



Office of the Washington State Climatologist

February 4, 2009

Rain and Flooding

Extreme flooding occurred in Washington in early January, caused by heavy precipitation and warm temperatures. Warm, moist air from the Pacific Ocean near Hawaii, known as a pineapple express, brought heavy rainfall to western Washington on January 6th and 7th. 72-hr rainfall totals, from 4 am on January 5th through 4 am on January 8th, are shown for various locations in western WA in Table 1. The heaviest

precipitation was over the Olympics, the Cascades, and the Southwest Interior.

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Figure 1: Looking over flooded NE 124th St near Duvall, at a bridge that is supposed to cross the Snoqualmie River (photo taken by Reid Wolcott*).

In addition to the heavy rainfall, warm temperatures that melted snow still on the ground from December are what made this a significant flooding event. Rivers across the state crested above flood stage, and two record crests were reported. The Snoqualmie River near Carnation crested at 62.31 ft, breaking the old record of 61.17 ft made in November 2006, and the Stillaguamish River near Arlington was recorded flowing at 50,300 cubic feet per second (cfs), breaking the old record of 44,000 cfs made in October 2003. Many other rivers had near record crests, and the damage was widespread. Figure 1, courtesy of Reid Wolcott, was taken on NE 124th Street near Duvall and pictures a flooded roadway and bridge that normally crosses the Snoqualmie River.

Impacts on humans were severe, with a total of 21 counties and 14 cities declaring emergencies throughout the entire flooding event. Evacuations were ordered, and shel-

ters were opened in all of the counties that declared an emergency. Major highway road closures were reported, and Interstate-5 was closed for a 20-mile stretch in Chehalis (King TV - 1/8/09). The three major highways that cross the Cascades closed because of the threat of landslides and avalanches, Amtrak service was cancelled between Seattle and Portland, and commuter trains were cancelled between Seattle and Tacoma (Seattle Times - 1/8/09). According to the Department of Natural Resources, 593 major and minor landslides resulted from the January rain event, mostly in western WA. In Spokane, the National Guard was activated on January 6th to help clear snow from the rooftops in preparation for the heaviest rain to avoid collapsing roofs.

Damage is estimated to total \$96 million across the state, and the estimated damage for each county is shown in Figure 2 (Washington State Emergency Management Division*). The estimated \$28 million in King County is much higher than the other counties.

| Station | 72-hr Total (inches) | Station | 72-hr Total (inches) |
|------------------------|----------------------|----------------------|----------------------|
| Shelton | 7.66 | Sea-Tac Airport | 3.57 |
| Olympia Airport | 6.58 | Bellingham | 3.23 |
| Quillayute Airport | 5.59 | Renton | 2.61 |
| Tacoma Narrows Airport | 5.20 | Seattle Boeing Field | 2.03 |
| Hoquiam Airport | 5.10 | Port Angeles | 1.98 |
| Fort Lewis | 4.89 | Friday Harbor | 1.61 |
| Tacoma Air Force | 4.87 | Whidbey Island | 1.54 |
| Kelso-Longview | 3.84 | Everett | 1.04 |
| Bremerton | 3.67 | Vancouver Pearson | 0.78 |

Table 1: Total 72-hour precipitation (inches) for selected Washington locations from 4 am PST on January 5th to 4 am PST on January 8th.

