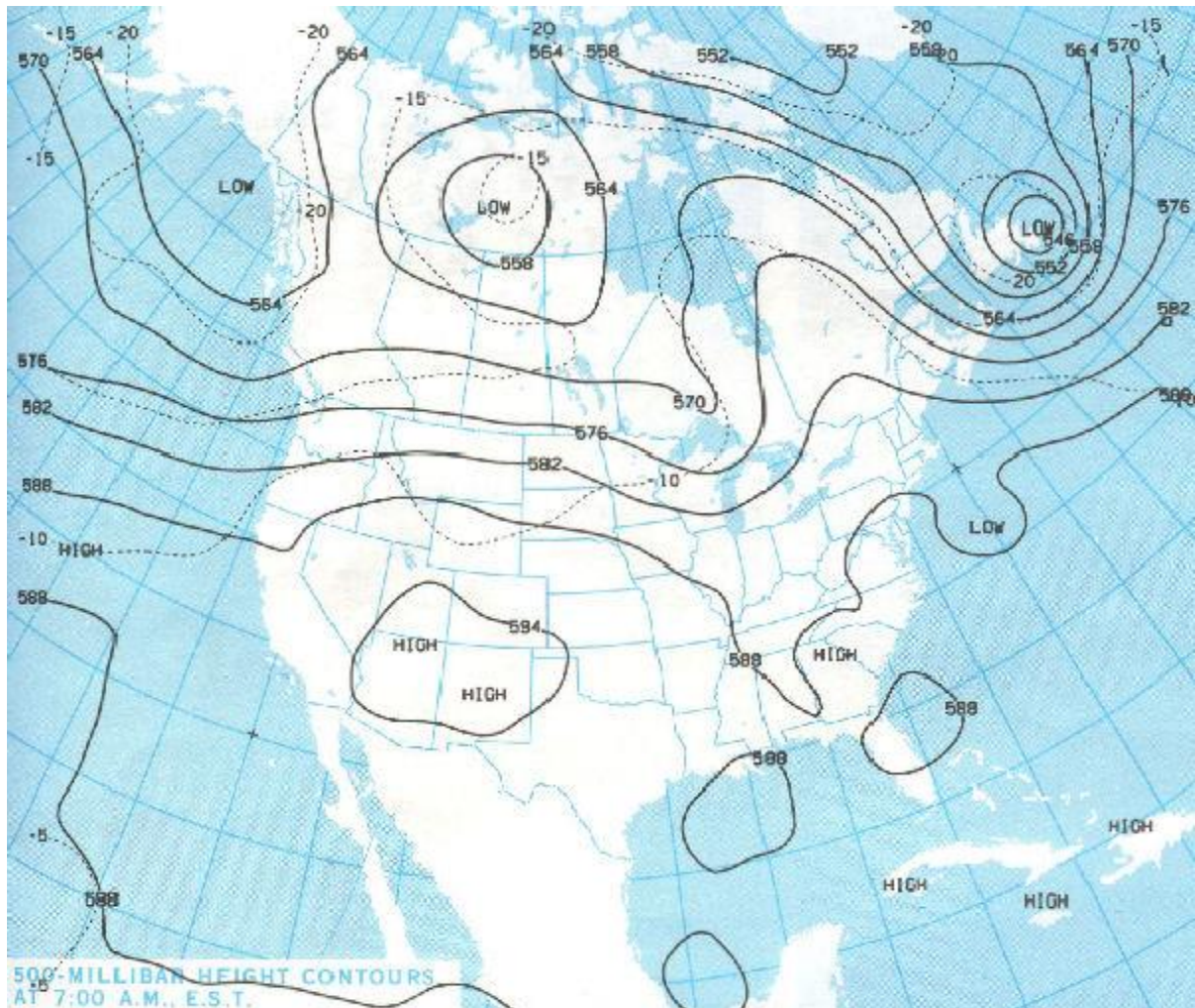


Montgomery Flash Flood of July 15, 1997



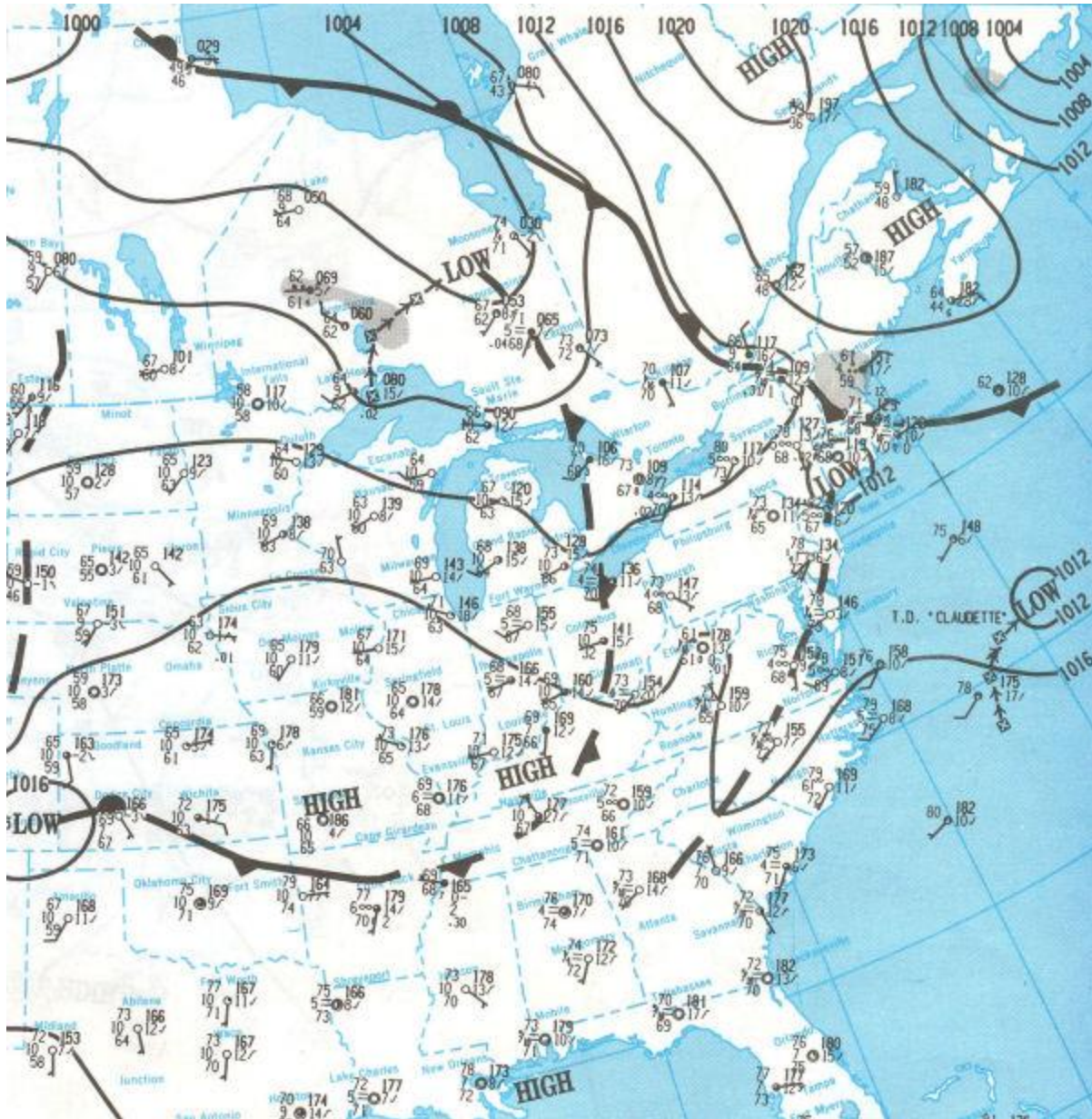
In the early morning hours of Tuesday, July 15, 1997, a flash flood of historic proportion struck Montgomery in northern Vermont. Although much of northern and central Vermont, including Orleans, Essex, Lamoille, and Caledonia counties, was affected by heavy rains and flash flooding that day, Franklin County and the town of Montgomery in particular were the hardest hit. By the time the flood waters receded, \$8 million in damage had been done across Franklin County, with the total damage across Vermont reaching nearly \$12 million.

