

# Volume II Hazard Annex

## Severe Winter Storm

### Causes and Characteristics of Severe Winter Storms

#### Weather patterns

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting Marion County typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.<sup>273</sup>

The National Climatic Data Center has established climate zones in the United States for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the Pacific Ocean give the state diversified climates. Marion County is in Zone 2 as seen in Figure 1. The climate in Zone 2 generally consists of wet winters and dry summers.<sup>274</sup>

**Figure 1**



Source: Taylor, George H. and Hannan, Chris. *The Oregon Weather Book*, OSU Press (1999).

While snow is relatively rare in western Oregon, the break in the natural Cascades barrier at the Columbia Gorge provides a low-level passage through the mountains. Cold air, which lies east of the Cascades, often moves westward through the Gorge, and funnels cold air into the Portland

<sup>273</sup> Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Salem, OR: Oregon State Police – Office of Emergency Management

<sup>274</sup> National Weather Service, Portland Bureau. March 2001.  
<http://www.wrh.noaa.gov/Portland/snowstorm.html>.

area, and can sink southward into the Willamette Valley. If a wet Pacific storm happens to reach the area at the same time that the cold air is present, larger than average snow events may result.<sup>275</sup> An example of this type of snowstorm event occurred in January 1980, when strong storms, accompanied by snow, ice, wind, and freezing rain hit Oregon statewide. Impacts in the Portland area alone included one fatality; 200,000 customers left without power or phone service for several days; and 125 boats, with a combined value of over \$3 million dollars, sank in the Columbia Gorge.<sup>276</sup>

Ice storms occasionally occur in northern areas of Oregon, resulting from cold air flowing westward through the Columbia Gorge. Like snow, ice storms are comprised of cold temperatures and moisture, but subtle changes can result in varying types of ice formation, including freezing rain, sleet, and hail. Freezing rain can be the most damaging of ice formations. While sleet and hail can create hazards for motorists when it accumulates, freezing rain can cause the most dangerous conditions within a community. Ice buildup can bring down trees, communication towers, and wires creating hazards for property owners, motorists, and pedestrians alike. The most common freezing rain problems occur near the Columbia Gorge, but also pose a hazard to Marion County. As noted above, the Gorge is the most significant east-west air passage through the Cascades. Rain originating from the west can fall on frozen streets, cars, and other sub-freezing surfaces, creating dangerous conditions.<sup>277</sup>

## History of Severe Winter Storms in Marion County

Destructive storms, producing heavy snow and ice, have occurred throughout northwestern Oregon's history. The most significant storms which have affected Marion County are listed below.

### December 1892

From December 20 to 23, 1892, substantial snow fell across most of northern Oregon, with the greatest snowfall reported over northwestern Oregon, where storm totals ranged from 15 to 30 inches.<sup>278</sup>

### January 1916

This winter storm affected the entire state. On January 6 through January 10, heavy snow fell in mountainous areas. During the second storm of January 11 through 15, every reporting station in western Oregon, except for the southwestern interior and the coastal areas, recorded storm totals of at least

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<sup>275</sup> National Weather Service, Portland Office.

[www.wrh.noaa.gov/Portland/snowstorm.html](http://www.wrh.noaa.gov/Portland/snowstorm.html).

<sup>276</sup> Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

<sup>277</sup> Ibid.

<sup>278</sup> Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

five inches and most locations had eight inches or more. McMinnville had the most snow in one day, with eleven inches falling on January 12. Higher elevations in the Cascades received very heavy snowfall.<sup>279</sup>

## December 1919

The December 1919 snowstorm was recorded as the third heaviest snowfall-producing storm in Oregon. The Columbia River froze over, closing the river to navigation from the confluence with the Willamette River upstream. The snowstorm affected nearly every part of the state, with heavy snow falling over a widespread area.<sup>280</sup>

## December 1924

In December 1924, temperatures stayed near or below the freezing mark for eleven days. At the time it was the coldest December ever in Oregon. Most streams and rivers were frozen and blocked with ice. People drove their automobiles across the Willamette River.<sup>281</sup> In addition to the cold weather, four inches of snow fell over much of the Willamette Valley. The weight of the snow downed 400 telephone lines in Salem, and this weather event caused 21 car accidents in Salem.<sup>282</sup><sup>283</sup> The freezing temperatures formed ice in the Willamette River that crushed a steamboat and caused several thousand dollars of damage to the Dennison Bath House.<sup>284</sup>