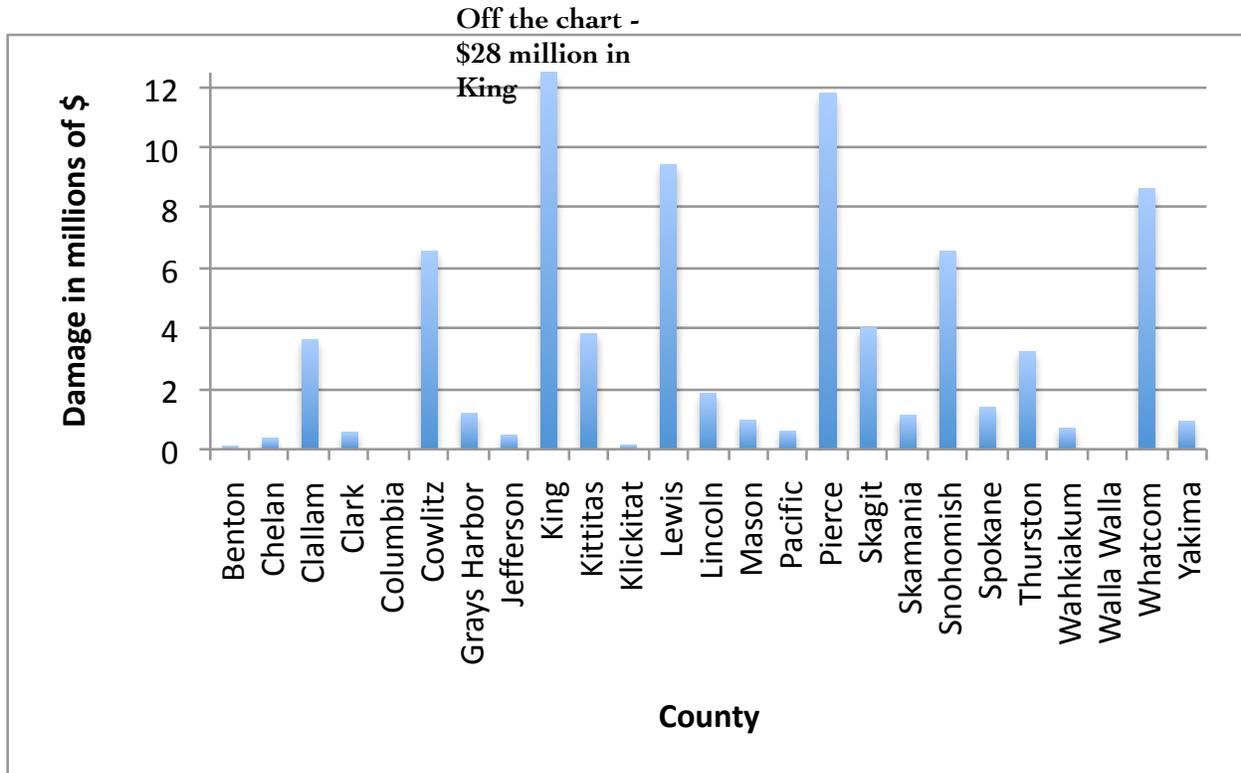


Figure 2: Estimated cost of damage from the January flooding from the Washington State Emergency Management Division. Note the estimated \$28 million in damages for King County that is off the chart.

January Temperature Inversion

A high pressure system settled over the state on the 12th and didn't budge. While offering a relief from the rain, the persistent high pressure and a strong temperature inversion caused air stagnation warnings, high pollution, fog, and freezing fog across the state for a series of days. The inversion, or the lower atmospheric layer where temperatures increased with height, stuck around until the 24th and caused some unseasonably warm temperatures at higher elevations. The Snotel plot pictured below (Figure 3) for the 2009 water year in Paradise, WA, shows warm temperatures (red curve) in the 50s and 60s in mid-January which are well above the normal temperatures (orange curve). Temperatures at lower elevations were much cooler at this time, in the the 30s and 40s - showing the strong temperature inversion at work!