The weather pattern that day consisted of a large 500 mb low pressure centered just off the Newfoundland coast, with another across the northern Canadian territories, the latter's trough extending through central Canada and into the upper Midwest of the United States. An upper level ridge was squeezed in between the Newfoundland low and the central Canadian trough, slowly building east into western New England. With the leading edge of the upper ridge just entering the state during the early morning hours, much of Vermont was under the influence of northwest flow aloft. Any embedded pulses of energy riding along the top of the ridge would have traversed across northern Vermont, promoting strong upward motion across the region.



500 mb height analysis at 8 am EDT, 12 UTC, July 15, 1997

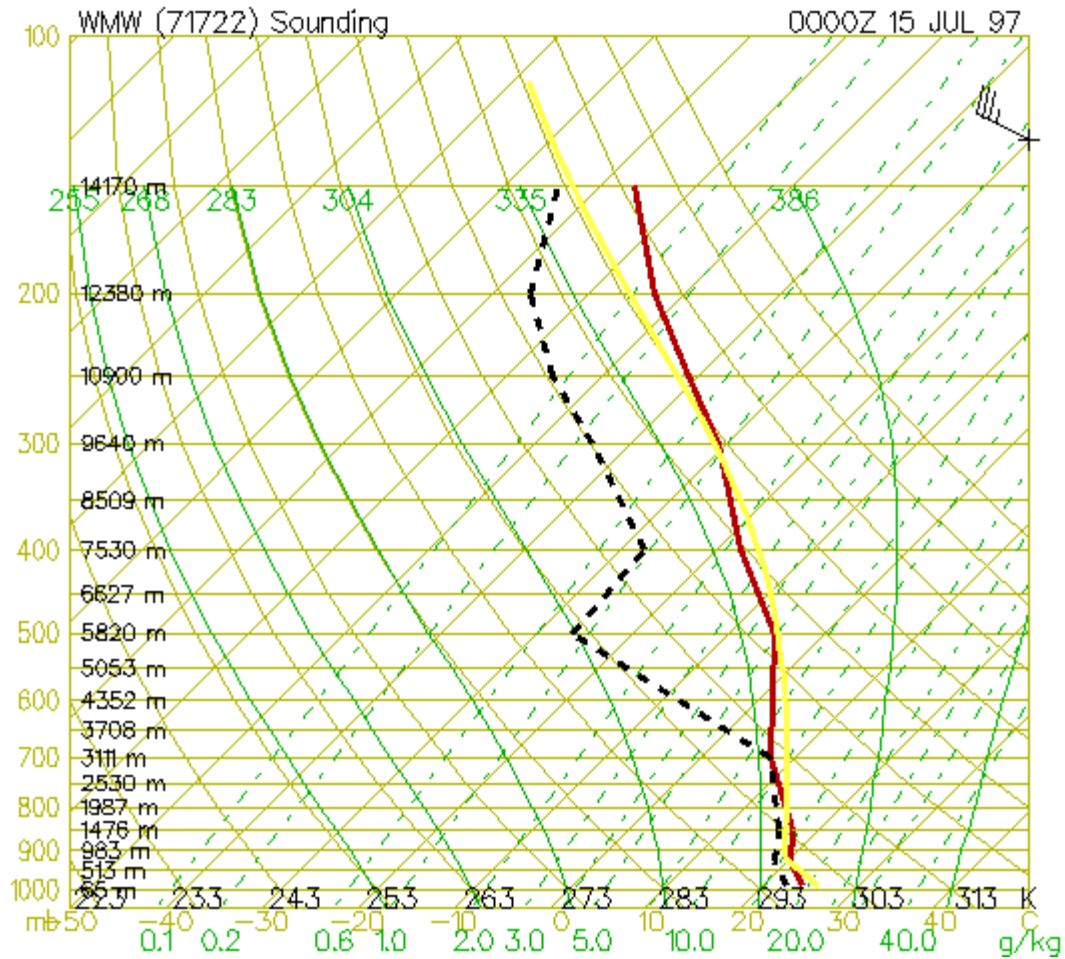
Meanwhile, at the surface, high pressure was spilling down across far eastern Canada and into Maine. To the west, across the rest of New England, a complicated scenario was setting up, with a low pressure center developing just north of Long Island, and a backdoor cold front, nearly stationary, lingering across central and northern Vermont, nearly parallel to the spine of the Green Mountains. The low pressure allowed Atlantic moisture, enhanced by the remnants of Tropical Storm Claudette, to stream into northern New England, riding up and over or just along the cold frontal boundary, providing more abundant lift to the atmosphere.



