

# Natural Hazards Assessment

Buffalo County, WI

Prepared by: NOAA / National Weather Service La Crosse, WI



# Natural Hazards Assessment for Buffalo County, WI

Prepared by NOAA / National Weather Service – La Crosse  
Last Update: October 2016

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# Natural Hazards Assessment

## Buffalo County, WI

Prepared by National Weather Service – La Crosse

### Overview

Buffalo County is in the Upper Mississippi River Valley of the Midwest with hilly terrain and bluffs. It is bordered by the Mississippi River to the west.

The area experiences a temperate climate with both warm and cold season extremes.

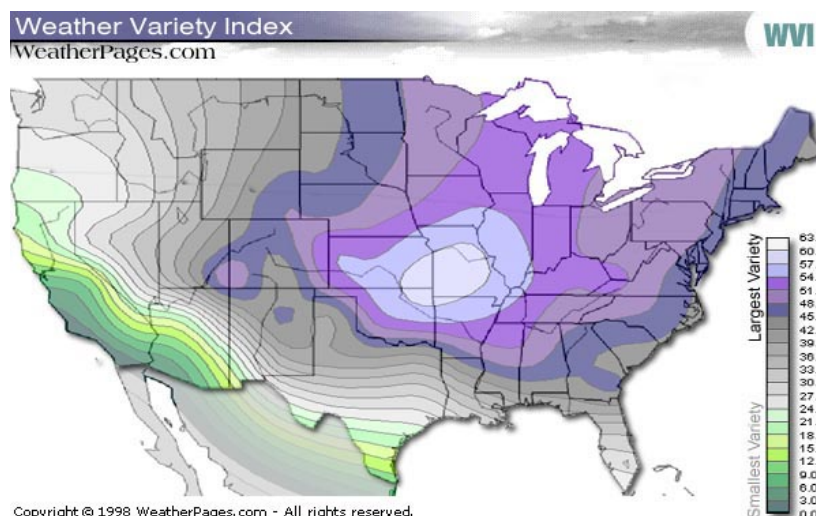
Winter months can bring occasional heavy snows, intermittent freezing precipitation or ice, and prolonged periods of cloudiness. While true blizzards are rare, winter storms impact the area on average about 3 to 4 times per season. Occasional arctic outbreaks bring extreme cold and dangerous wind chills.

Temperatures between river valleys and surrounding ridges can vary greatly. Typically high temperatures on ridges are 3° to 5°F colder than valleys. This can lead to slightly more average snowfall on ridge tops and occasionally a difference in winter precipitation types from ridge to valley.

Thunderstorms occur on average 30 to 50 times a year, mainly in the spring and summer months. The strongest storms can produce associated severe weather like tornadoes, large hail, or damaging wind. Both river flooding and flash flooding can occur, along with urban-related flood problems. The terrain can lead to mud slides and generally increases the flash flood threat. Heat and high humidity is occasionally observed in June, July, or August.

The autumn season usually has the quietest weather. Valley fog is most common in the late summer and early fall months. On calm nights, colder air settles into valleys leading to colder low temperatures compared to ridge top locations. High wind events can also occur occasionally, usually in the spring or fall.

The variability in weather can be seen in the following graphic, created by a private company (weatherpages.com) that rated each city on variations in temperature, precipitation, and other factors. La Crosse, WI ranked 27<sup>th</sup> highest in variability out of 277 cities.