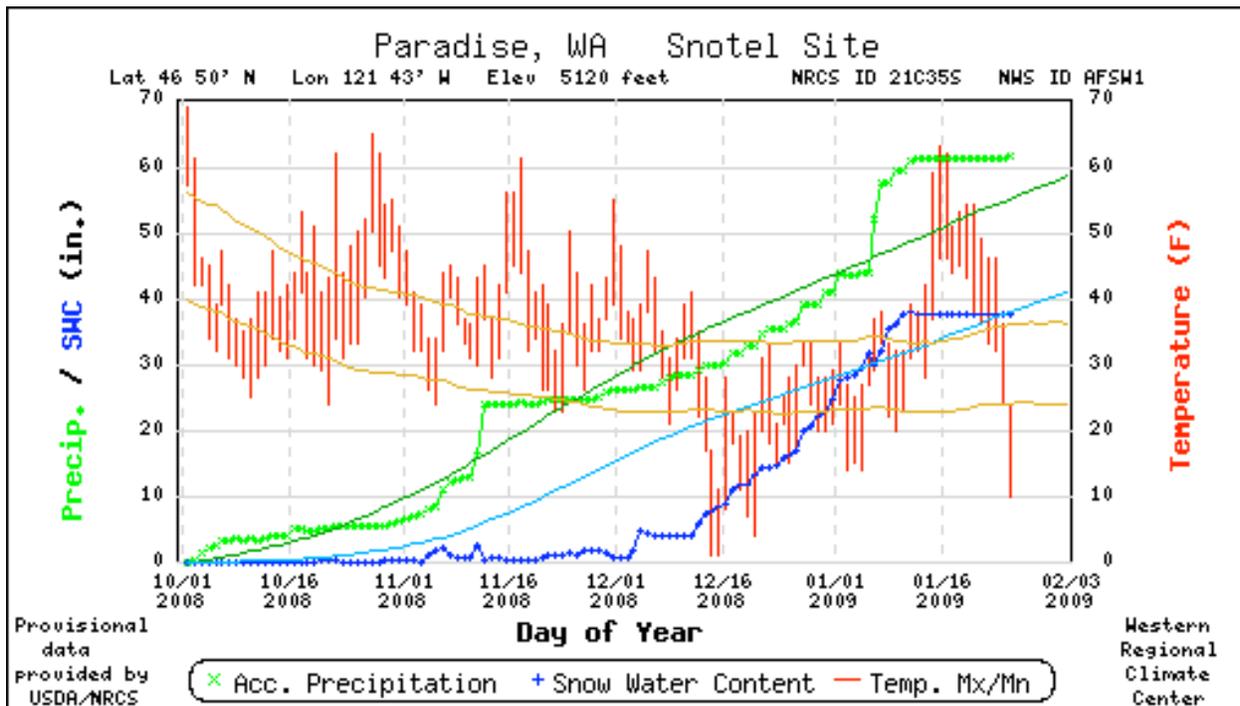


Figure 3: Snotel plot for Paradise, WA for the 2009 water year thus far. Note the warmer than normal temperatures in mid-January (red lines versus the orange curve) due to the persistent inversion layer (from NRCS).

Snowpack

The snowpack has continued to improve in Washington. The snowpack is near-normal in the south and central Cascades, and has improved in the northern Cascades from about 50% of normal in December. The Olympics have worsened, however, and are now down to 55% of normal from 62% of normal in December. Figure 4 shows the percent of average snow water content in Washington and the west from the Natural Resources Conservation Service.

