

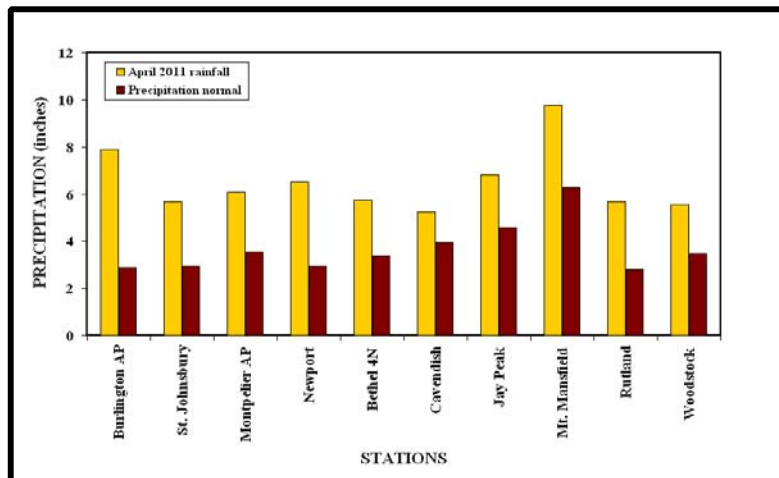


Vermont State Climate Office  
Climate Impacts Summary  
**April 2011**

Dr. Lesley-Ann Dupigny-Giroux  
Stephen Hogan

*...April snowmelt and record rainfall resulted in flooding across portions of Vermont...*

During the month of April, 2011, *the major societal impacts from our weather patterns were associated with flooding*; both river and stream flooding as well as Lake Champlain shore line flooding. By month's end, unofficial early estimates of town and state road and private or public property infrastructure damage were in the millions. This flooding was triggered by rainfall across northern Vermont which was generally 3-5 inches above the average monthly total (Figure 1).



**Figure 1: April 2011 precipitation totals at selected Vermont stations relative to their most recent averaging period (1971-2000 in most cases)**

### **I. River and stream flooding**

Snowmelt, combined with frequent periods of rain on April 4-5, 10-11, 16-17, 20, 23 and 25-28 resulted in rivers reaching and eventually exceeding flood stages. Thunderstorms occurred in Burlington on April 11-12, 20, and 26-28 with locally heavy rainfall.

The heaviest rainfall event was associated with thunderstorms during the late afternoon of April 26<sup>th</sup> into the early morning hours of April 27<sup>th</sup>. These storms resulted in record and near record rainfall and flooding across portions of northern Vermont.