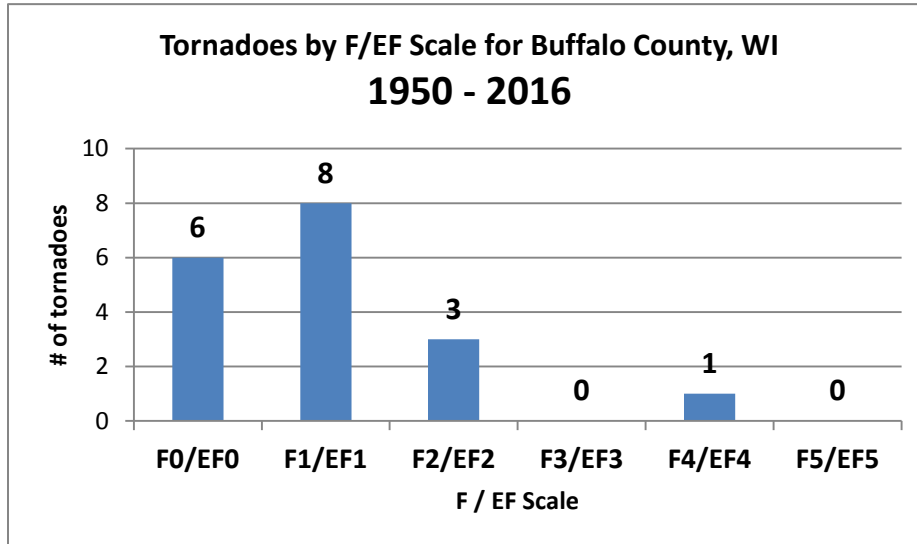


Since 1998, Buffalo County has been included in a FEMA Federal Disaster Declaration 3 times:

- 1998 – Severe storms
- 2001 – Flooding
- 2010 – Severe storms / Flooding

## Tornadoes

Even though Wisconsin averages about 21 tornadoes per year, Buffalo County has only had 18 tornadoes since 1950, averaging about one tornado every 4 years. Most tornadoes are short-lived and small. May and June are the peak months and most occur between 3 and 9 p.m., but they can occur nearly any time of year and at all times of the day.



### Most recent tornadoes:

- July 5, 2016 (EF1)
- July 5, 2016 (EF1)
- June 17, 2010 (EF1)
- June 11, 2001 (F0)
- July 8, 1999 (F1)
- May 15, 1998 (F0)
- Mar.29, 1998 (F0)
- Oct.8, 1992 (F0)
- Sept.9, 1990 (F1)
- June 17, 1984 (F0)
- May 17, 1982 (F2)
- May 17, 1982 (F2)

It has been quite a few years since a sizeable tornado has hit Buffalo County. In May 1982, two medium sized tornadoes (F2) moved through the county causing 6 injuries. Nearly 25 barns were destroyed along with several homes being damaged. A very sizeable tornado hit areas northeast of Fountain City, WI in May 1953 causing nearly a million dollars in damage and injuring several people. In more recent years a tornado hit Mondovi, WI on July 8, 1999 damaging two homes and a garage leading to 3 injuries. The terrain may limit some tornadoes from forming but brief touchdowns and tracks can still occur even through the bluffs and valleys.

### Strongest tornadoes: (1850-2016)

- Oct. 3, 1903 (F4) – 45 inj, 9 dead
- May 10, 1953 (F4) – 10 inj, 0 dead
- June 17, 1899 (F3) – 5 inj, 0 dead
- May 17, 1982 (F2) – 6 inj, 0 dead
- June 28, 1960 (F2) – 0 inj, 0 dead

### Buffalo County Tornado Facts:

- No F5 or EF5 tornadoes
- Two F4 tornadoes and one F3
- 21 deaths and 72 injuries since 1850
- Tornadoes have occurred March – October
- Most have occurred in May (7)