Surface analysis at 8 am EDT, 12 UTC, July 15, 1997

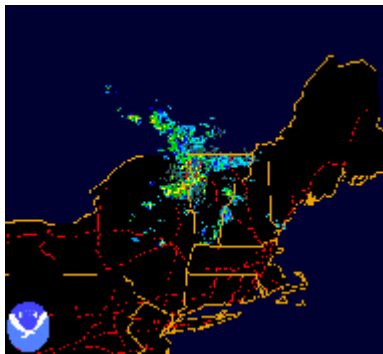
Adding to the mix of meteorological dynamics was the orographic factor. It is well known that northwest flow is very favorable for upslope flow across the higher elevations of northern Vermont and the western slopes of the Green Mountains. With the upper flow nearly perpendicular to Vermont's topography (and to the stationary frontal boundary, as well), the moisture-laden air was forced upward even more; yet another favorable factor for lift and precipitation development.

With the aforementioned feed from Tropical Depression Claudette, moisture was abundant over the area, with precipitable water values approaching 2 inches. The Maniwaki, Quebec, July 15 00 UTC (July 14, 8 pm EDT) sounding is indicative of the air mass that was being lifted up the western slopes of the Green Mountains and over the cold frontal boundary. A deep moist layer, with the sounding nearly saturated up to 700 mb, is clearly evident. Also notice that the freezing level is around 550 mb. This warm moist layer is indicative of a tropical air mass. Such air masses are very efficient at producing heavy precipitation.

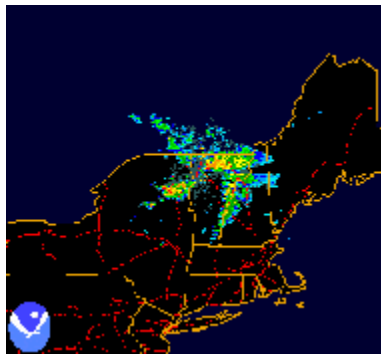


July 15 00z Maniwaki, QC, Skew-T diagram, from Plymouth State University

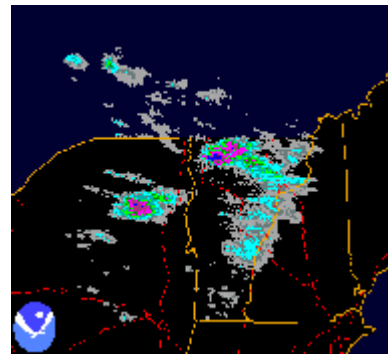
The combination of all these factors produced torrential rainfall, focused along the frontal boundary and terrain, that trained over the same area for hours. The first flash flood warning, for Franklin County, was issued from the NWS office in Burlington, VT at 3 am EDT (07 UTC); by that time, heavy rain had been falling on the area for a couple of hours. This is evidenced by radar imagery. Click on the images below to view a time-lapse animation.