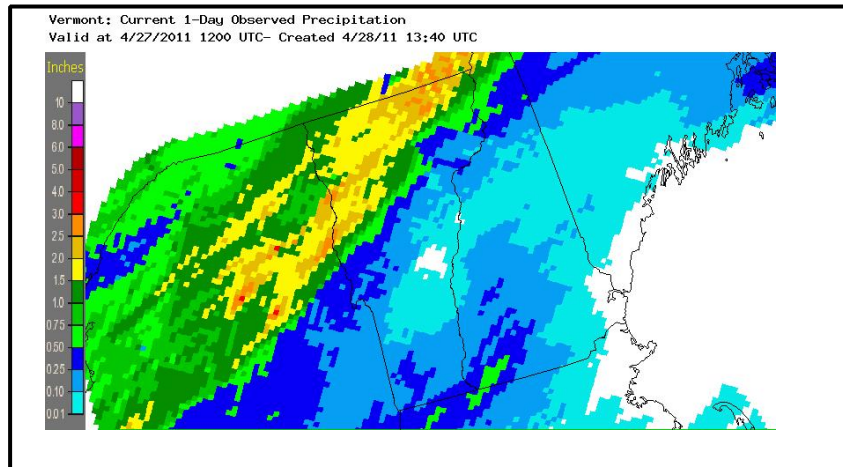
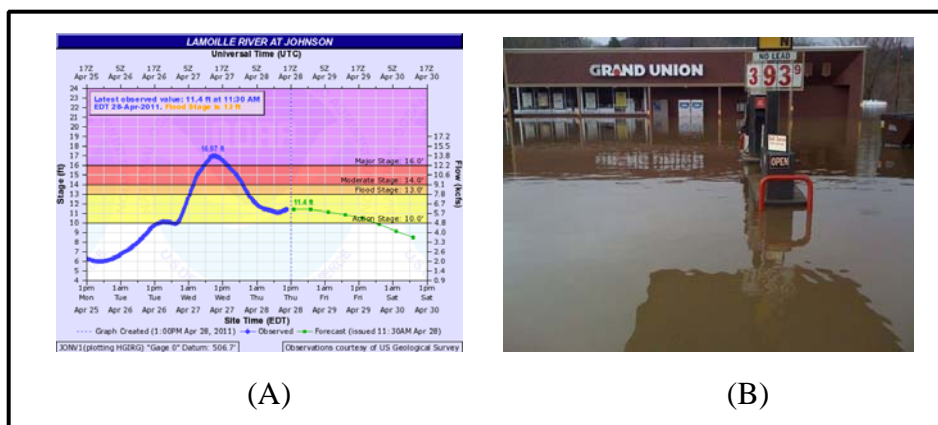
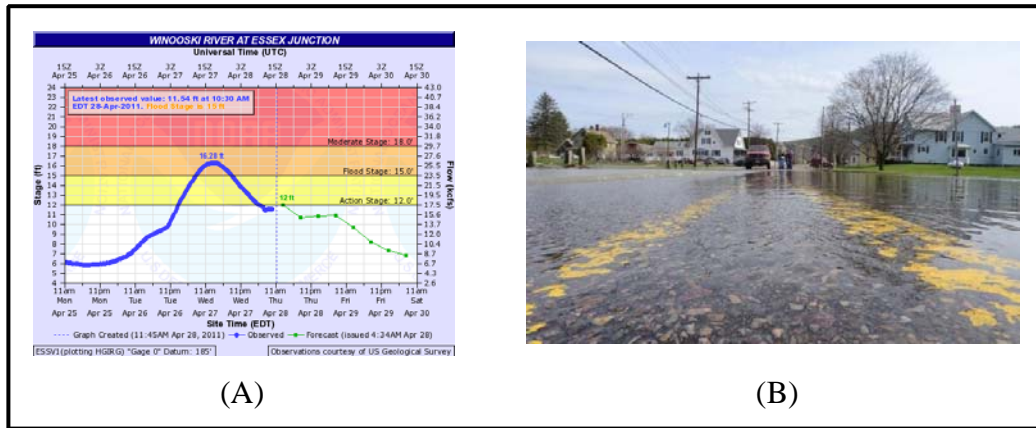


Figure 2 shows that the heaviest rainfall on 26-27 April occurred diagonally across the northwest third of the state complex geographical area of river valleys and mountains. This area included the counties of Addison to Washington to Caledonia and Essex north to the US-Canadian border. The major river systems affected were the Missisquoi, Lamoille, Winooski, Passumpsic, Connecticut and northern portion of the Otter creek.

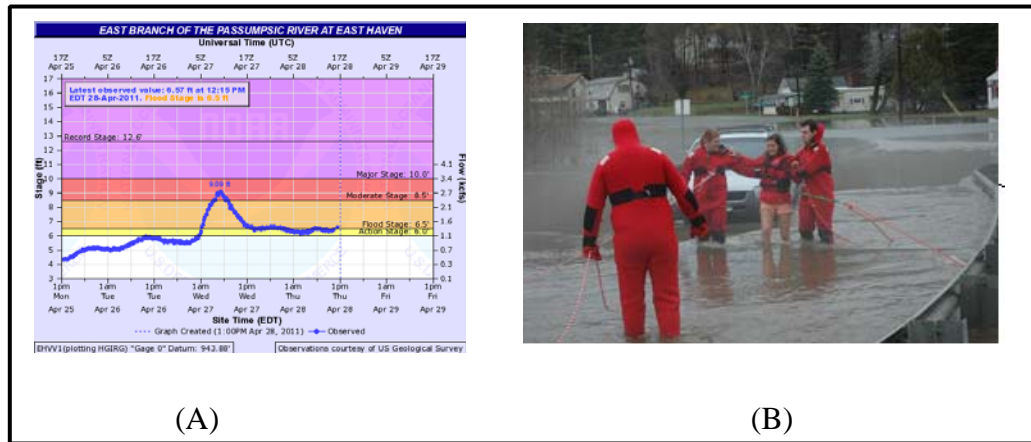
Figures 3-5 highlight the dramatic stage increases (12 hours or less) at USGS gauging stations along the main stems of the Lamoille and Winooski Rivers in western Vermont as well as the Passumpsic River in the northeast. associated flood photographs on the east-west Lamoille and Winooski rivers as well. These rapid main stem rises resulted from the flashy responses along small feeder rivers and streams, such as the Browns and Gihon Rivers. The flood crests along the Lamoille and Winooski Rivers were mirrored at the USGS gauges on Lake Champlain about two days later (refer to part II of this report).