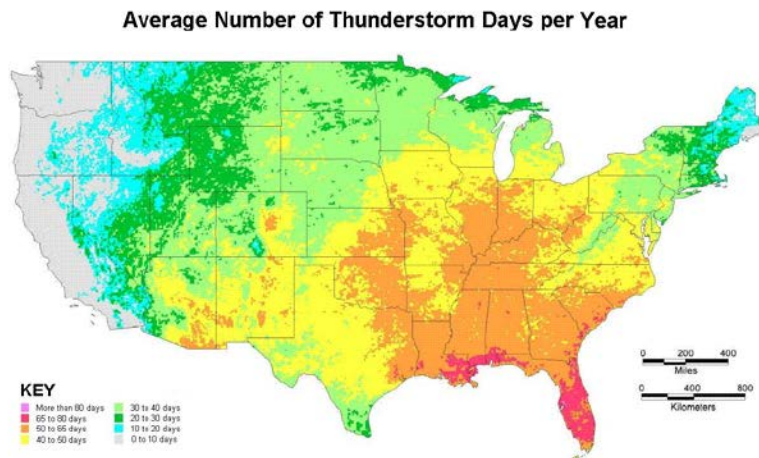
Tornado Watches		Tornado Warnings	
Year		Year	
2016	0	2016	2
2015	1	2015	0
2014	1	2014	0
2013	3	2013	0
2012	2	2012	1
2011	3	2011	1
2010	4	2010	0
2009	3	2009	0
2008	9	2008	0
2007	4	2007	0

Enhanced Fujita (EF) Scale	
EF0	65-85 mph
EF1	86-110 mph
EF2	111-135 mph
EF3	136-165 mph
EF4	166-200 mph
EF5	>200 mph

## Severe Thunderstorms / Lightning

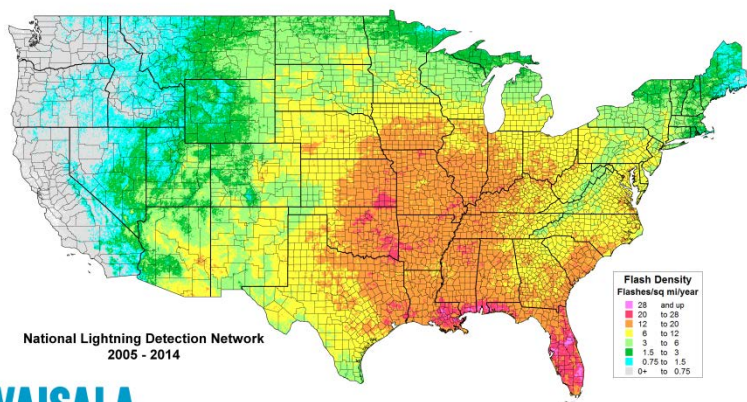
Buffalo County averages 38 thunderstorm days per year. The National Weather Service (NWS) considers a thunderstorm severe when it produces wind gusts of 58 mph (50 knots) or higher, 1 inch diameter hail or larger, or a tornado.

Downdraft winds from a severe thunderstorm can produce local or widespread damage, even tornado-like damage if strong enough. Most severe thunderstorm winds occur in June or July and between the hours of 4 and 8 p.m., but can occur at other times. Most damage involves blown down trees, power lines, and damage to weaker structures (i.e. barns, outbuildings, garages) with occasional related injuries. In May 1996, an area of strong winds hit the Alma, Nelson, and Mondovi area injuring 2 and causing damage to many barns and outbuildings. Power was loss in most of the area. There have been about 92 damaging wind reports since 1982 in the county.



Large hail can also occur in a severe thunderstorm. June is the peak month with the most common time between 1 and 9 p.m., but it can occur in other warm season months and at any time of day. Hail is typically a crop damaging hazard but can damage roofs, windows, and vehicles if large enough (> 1"). Expenses can be high. Injuries or fatalities are rare for hail. In July 1973, hail as large as softballs was reported from the small town of Buffalo, WI, but two inch hail was reported in Cochrane in 1995. There have been about 94 large hail ( $\geq 3/4$ ") reports in the county since 1982.

Non-severe thunderstorms still pose a lightning risk. According to the Vaisala Group, an average of just under 300,000 cloud-to-ground strikes hit Wisconsin each year based on data from 2006 to 2015. Nationally, Wisconsin ranks 11<sup>th</sup> in lightning related fatalities with 9 deaths reported from 2006 to 2016. There were lightning fatalities in Wisconsin in 2007, 2008, 2011, and 2016 but there have been no reported injuries or fatalities from lightning in the county since 1982.