## January 1937

The storms that hit Marion County in January 1937 broke an eighteen year record for snowfall in Salem with 27 inches and caused \$50,000 in property damage. Much of the damage occurred as structures collapsed from the weight of the snow. For example, in Salem, four storefront marquees collapsed, a shed fell on five vehicles in a lumberyard, the Salem Ferry Street Tabernacle collapsed and six structures at the Marion County Fairgrounds were damaged.<sup>285</sup> In addition to property damage, many major roads were closed and residents of Detroit and Mill City were stranded for five days as heavy snow and a landslide blocked a connecting highway.<sup>286</sup>

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<sup>279</sup> State of Oregon Natural Hazards Mitigation Plan. August 2004. Available on the World Wide Web

[http://csc.oregon.edu/pdr\\_website/projects/state/snhmp\\_web/index.htm](http://csc.oregon.edu/pdr_website/projects/state/snhmp_web/index.htm)

<sup>280</sup> Ibid.

<sup>281</sup> Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

<sup>282</sup> *The Oregon Statesman*, December 17, 1924: page 3.

<sup>283</sup> *The Oregon Statesman*. December 16, 1924: page 1.

<sup>284</sup> *The Oregon Statesman*. December 25, 1924: page 1.

<sup>285</sup> National Weather Service, Portland Office.

[www.wrh.noaa.gov/Portland/snowstorm.html](http://www.wrh.noaa.gov/Portland/snowstorm.html).

<sup>286</sup> *Oregon Statesman*. February 4, 1937. No. 270, page 1.

## January 1950

The entire month of January 1950 was cold and frequent snowstorms occurred statewide. Snowfall and precipitation including freezing rain was heaviest from January 9<sup>th</sup> through the 18<sup>th</sup>.<sup>287</sup> During this time, Marion County experienced wind gusts up to 80 mph and sustained winds up to 25 mph.<sup>288289</sup> Thirty-nine inches of snow fell on Salem over the course of the month, 54 inches fell in Detroit and 122 inches blanketed Detroit Dam.<sup>290291</sup> In Salem, Mill Creek flooded onto airport roads and in Detroit, a rod-and-gun club's roof collapsed under the weight of 20 inches of snow. The severe weather caused power outages in Mt. Angel and cut telephone service in Silverton. Schools throughout the county were sporadically closed and at least two weather-related traffic fatalities occurred in Oregon, one in Lyons.

## January 1957

The cold weather in January 1957 was the result of an arctic air mass that moved into Eastern Oregon and spread west toward the coast. The cold temperatures brought four inches of snow to Lyons and eleven inches to Detroit, as well as icy roads throughout Marion County.<sup>292</sup> Temperatures in Marion County during this seven-day period were in the mid-teens, not considering the wind-chill created by 21 mph wind gusts. The cold snap cut electricity for 100 Salem residents and froze water pipes in many homes.<sup>293</sup> Dozens of fires were reported in Salem from overheated chimneys and stoves, or from blowtorches used to thaw pipes. The cold temperatures also caused the Bonneville Power Authority to cut interruptible power to the regions' industrial customers because ice behind the dam slowed water flow and limited the ability to generate power.<sup>294</sup>

## March 1960

The first week of March 1960 was marked by a winter storm that brought more snow to Marion County than any time since 1950. Salem received 8.5 inches of snow and higher elevations received as much as 11 inches.<sup>295</sup> This storm was responsible for two fatalities in Oregon, and 100 storm-related

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<sup>287</sup> National Weather Service, Portland Office.

[www.wrh.noaa.gov/Portland/snowstorm.html](http://www.wrh.noaa.gov/Portland/snowstorm.html).

<sup>288</sup> Oregon Statesman. January 14, 1950: No.316, page 1.

<sup>289</sup> Oregon Statesman. January 10, 1950: No. 308, page 1.

<sup>290</sup> Oregon Statesman. January 27, 1950: No.307, page 1.

<sup>291</sup> National Weather Service, Portland Office.

[www.wrh.noaa.gov/Portland/snowstorm.html](http://www.wrh.noaa.gov/Portland/snowstorm.html).