0.5 degree reflectivity



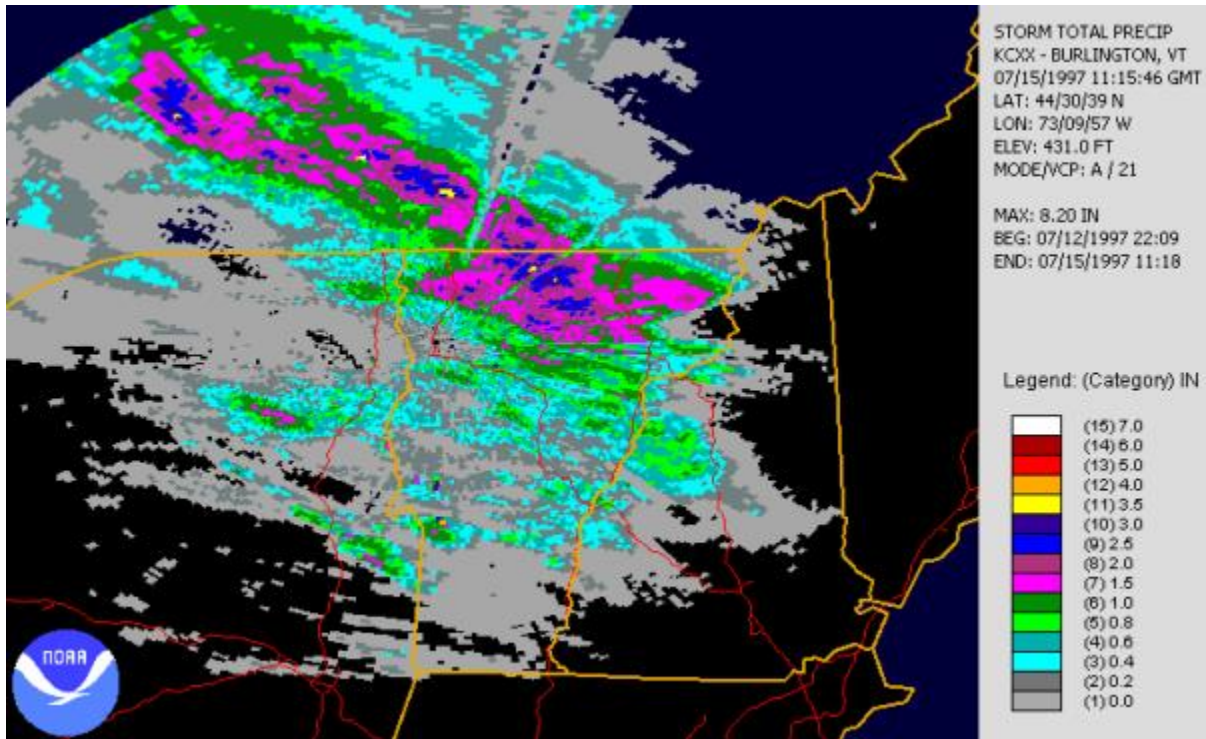
1.5 degree reflectivity



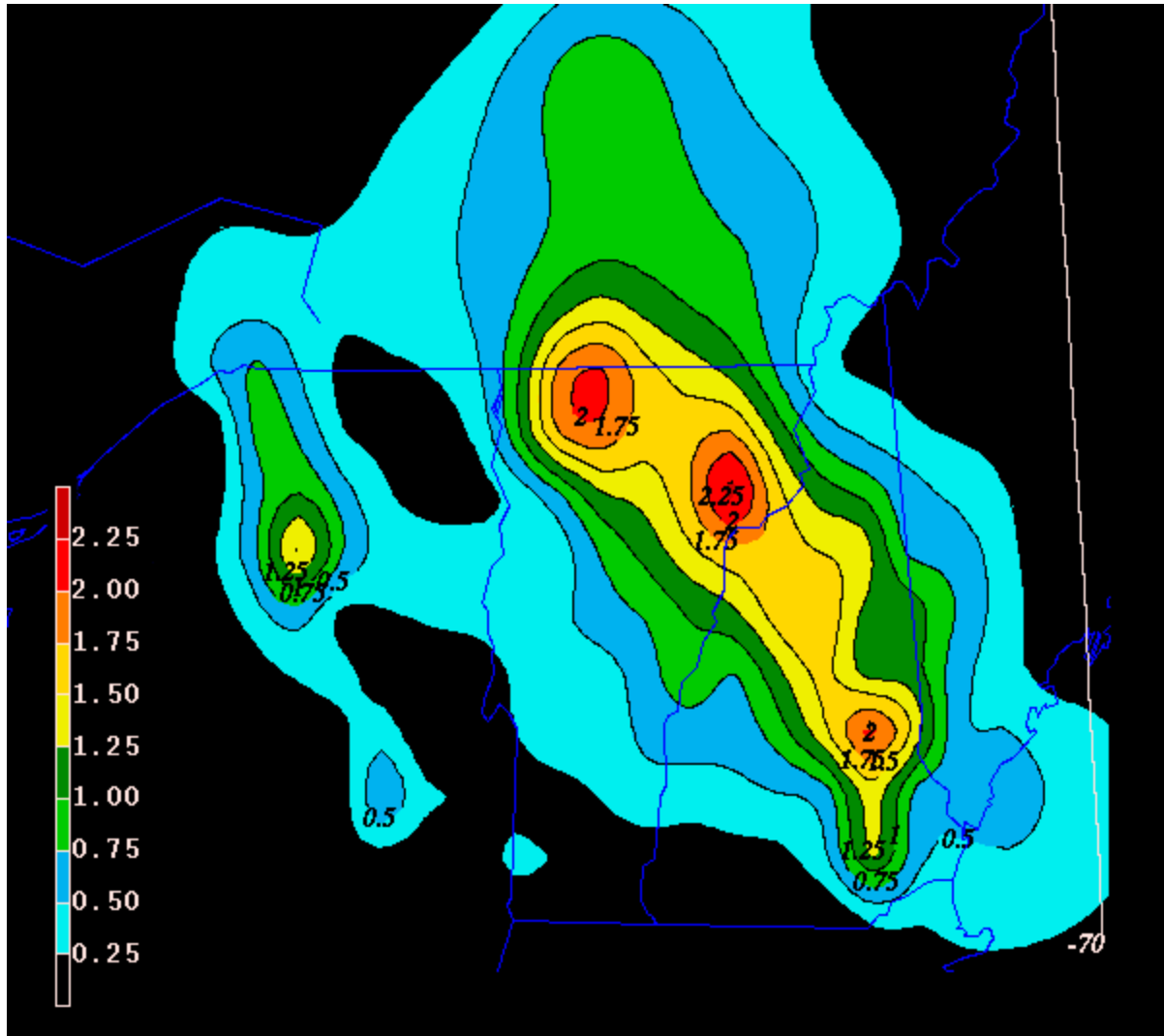
One hour precipitation

By the time the rain dissipated during the late morning hours of July 15, nearly 6 inches had fallen across portions of northern Vermont, with Jay Peak recording 6.10 inches, and Enosburg Falls

receiving 2.84 inches. It is important to note that rain also fell in the area the previous day, July 14, with area observers reporting anywhere from one-third to nearly one inch of precipitation. Radar-derived storm total precipitation, taken at 11:15 UTC, or 7:15 am EDT, shows a large swath of 2 to 3 inch amounts across northern Vermont, with localized areas of 3.5 to 4 inches. These numbers may be underestimated due to two factors. First, it appears that the radar was not placed in tropical mode. As mentioned previously, the airmass in place over the region was very warm and moist; if the radar operates in standard mode in this kind of environment, it often will underestimate the total rainfall by about a factor of two due to the atmosphere's increased efficiency at producing precipitation. Secondly, the lower elevation of the radar beam were probably blocked by the Green Mountains.



A combination of daily rain gauge data, from such sources as the NWS Cooperative Observer Program and the River Forecast Centers, is shown below. Like the radar-derived rainfall accumulation, the amounts depicted are under-represented due to resolution constraints of the gridded data. However, the graphic below clearly shows where the maximum rainfall occurred; namely, northern Vermont. The rain gauge dataset is compiled and provided by the [Climate Prediction Center's Earth System Research Laboratory](#).