Severe Thunderstorm Watches		Severe Thunderstorm Warnings	
Year		Year	
2016	5	2016	6
2015	5	2015	7
2014	5	2014	10
2013	9	2013	18
2012	10	2012	11
2011	12	2011	8
2010	12	2010	11
2009	4	2009	5
2008	10	2008	11
2007	18	2007	9



## Flooding and Hydrologic Concerns

On occasion intense, heavy rain producing thunderstorms or consecutive thunderstorms (“training”) can bring excessive rainfall leading to flash flooding in Buffalo County. The hilly terrain promotes rapid runoff and enhances the threat. Mudslides can occur in extreme cases. Intense rainfall rates also lead to occasional urban street flooding.

June is the most common month for flash floods, but they can occur from May through September. They are most common in the evening hours, between 8-10 p.m., but can occur at other times and typically last from 3-6 hours. Since 1982, there were 9 deaths from flooding in Wisconsin.

A flash flood hit the Fountain City, WI area in August 1997 when 3 to 4 inches of rain fell in 2 hours leading to mud slides, flooding of streets, and water in basements. Flash flooding was also reported in August 2009 and September 2016 when 4-7 inches of rain fell closing many area roads and creating mudslides.

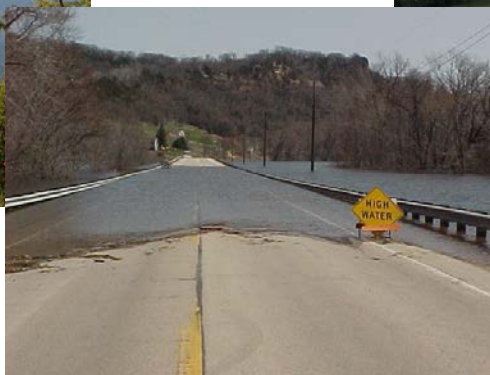
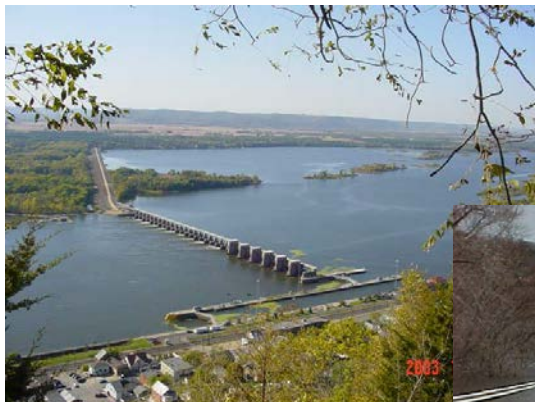
Buffalo County is bordered by three rivers - the Mississippi River, the Trempealeau River, and the Chippewa River. The Buffalo River bisects the county and empties into the Mississippi. There are many other creeks and drainage areas as well. The Mississippi River is often highest in the spring associated with the seasonal snowmelt, but on rare occasions can reach flood stage during the summer or fall from heavy rain patterns. The combination of up-river snowmelt and area rain brought major flooding along the Mississippi River in April 2001, setting the 2<sup>nd</sup> highest crest levels in many locations. The record crest year remains 1965.

Flash Flood Warnings	
Year	
2016	5
2015	2
2014	1
2013	1
2012	0
2011	0
2010	2
2009	3
2008	0
2007	1
2006	0

Mississippi River @ Alma, WI Top 5 Crests (FS: 16 feet)	
Date	Crest
4/19/1965	19.78'
4/16/2001	18.15'
4/18/1969	17.53'
4/18/1952	16.30'
4/16/1951	16.20'

Flooding along the Trempealeau and Chippewa Rivers can be a bit more frequent, sometimes stemming from heavy rain patterns as opposed to just snowmelt. Both rivers tend to rise and fall relatively quickly with rare property damage concerns. (Image below right: Trempealeau River @ Dodge, WI) In September 2010, nearly ten inches of rain created widespread flooding on most area tributaries.