**Figure 3: USGS gauging station at Johnson, VT on the Lamoille River gage for 25-28 April, 2011 (A), with the resulting flooding of the Grand Union supermarket on 27 April, 2011 (B) [Photo credit: The Burlington Free Press].**



**Figure 4: USGS gauging station at Essex Junction, VT on the Winooski River for 25-28 April, 2011 (A), with the associated flooding in Richmond, VT on 27 April, 2011 (B) [Photo credit: The Burlington Free Press].**



**Figure 5: USGS gauging station at East Haven, VT on the Passumpsic River for 25-28 April, 2011 (A), with the associated flooding in Lyndonville, VT on 27 April, 2011 (B) [Photo credit: The Burlington Free Press].**

During the calendar day of April 26<sup>th</sup>, Burlington set a record for the most rainfall on any calendar day in April with 2.74 inches. In fact, Burlington set a new record for the monthly total precipitation with 7.88 inches. Other stations to set records are noted in Table-1.

**Table 1: Twenty-four hour daily record rainfall (inches) totals for the April 26-27, as observed at 0700 on 27 April unless otherwise noted**

REGION	STATION	RAINFALL TOTAL (inches)
Western VT	Burlington	2.74 (Calendar day 26 April)
	Essex Junction 1N	2.63

Northeastern VT	Eden 2S	2.31
	Newport	2.13

Along with river flooding, flash flooding occurred on small streams in northwest and north central Vermont during the overnight hours of April 26-27 with some road washouts (Figure 6). A beaver dam added to flood waters in the area of Jericho and Underhill, with local mudslides near the northern town of Highgate. This was followed by main stem river flooding of larger rivers in the northern half of Vermont. The major impacts were field, road and basement or first floor flooding. See Table 2 for road impacts.

**Table 2: Summary of 26-27 April 2011 flooding in northern Vermont by river and roads affected**

REGION	WATER BODY	ROAD CLOSURES
Western VT	Mississquoi River & tributaries	<ul style="list-style-type: none"> <li>▸ Vermont Route 105 between Route 235 and 120 in Sheldon</li> <li>▸ Lower Pleasant Valley Road in Cambridge</li> </ul>
	Lamoille River	<ul style="list-style-type: none"> <li>▸ Route 15 at the Wrong Way Bridge in Cambridge</li> <li>▸ Route 109 at the Waterville/Cambridge town line</li> <li>▸ Route 108 off Route 15 and north in Cambridge</li> <li>▸ Route 15 Johnson to Jeffersonville</li> <li>▸ Routes 108 North in Cambridge</li> <li>▸ Route 109 in Cambridge</li> </ul>
	Winooski River & tributaries	<ul style="list-style-type: none"> <li>▸ North Williston Rd in Williston</li> <li>▸ Bridge St in Richmond</li> <li>▸ Flooding in Town of Waterbury</li> </ul>
	Brown's River	<ul style="list-style-type: none"> <li>▸ Route 128 at the Essex/Westford town line</li> </ul>
Northeastern VT	Miller's Run River Passumpsic River	<ul style="list-style-type: none"> <li>▸ The Junction of Routes 114 and 122 in Lyndonville</li> <li>▸ Route 5 near Red Village Road in Lyndon</li> <li>▸ Route 5 in St. Johnsbury</li> <li>▸ Route 122 in Lyndon near Interstate 91</li> </ul>

	Trout River	► Route 118 at the intersection of Route 105 in East Berkshire
	Neal Brook	► Town of Lunenburg road flooding
	Clyde River Barton River	► Towns of Morgan and Glover reporting water on roads with washouts



**Figure 6 Road washouts due to flash flooding between Jericho and Underhill, VT [Photo credit: The Burlington Free Press]**

*Other impacts included; up to 4000 homes experienced disruption of power* as reported by Vermont Emergency Management. These outages were due to both lightning strikes and flooding. *A resident of Richmond, Vermont was injured when struck by lightning.* In St Albans, Vermont, *nickel size hail was reported* during the late evening of April 26<sup>th</sup> with thunderstorms.