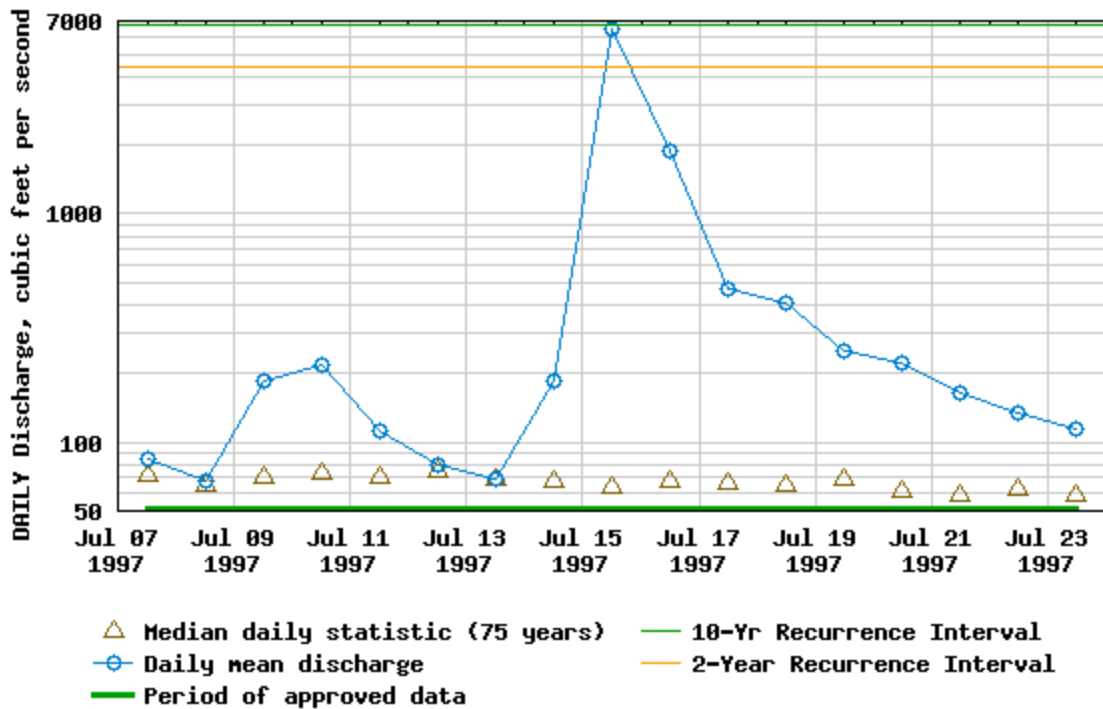


24-hour rainfall at 8 am EDT, 12 UTC, courtesy CDC and John Gyakum and Eyad Atallah of McGill University

With the ground most likely already saturated from antecedent precipitation, the 2 to 6 inches that fell across northern Vermont on July 15 quickly became runoff into the area's waterways, which were already on the rise. Streams and rivers were quickly overwhelmed. Smaller tributary rivers quickly swelled over their banks, followed by flooding along the larger, mainstem rivers. Along the Missisquoi River, North Troy recorded a new record peak flow value that exceeded the 10-year recurrence interval.



USGS 04293000 MISSISQUOI RIVER NEAR NORTH TROY, VT



Flooding of the Trout River was especially severe, and it was this that resulted in the widespread devastation in Montgomery Center. As the river overflowed its banks, the rushing water was made all the more dangerous as it traveled down the surrounding terrain, picking up speed under the influence of gravity. Numerous roads and bridges were washed out, and many houses, cars, and other property sustained damage or were destroyed. Fortunately, no serious injuries or fatalities occurred with this flood. This may be attributed to the timing of the flooding; since the rains occurred during the early morning hours, people were more likely to be in the relative safety of their homes, as opposed to being outside or in a vehicle. Never drive across a flooded road; Turn Around, Don't Drown! To learn more about flood safety, click [here](#).

A selection of damage pictures in and around the Montgomery area are posted below. Click on the thumbnail to see a larger version of the photo.