The US Army Corps of Engineers maintains a Lock and Dam (#4) at Alma, WI that is used to manage navigational water levels, not for flood control. (Photos left and below)



## Winter Storms and Extreme Cold

Hazardous winter weather can bring a variety of conditions to Buffalo County. Since 1982, an average of 3-4 winter storms impact the area each season. The terrain in the county does limit the number of true blizzards (only 3 since 1982) but heavy snow, blowing snow, ice, and sleet all occur. There have been a total of 6 documented deaths and 51 injuries as a direct result from winter storms in Wisconsin since 1982.

The 30-year average seasonal snowfall at Alma, WI is 35.5 inches, but at Mondovi, WI the average is 51.9 inches. Ridge tops are typically 3-5° F cooler and can average closer to 50 inches. Blowing snow is more common on ridge tops as well. The all-time record one-day snowfall at Alma is 14.0 inches set on March 23, 1952. The bulk of snow falls between December and March. The largest winter storms tend to form over the central or southern Plains, then move northeast towards the western Great Lakes.

On February 23-25, 2007, a major winter storm impacted Buffalo County. Heavy snow, including lightning, brought nearly a foot of snow the first night. Winds later increased and created major blowing and drifting. Some sleet and freezing rain fell next, followed by another round of heavy snow and blizzard conditions the next night. When the storm finally moved out, 20.4 inches of snow had fallen in southern parts of the county (at Dodge, WI), with 12 to 14 inches across the rest of the county. A blizzard December 8-9, 2009 also produced 14 inches of snow at Cochrane and near Gilmanton, WI.

Top 5 Seasonal Snowfalls at Alma, WI	
Years	Snowfall
1951-52	74.3"
1950-51	67.4"
1996-97	64.8"
2012-13	58.8"
1966-67	56.6"

March can often be a snowy month. Even though snowfall may be less frequent, heavy wet snow can form from large spring storms. In March 1934, 23.3 inches of snow fell in 3 days at Mondovi, WI while the record one-day snowfall was also set in March at Alma, WI.

Ice storms (1/4" of ice or more) can occur but are relatively rare with only 6 occurrences since 1982.

Arctic cold outbreaks can occur in the upper Midwest as well. Snow depth can modify these cold temperatures leading to sub-zero readings on average 32 times a winter, but the warmer temperatures of the Mississippi River limit sub-zero readings to an average of only 21. Occasionally strong northwest winds will combine with arctic outbreaks to create dangerous wind chill conditions as well. The coldest temperatures are usually in January and February with average lows in the single digits and record lows colder than -25°F most days. The all-time record low at Mondovi, WI is -45°F set on January 30, 1951.



In January and February 1996, Alma, WI went nearly 6 consecutive days with temperatures below zero degrees (F) following a blizzard about a week earlier. Low temperatures of -23°F, -38°F, -26°F, -34°F, -35°F, and -33°F were set on six straight mornings. A low of -39°F was set in Mondovi, WI during this same stretch.

Coldest Lows at Alma, WI	
Low	Date
-38°F	1/31/1996
-37°F	1/20/1994
-36°F	1/30/1951
-35°F	2/3/1996
-34°F	2/2/1996

Since 1982 there have been 27 fatalities in Wisconsin from cold weather and 42 direct injuries. The La Crosse National Weather Service issues Wind Chill Advisories when wind chill readings of -20°F to -34°F are expected. Wind Chill Warnings are issued when wind chill values at or below -35°F are expected or occurring.

## Heat, Drought, and Wildfires

On occasion the weather pattern across the upper Midwest favors prolonged heat and humidity, leading to heat waves. June through August are the warmest months with average high temperatures in the 80s and record highs above 95°F most days. The warmest temperature on record at Alma, WI is 101°F which was set on August 7, 2001 and June 11, 1956. At Mondovi, the all-time record high temperature is 110°F set July 14, 1936.