<sup>292</sup> The Oregon Statesman. January 25, 1957: page 1.

<sup>293</sup> Oregon Statesman. January 27, 1957: page 1.

<sup>294</sup> Oregon Statesman. January 28, 1957: No. 307, page 1.

<sup>295</sup> Oregon Statesman. March 4, 1960: No. 342, page 1.

accidents in Marion County. In addition, most schools throughout the county were closed for several days.<sup>296</sup>

### **January 1963**

Cold temperatures and snow showers created hazardous driving conditions in Marion County during the last days of January 1963. Four inches of snow were recorded at McNary Field in Salem, Detroit recorded thirteen inches and Stayton reported that slush had frozen on area roadways.<sup>297</sup>

### **January 1978**

During the early days of January 1978, a layer of cold air was driven into the Willamette Valley from Eastern Oregon via the Columbia Gorge. Rain from a higher warm air mass fell through the cold air below causing it to freeze. The cold temperatures and freezing rain iced roads throughout Marion County and the Willamette Valley causing eight traffic fatalities and dozens of traffic accidents.<sup>298</sup>

### **February 1989**

The February 1989 storm dropped seven inches of snow on Marion County and saw temperatures as low as zero degrees Fahrenheit with a wind-chill factor dipping to 75 degrees below zero. The storm led to accidents on Interstate 5 that closed the highway between Salem and Albany. Near Woodburn, an overturned truck spilled 1,000 gallons of oil. There was also a storm related, four-vehicle accident on Highway 22 near Silverton. Hospitals in Salem reported 25 snow related injuries. The Oregon Department of Transportation estimated \$25,000 in additional costs were necessary for wages and supplies to deal with the storm's effects.<sup>299,300,301</sup> In Salem, the adverse weather cost \$40,000 to keep streets open, \$10,000 more than the city budgeted for the storm.<sup>302</sup> In addition, the extreme cold damaged 20 to 40 percent of the county's cranberry crop, forced mills to send home thousands of employees, and froze or burst 200 Salem residents' water pipes.<sup>303,304,305</sup>

### **February 1993**

This storm event dropped nearly twelve inches of snow in Salem between February 18<sup>th</sup> and 19<sup>th</sup>; the greatest amount of snowfall ever recorded in a 24-hour period in Salem. As a result of the storm 2,100 Silverton area residents

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<sup>296</sup> Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

<sup>297</sup> *The Oregon Statesman*. January 29, 1963: No. 308, page 1.

<sup>298</sup> *The Oregon Statesman*. January 3, 1978: Vol. 127, No. 195, page 1.

<sup>299</sup> *Statesman Journal*. February, 3, 1989: page 2.

<sup>300</sup> *Statesman Journal*. February 4, 1989: page 2.

<sup>301</sup> *Statesman Journal*. February 2, 1989: page 1.

<sup>302</sup> *Statesman Journal*. February 9, 1989: page 2.

<sup>303</sup> *Statesman Journal*. February 8, 1989: page 2c.

<sup>304</sup> *Statesman Journal*. February 9, 1989: page 1, 2.

<sup>305</sup> *Statesman Journal*. February 4, 1989: page 1, 4.

and 1,500 residents on Highway 99E north of Salem lost power. There were also several minor, storm-related injuries reported by Salem hospitals.<sup>306</sup>

## February 1996

Similar to the 1978 event, this storm began with a mass of cold air trapped in western Oregon followed by a warmer front that blew over the top of the cold air mass. Once the two fronts collided, they created a severe ice storm. Traffic accidents and power outages plagued the Willamette Valley. Freezing rain fell for two days, causing a 100-car pileup between Clackamas County and Salem, and a 22-car pile-up on Highway 22 near Eola. One fatality occurred in a different traffic accident.<sup>307,308</sup>

## December 2003 – January 2004

The winter snowstorm that blew through northwest Oregon at the end of December turned into an ice storm in January.<sup>309</sup> According to state climatologist George Taylor, snowstorms that swept through the region beginning December 26, 2003, resulted in the snowiest, coldest winter since 1992-3. The storm resulted from the collision of a mass of moisture from the Pacific with an arctic cold front. Climatologists considered this the worst storm to pelt the west side of Oregon's Cascade Range since 1992. According to the National Weather Service, Salem received three inches of snow on January 6<sup>th</sup>. The storm's impact at Portland International Airport had thousands of passengers stranded for several days after the freezing rain cancelled flights. The runway conditions were among the worst in recorded history.<sup>310</sup>