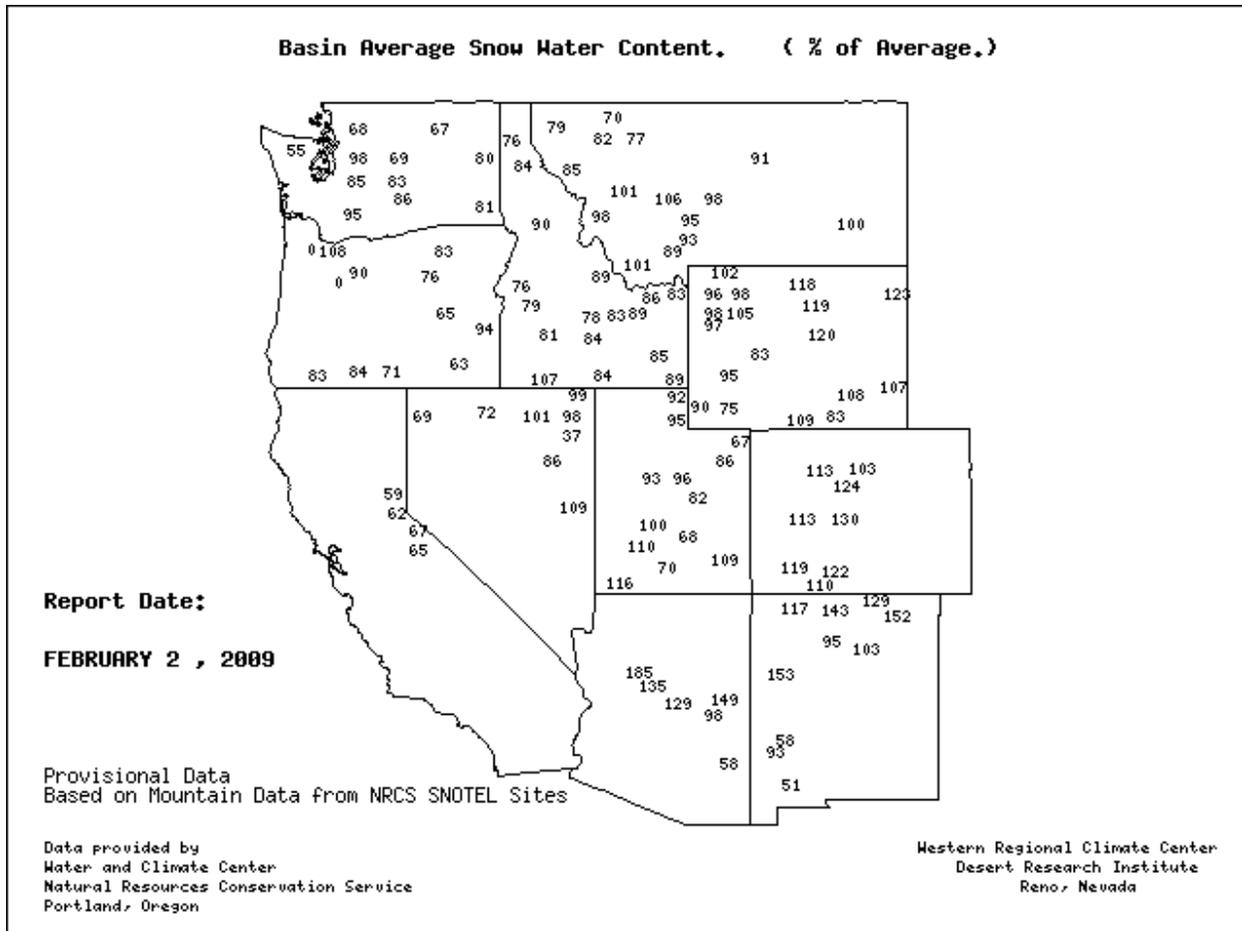
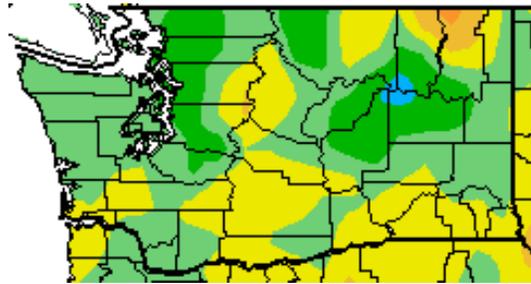


Figure 4: Percent of average snow water content in the West (from NRCS).