Since 1982, there have been 122 fatalities directly related to heat waves and another 95 indirectly, in Wisconsin. In Buffalo County, there have been 16 heat waves since 1982 but no documented fatalities.

One of the longest heat waves on record occurred in July 1936 when Buffalo County hit 90°F or higher for 12 consecutive days, including 8 days at or above 100°F and an all-time record of high of 110°F as noted above. In more recent years, heat waves with high temperatures in the 90s to lower 100s hit in 2012, 2006, 2001, 1995, and 1988.

Warmest Highs at Alma, WI	
High	Date
101°F	8/7/2001
101°F	6/11/1956
100°F	7/13/1995
100°F	7/31/1988
100°F	7/21/1983



Prolonged dry spells can also lead to drought causing extreme damage to crops. Droughts vary in length and intensity but abnormally dry to moderate drought conditions can occur quite frequently. Severe to extreme droughts occur far less frequently, but did impact the region during the summer of 2012.

Dry weather can also lead to a wildfire threat, especially in the spring before foliage has emerged (i.e. before green up) or in the fall after vegetation has started to die off. Warm, dry (i.e. lower relative humidities), and windy conditions all favor higher fire danger and can lead to sporadic grass and field fires in Buffalo County. April is the peak threat month. Thick, wooded areas also pose a threat for wildfires under extremely dry conditions but occur far less frequently.





## Local Climatology

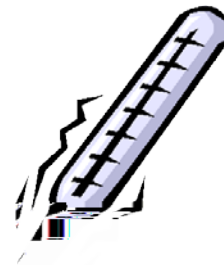
Here are some basic climatology figures for the Buffalo County area. Data is valid for Alma, WI based on normals from a 30-year period (1981-2010).

Month	Normal Maximum Temperature	Normal Minimum Temperature	Average Temperature	Precipitation	Snowfall
JAN	25.6	9.7	17.7	0.86"	9.3"
FEB	30.7	14.5	22.6	0.77"	6.7"
MAR	42.5	25.7	34.1	1.71"	7.0"
APR	58.6	38.4	48.5	3.27"	1.0"
MAY	69.8	49.6	59.7	4.22"	0.0"
JUN	78.6	58.9	68.8	4.87"	0.0"
JUL	82.5	63.7	73.1	4.89"	0.0"
AUG	80.3	62.0	71.1	5.04"	0.0"
SEP	72.1	53.8	62.9	4.27"	0.0"
OCT	59.2	41.7	50.4	2.44"	0.0"
NOV	43.0	28.6	35.8	2.18"	3.2"
DEC	28.9	14.7	21.8	1.03"	9.3"
Year	56.1	38.7	47.4	35.87"	35.5"

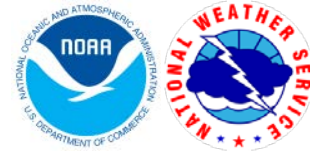
(Note: Climate information for Alma, WI is available since 1936)

Miscellaneous facts:

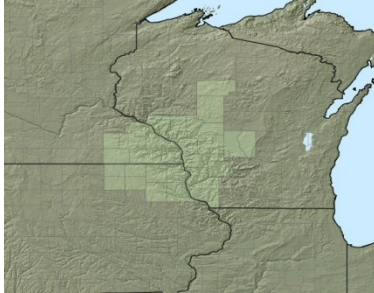
- Warmest year on record – 2012 (51.7°F) (although 2016 might end up being the warmest)
- Warmest month on record – July 2012 (79.4°F)
- Warmest day on record – August 7, 2001 (101°F)
- Greatest number of days with 90°F or warmer – 1988 (36 times)
- Coldest year on record – 1979 (43.1°F)
- Coldest month on record – January 1977 (+1.5°F)
- Coldest day on record – January 31, 1996 (-38°F)
- Greatest number of days at 0°F or colder – 1978 (56 times)
- Wettest year on record – 1991 (50.97")
- Wettest month on record – September 2010 (13.50")
- Wettest day on record – July 22, 1991 (5.91")
- Driest year on record – 1976 (16.91")
- Driest month(s) on record – December 1989 & November 1976 (0.00")
- Highest seasonal snowfall on record – 1951/52 (74.3")
- Highest monthly snowfall on record – March 1951 (39.5")
- Highest one-day snowfall on record – Dec.9, 2009 & Mar.23, 1952 (14.0")
- Least seasonal snowfall on record – 1986/87 (9.5")