The hardest hit areas are the eastern and southern sections of the service territory, including east Multnomah County, Oregon City, Estacada, Molalla and Mulino, and the Salem area.<sup>311</sup> Champoeg State Heritage Area lost historic trees i.e., oaks estimated to be around 200 years old. During the winter storm, campers at the Heritage Area were trapped for a day because trees fell across the road, and park staff could not get to the park.<sup>312</sup> The Heritage Area qualified for FEMA funding, and it took four to five months to make repairs.<sup>313</sup> Fir and filbert trees were decimated at Willamette

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<sup>306</sup> Statesman Journal. February 20, 1993: page 1.

<sup>307</sup> The Oregon Statesman. February 4, 1996: page 1.

<sup>308</sup> Taylor, George H. and Chris Hannan. 1999. The Oregon Weather Book. Corvallis, OR: Oregon State University Press.

<sup>309</sup> "Storm Leaves Northwest in a Standstill." January 7, 2004. KATU News. Available on the World Wide Web

<http://www.katu.com/news/story.asp?ID=63527>.

<sup>310</sup> "Some Areas Thawing, While Others Remain Icy." KATU News. January 8, 2004. Available on the World Wide Web

<http://www.katu.com/news/story.asp?ID=63532>.

<sup>311</sup> Ibid.

<sup>312</sup> Wylie, Dennis. Park Manager, Champoeg State Heritage Area. Personal Interview. November 5, 2004.

<sup>313</sup> Ibid.

Mission State Park, but walnut trees withstood the storm.<sup>314</sup> Willamette Mission State Park suffered over \$30,000 in damage.<sup>31</sup>

For the Cascades, this storm was a typical storm (versus on the valley floor where it was severe), although residents in the Santiam Canyon experienced problems with services (e.g., gas stations and stores closed) and power (e.g., disruption in electricity service). In the Cascades, a severe winter storm means that typically four to five feet of snow falls in a short period of time.

## January-February 2008

Over several weeks in early 2008, the foothills of eastern Marion County received unusually high amounts of snow from a series of storms. While the Marion County towns of Idanha and Detroit commonly receive heavy snowfall each winter, they were both buried by 12 feet of snow over these two months.<sup>315</sup> Three dozen National Guard soldiers, along with snow removal equipment, inmate crews, and engineers, were sent by the State into the towns to remove snow and help those in need.<sup>316</sup>

## December 2008

A prolonged snowstorm hit the region during the 2008-2009 winter season, with its worst effects felt from December 20-26, 2008. During this time, Salem received over a foot of snow. Lafayette, near the border of Marion County received almost two feet of snow, while Portland airport received a record 18.9 inches.<sup>317</sup><sup>318</sup> A disaster for this snowstorm, and its associated landslides and mudslides, was declared on March 2, 2009. Per capita damages for Marion County were estimated at \$43.94.<sup>319</sup>

# Risk Assessment

## How are Hazard Areas Identified?

All of Marion County is vulnerable to winter storms and impacts typically extend region-wide. The magnitude or severity of severe winter storms is determined by a number of meteorological factors including the amount and extent of snow or ice, air temperature, wind speed, and event duration.

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<sup>314</sup> Timmons, Eric. Park Manager, Willamette State Park Management Unit. Personal Interview. November 9, 2004.

<sup>315</sup> "Region 3: Mid/Southern Willamette Valley Regional Profile. January 2009.

<sup>316</sup> "Oregon National Guard Aids Detroit and Idanha Communities." February 5, 2008.

[http://salem-news.com/articles/february052008/guard\\_detroit\\_2-5-08.php](http://salem-news.com/articles/february052008/guard_detroit_2-5-08.php)

<sup>317</sup> "Some of Area's Snowstorms." National Weather Service, Portland Office.

<http://www.wrh.noaa.gov/pqr/paststorms/snow.php>

<sup>318</sup> "Public Information Statement." National Weather Service Portland Office.