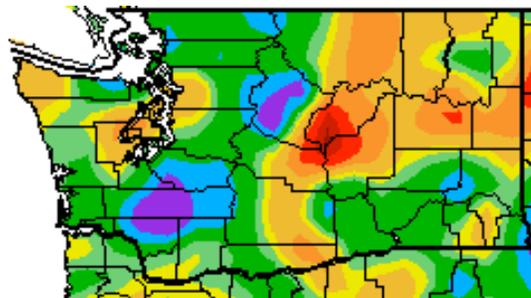
Climate Summary

January temperatures were near normal for the entire state of Washington, offering a break from the cold temperatures experienced in December. The average monthly temperature was cooler than normal in some areas (ex. Ephrata, Table 2), but only by about 2-4°F.

Precipitation was mixed across the state, with the eastern flank of the Cascades extending into the Spokane region, and a small part of the central Puget Sound receiving below normal precipitation for January. Omak and Ephrata were dry spots in the east, only receiving 59% of their normal precipitation for the month (Table 2). The rest of the Puget Sound, where the heaviest rain was reported in the early January storm, had above normal precipitation for the month. The normal baseline is from 1971-2000.



Temperature (°F)



Precipitation (%)



(January temperature (°F) departure from normal (top) and January precipitation % of normal (bottom). Source: High Plains Regional Climate Center (<http://www.hprcc.unl.edu>).

| | Temperature (°F) | | | Precipitation (inches) | | |
|-----------|------------------|--------|-----------------------|------------------------|--------|-------------|
| | Avg | Normal | Departure from Normal | Total | Normal | % of Normal |
| Olympia | 38.1 | 38.1 | 0 | 8.58 | 7.54 | 114 |
| Seattle | 39.7 | 40.8 | -1.1 | 3.42 | 4.49 | 76 |
| Sea-Tac | 39.0 | 40.9 | -1.9 | 5.40 | 5.13 | 105 |
| Vancouver | 39.8 | 39.0 | 0.8 | 5.00 | 5.81 | 86 |
| Pasco | 33.9 | 33.9 | 0 | 1.18 | 1.05 | 112 |
| Spokane | 25.9 | 27.3 | -1.4 | 1.19 | 1.82 | 65 |
| Omak | 23.6 | 23.0 | 0.6 | 0.69 | 1.16 | 59 |
| Yakima | 30.2 | 29.1 | 1.1 | 0.97 | 1.17 | 83 |
| Ephrata | 24.9 | 28.0 | -3.1 | 0.49 | 0.83 | 59 |
| Pullman | 29.3 | 29.6 | -0.3 | 2.79 | 2.46 | 113 |

Table 2 - January Climate Summaries from locations in western Washington and eastern Washington (highlighted in orange) from NWS (climate normal baseline is 1971-2000).

Outlook

The seasonal climate forecast by the NOAA Climate Prediction Center for February-March-April (FMA) calls for at least a 40% chance of below normal temperatures for most of Washington, and at least a 33% chance of below normal temperatures for a small corner of southeastern Washington. The FMA outlook calls for an equal chance of below, equal to, or above normal precipitation. The outlook for spring, March-April-May, calls for equal chances of above, equal to, or below normal temperatures and precipitation.



(February-March-April outlook for temperature (left) and precipitation (right) from the CPC).

The atmosphere and ocean are resembling characteristics of a La Niña. The most recent Oceanic Niño Index is -0.3°C for October through December which is just shy of the -0.5°C threshold to be classified as a La Niña. A La Niña is expected to develop soon, and is forecasted to last through the early part of this year (<http://www.cpc.noaa.gov/products/precip/CWlink/MJO/enso.shtml>).

CoCoRaHS



Thank you, CoCoRaHS observers! Your participation has been very helpful during the heavy rain in January. We are gearing up for a national competition in March, where each participating state will battle to get the most new volunteers. Do you know someone who is interested in becoming a daily weather observer? See cocorahs.org or contact us at wash.cocorahs@gmail.com. New observers may be eligible for a free rain gauge!

*OWSC would like to thank Reid Wolcott for letting us use his photo (Figure 1). Please do not reprint without permission. We would also like to thank Gary Urbas from the WA State Emergency Management Division for the estimated damage from the flooding.