## NOAA/National Weather Service Support and Weather Monitoring



NOAA's National Weather Service (NWS) forecast office at La Crosse, WI serves Buffalo County with weather information and support on a continuous basis. Operating 24 hours a day, a staff of 23 issues routine and non-routine informational products for the area, including all watches, warnings, and advisories related to natural hazards. Doppler radar (WSR-88D) is co-located with the La Crosse NWS office and covers the region.



NWS La Crosse has a web site at: [www.weather.gov/lacrosse](http://www.weather.gov/lacrosse)

Normal communication during hazardous weather scenarios is via telephone.

NOAA Weather Radio coverage in Buffalo County includes:

- WXJ86 (La Crosse) on 162.550 MHz
- KGG95 (Winona) on 162.425 MHz
- WXK41 (Rochester) on 162.475 MHz
- WXJ88 (Eau Claire) on 162.400 MHz

Limited storm spotter groups consist mainly of fire departments and the general public. Spotter training was held in 2010 with an attendance of 32, but previously had not been held since 2004.

There are a variety of weather monitoring sources in Buffalo County, including:

Automated weather station(s):

- Winona, MN (ONA)

River Gauge(s):

- Mississippi River @ Wabasha, MN
- Mississippi River Lock & Dam #4 @ Alma, WI
- Mississippi River Lock & Dam #5 @ Minnesota City, MN
- Mississippi River Lock & Dam #5A @ Winona, MN
- Mississippi River @ Winona, MN
- Trempealeau River @ Dodge, WI
- Chippewa River @ Durand, WI

Cooperative Observers

- Alma Dam 4
- Mondovi



In addition, numerous volunteer reports from around the county are received at the La Crosse NWS office including rainfall, snowfall, and temperatures, on a routine basis.

## Resources

National Weather Service – La Crosse	<a href="http://www.weather.gov/lacrosse">www.weather.gov/lacrosse</a>
NWS La Crosse Tornado Database	<a href="http://www.weather.gov/arx/tornadomain">www.weather.gov/arx/tornadomain</a>
NWS La Crosse River Monitoring	<a href="http://www.crh.noaa.gov/ahps2/index.php?wfo=arx">http://www.crh.noaa.gov/ahps2/index.php?wfo=arx</a>
NWS La Crosse Climate	<a href="http://www.weather.gov/climate/index.php?wfo=arx">www.weather.gov/climate/index.php?wfo=arx</a>
NWS La Crosse Drought information	<a href="http://www.weather.gov/arx/drought">www.weather.gov/arx/drought</a>
NWS La Crosse Storm Summaries	<a href="http://www.weather.gov/arx/events">www.weather.gov/arx/events</a>
NWS La Crosse NOAA Weather Radio page	<a href="http://www.weather.gov/arx/nwr">www.weather.gov/arx/nwr</a>
NWS La Crosse Severe Weather Climatology	<a href="http://www.weather.gov/arx/svr_climate">www.weather.gov/arx/svr_climate</a>
NWS Storm Prediction Center	<a href="http://www.spc.noaa.gov/">http://www.spc.noaa.gov/</a>
SPC Online Severe Weather Climatology :	
-	<a href="http://www.spc.noaa.gov/new/SVRclimo/climo.php?parm=anySvr">http://www.spc.noaa.gov/new/SVRclimo/climo.php?parm=anySvr</a>
-	<a href="http://www.spc.noaa.gov/climo/online/rda/ARX.html">http://www.spc.noaa.gov/climo/online/rda/ARX.html</a>

## Contact information:

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