<http://www.wrh.noaa.gov/pqr/paststorms/200812/pns3.txt>

<sup>319</sup> "Oregon Severe Winter Storm, Record and Near Record snow, landslides and mudslides." FEMA Disaster Information.

<http://www.fema.gov/news/event.fema?id=11189>

Precipitation, an additional element of severe winter storms, is measured by gauging stations. The National Weather Service, Portland Bureau, monitors the stations and provides public warnings on storm, snow, and ice events as appropriate.

## **Probability of Future Occurrence**

Marion County has experienced 17 severe winter storms in the last 120 years, in the form of snow, ice or severe cold. This averages out to one severe winter storm every 7 years. The Marion County steering committee determined that the county's probability of a severe winter storm is **high**, meaning that Marion County will likely experience one winter storm within a 10-35 year period. This high probability ranking is consistent with the 2006 Marion County Hazard Analysis.

## **Vulnerability Assessment**

Severe winter storms can cause power outages and transportation and economic disruptions, and pose a high risk for injuries and loss of life. The events can also be typified by a need to shelter and care for adversely impacted individuals. Marion County has suffered severe winter storms in the past that brought economic hardship and affected the life and safety of residents. Future severe winter storms may cause similar impacts countywide.

The Marion County steering committee determined that the county's vulnerability to a severe winter storm is **high**, meaning more than 10% of the population or regional assets would be impacted by a severe winter storm. This high rating is consistent with the 2006 Marion County Hazard Analysis.

## **Risk Analysis**

A risk analysis estimating the potential loss of life and property from a winter storm in Marion County has not been completed at this time. However, given the high probability of a winter storm occurring and the county's high vulnerability, a risk analysis should be completed when data is available (see Multi-Hazard Action # 8).

## **Community Hazard Issues**

### **What is susceptible to damage during a hazard event?**

Severe winter weather can be a deceptive killer. Winter storms which bring snow, ice and high winds can cause significant impacts on life and property. Many severe winter storm deaths occur as a result of traffic accidents on icy roads, heart attacks while shoveling snow, and hypothermia from prolonged exposure to the cold. The temporary loss of home heating can be particularly hard on the elderly, young children and other vulnerable individuals.

Property is at risk due to flooding and landslides that may result if there is a heavy snowmelt. Additionally, ice, wind and snow can affect the stability of

trees, power and telephone lines and TV and radio antennas. Down trees and limbs can become major hazards for houses, cars, utilities and other property. Such damage in turn can become major obstacles to providing critical emergency response, police, fire and other disaster recovery services.

Severe winter weather also can cause the temporary closure of key roads and highways, air and train operations, businesses, schools, government offices and other important community services. Below freezing temperatures can also lead to breaks in uninsulated water lines serving schools, businesses, and industry and individual homes. All of these effects if lasting more than several days can create significant economic impacts for the communities affected as well for the surrounding region, and even outside of Oregon. In the rural areas of Oregon severe winter storms can isolate small communities, farms and ranches and create serious problems for open range cattle operations such as those in southeastern Oregon. Bedroom communities such as Silverton, Stayton, Elkhorn and Breitenbush are particularly vulnerable to isolation from severe winter storms.

Winter storms can have significant impacts to the local economy. Early and late season extreme cold can damage agricultural crops, while snow and ice can block access for the distribution of crops and provision of agricultural services. Also, a lack of access to employment centers, like correctional facilities, the state mental hospital, Willamette University, and the city of Salem, can have detrimental economic impacts.

## **Existing Mitigation Activities**

The Road Department applies anti-icing agents as a precautionary measure. When a storm occurs and at times when an ice storm is anticipated, the Road Department sands the county's paved roads.

The City of Salem maintains a record of all homes with disabled residents.

Marion County Emergency Management has information for the public on how to prepare for winter storms and steps residents and businesses can take to prevent damage to future winter storms.

Marion County has adopted the International Building Code which sets standards for structures to withstand heavy snow and ice loads.

## **Severe Winter Storm Mitigation Action Items**

The following actions have been identified by the Marion County steering committee, and are recommended for mitigating the potential effects of winter storms in Marion County. Please see full action item worksheets in Appendix A.

**WS1:** Assure a sufficient supply of sand and anti-icing agent to use on priority and secondary transportation routes for a minimum of one major winter storm each year.

