are sometimes made for either extreme cold or extreme heat periods. Closures during extreme heat are more likely for schools without air conditioning.

Extreme temperatures also pose some risk to school facilities in several ways:

- Heating and air conditioning systems in schools are more prone to equipment failures at times of extreme demand, such as during periods of extreme temperatures.
- Water pipes in poorly insulated school buildings may freeze during periods of extreme cold, resulting in burst pipes and water damage.
- Utility systems providing electric power and water to schools are more prone to failures during periods of extreme temperatures:

- Electric power systems have more failures during periods of either extreme cold or extreme heat and such power outages may require school closures, depending on the duration of the outage.
- Potable water systems may suffer damage during periods of extreme cold, especially small, rural systems with small diameter water pipes with low water flow rates. Loss of water supply typically necessitates school closures.

Severe Weather Events for the South Whidbey School District

Wind, snow and cold weather are the most likely severe weather events South Whidbey School District will experience. In the last 20 years, the district has experienced damage due to severe weather including the following:

- Minor roof damage due to wind
- Frozen pipes during cold weather
- Roof leaks due to snow buildup
- Electrical equipment failure related to weather related power outages

Following the emergency response plan, drainage inspection plan and winter weather checklist will do much to minimize the negative consequences of severe weather in our district.

For the most part, addressing severe weather is more in the domain of emergency planning than mitigation planning. Emergency planning measures include developing and practicing responses for events that may require shelter in place (such as tornado warnings) or events that may require evacuations (such as power outages, loss of water service, or loss of air conditioning or heating during periods of extreme heat or cold).

Possible mitigation measures for severe weather events include the following:

- High Wind Events
  - Tie-downs for portable buildings.
  - Increased trimming for trees near above ground electric power lines feeding a school or large trees near school buildings.
  - Installing wind-resistant roofing materials for schools in high wind areas or with a history of wind damage to roofs.
- Snow and Ice Storms
  - Increased trimming for trees as for high winds as noted above.
  - Evaluate and possibly retrofit older buildings, especially large span buildings that may have been designed for inadequate snow loads.
- Extreme temperatures
  - Maintain heating and cooling systems in good working order and replace systems near the end of their useful life.
  - Insulate water pipes with a history of freezing or with poor insulation, in locations with frequent extended periods of below freezing temperatures.
- All Severe Weather Events

- Install back-up power systems for selected district facilities, such as those designated as emergency shelters.

8.3 Subsidence

The term "subsidence" refers to the lowering of ground elevations, which may occur gradually over long time periods or very suddenly for several reasons:

- Gradual subsidence which typically occurs from ground water pumping or petroleum extraction,
- Gradual or sudden subsidence from ground failures in locations of historical underground coal mining, and
- Sudden subsidence along the Pacific Coast which will occur from a major interface earthquake on the Cascadia Subduction Zone.

Subsidence at any given location which occurs gradually and smoothly over a large area may be almost imperceptible and have little or no impact on buildings. However, subsidence that is sudden can result in substantial damage to buildings and underground utility lines, especially at soil type boundaries where there may be discontinuities in the extent of subsidence.

For schools located on or near the Pacific Ocean coast, subsidence from an M9.0 earthquake on the Cascadia Subduction Zone will range from approximately 1 meter to 3 meters, depending on location. This level of subsidence will significantly increase flood risk for school campuses at low elevations near the coast and may result in significant building damage if the extent of subsidence varies across a given campus. This type of subsidence may also result in flooding which could block some evacuation routes for locations subject to tsunamis.

None of South Whidbey School Districts facilities are known to be at increased risk from subsistence.

References

1. Washington State Enhanced Hazard Mitigation Plan (2013). Washington State Military Department, Emergency Management Division.

Table 8.1
South Whidbey School District: Other Natural Hazards Mitigation Action Items

Hazard	Action Item	Timeline	Source of Funds	Responsible Party	Plan Goals Addressed			
					Life Safety	Protect Facilities	Enhance Emergency Planning	Enhance Awareness and Education
Other Natural Hazards Mitigation Action Items								
Short-Term #1	Evaluate portable buildings to make sure that they are adequately tied down to resist high winds and implement mitigation measures, if necessary.	1-3 Years	District and Grants	Supt.	X	X		
Short-Term #2	Review and implement district emergency response plan for facilities	On-going	District and Grants	Supt.	X	X	X	X
Short-Term #3	Review and implement winter weather facility checklist.	On-going	District and Grants	Supt.	X	X	X	X
Short-Term #4	Review and update emergency response plan evacuation routes in terms of natural hazards.	On-going	District and Grants	Supt.	X		X	X
Short Term #5	Evaluate each district site and develop plan for tree trimming or removal to better protect facilities from damage due to severe weather.	1-3 Years	District and Grants	Supt.	X	X	X	X