## **II. Lake Champlain shoreline flooding**

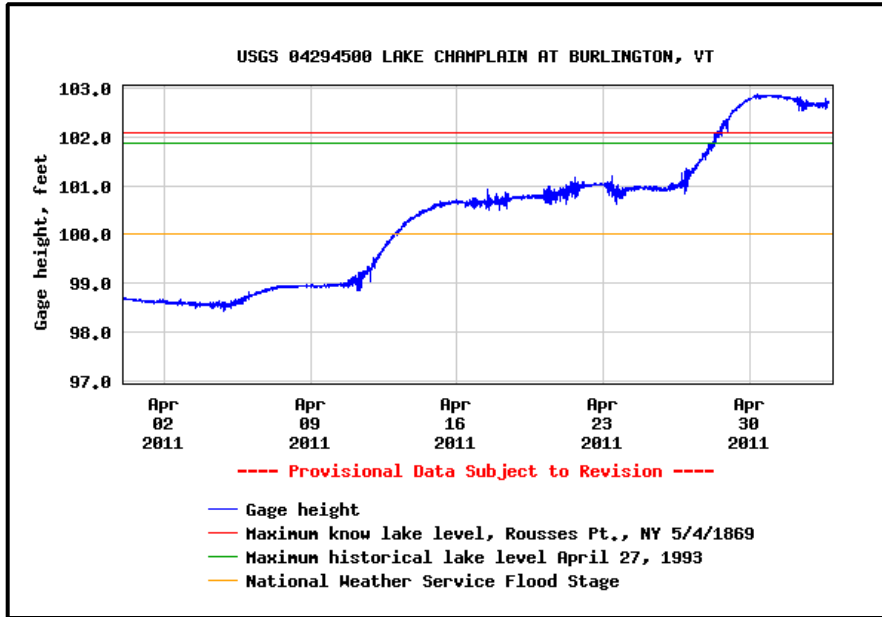
Flooding along the shores of Lake Champlain is a normal occurrence during April and the first part of May. In 2011, however, the flooding has been exacerbated by runoff from the melting snowpack and heavy convective rains.

The month of April 2011 began with the lake level at the King Street Ferry dock in Burlington at 98.64 feet, well below the flood stage of 100 feet. By month's end, the lake level at this location was at a record setting 102.87 feet. The USGS gauging station at the ECHO Lake Aquarium and Science Center offers continuous monitoring of lake levels, and as the April hydrograph shows (Figure 7), there were two periods of rapid lake level rise. The first (10-15 April) was associated with runoff from snow melt due to mild weather and a rainy period. The second period between the 27<sup>th</sup> and 30<sup>th</sup> was associated with runoff from heavy convective rain.

*Major impacts were flooding of shore roads, State parks and basements of residential homes and cottages along the lake shore. Route 2 through the Champlain Islands was kept open, but limited to one lane, as barriers were installed to hold water back. Debris floating down the rivers into the lake is also a potential hazard for spring boaters.* By late April, the parking area for the ferry at the King Street Ferry dock was totally under water (Figure 8).



Periodic episodes of gusty winds enhanced the lakeshore flooding due to wave action. This was especially the case along south facing coastlines. This was especially the case on April 23 with south winds gusting in the late morning to mid afternoon at speeds of 30 and 50 mph. Figure 9 shows the waves along Route 2 in North Hero, Vermont.



**Figure 7: USGS hydrograph showing the stage at Burlington, VT gauging station on Lake Champlain for April 2011.**



**Figure 8: King Street Ferry Dock entrance in Burlington, VT on Friday 29 April, 2011. The speed limit sign is for vehicular traffic, not boat traffic. [Photo credit: S. Hogan]**

**Figure 9: Wind-enhanced wave action on Lake Champlain along Route 2 in North Hero, VT on 23 April, 2011. [Photo credit: Burlington Free Press]**

As April drew to a close, sediment-laden rivers continued to enter Lake Champlain, producing sediment plumes, debris accumulation along the shoreline (Figures 10-12) and contributing to a new record lake level.

Figure 10: The sediment-laden Winooski River as it rushes past the Winooski Mills at the line between the cities of Burlington and Winooski on 27 April 2011 [Photo credit: The Burlington Free Press]



Figure 11: A marked sediment plume at the mouth of the Winooski River as it enters Lake Champlain on 27 April, 2011 [Photo credit: The Burlington Free Press].



Figure 12: Debris floated or submerged on Lake Champlain. Some of it also washed up along the lakeshore. [Photo credit: Burlington Free Press, Wednesday 27 April, 2011]



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#### **ADDITIONAL RESOURCES:**

<http://www.echovermont.org/lakeweather/>

[http://vt.water.usgs.gov/echo\\_gage/](http://vt.water.usgs.gov/echo_gage/)