



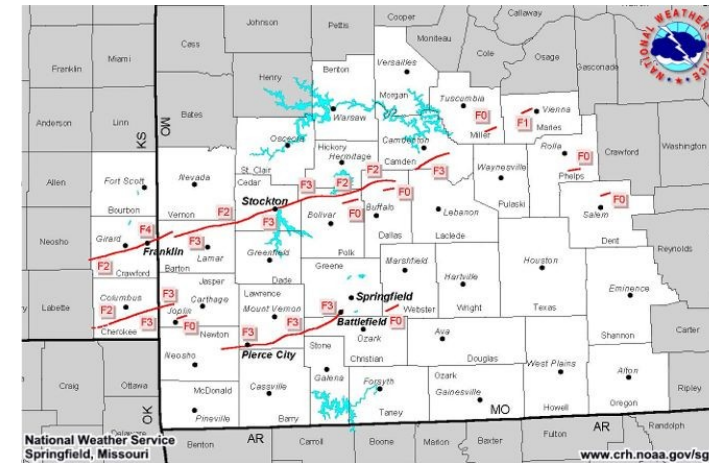
“To provide weather and flood warnings, public forecasts and advisories for all of the United States...and its territories...for the protection of life and property.”

National Weather Service

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National Weather Service

Natural Hazard Risk Assessment Information For: **Benton County Missouri**



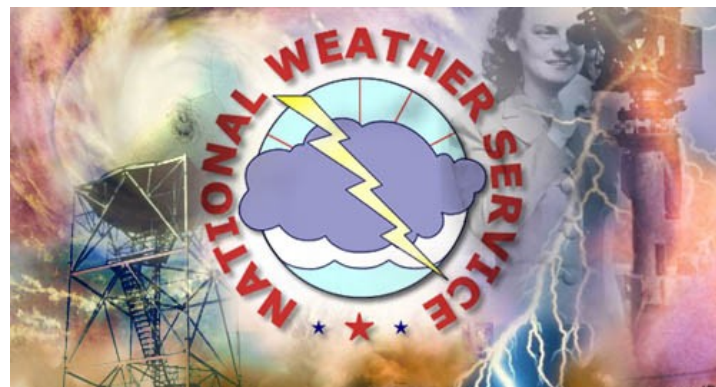
Information Provided By
WFO Springfield, Mo

2009 Update

Includes data and information
through December 2008

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This document is intended to provide general information on severe weather that has affected Benton County and the communities with in the county.

By Gene Hatch
 Meteorologist Intern WFO Springfield. Mo.

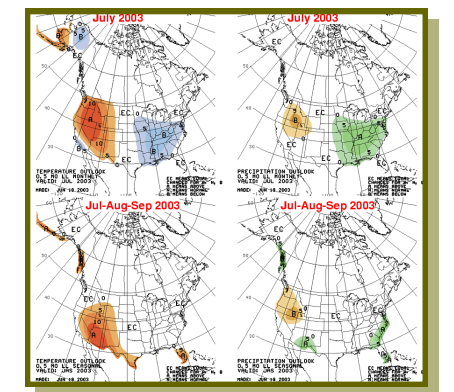
Local Climatology

Averages and records for Warsaw, Missouri in Benton County

41	18	6.8	80	-29	30.5
48	24	5.1	86	-40	16.0
59	34	2.5	94	-12	19.0
70	44	0.3	94	17	8.0
77	52	0	104	27	0
85	61	0	111	34	0
92	67	0	118	44	0
90	65	0	113	40	0
82	57	0	107	28	0
72	45	0	98	17	2.5
58	35	1.8	89	-1	11.0
46	25	3.3	82	-13	18.5

Links for Climate information

- www.crh.noaa.gov/sgf/
- www.cpc.ncep.noaa.gov/
- www4.ncdc.noaa.gov
- web.missouri.edu/~moclimat/
- mrcc.sws.uiuc.edu/
- agebb.missouri.edu/weather/index.htm



Historic Weather in Southwest Missouri

Jan. 8th-1997...Six inches or more of snow fell over much southwest, south central and central Missouri from noon on the eighth to noon on the ninth. The heaviest snow fell in a band from Cassville to Springfield north to Hermitage where up to ten inches was recorded. Damage estimates at 670K dollars were due to the cost of snow removal.

Mar. 12th-1961...A tornado touched down at 745 am in southern Greene County and moved northeast from near Plainview road towards the KWTO towers. The tornado blew down 2 of KWTO's towers, damaged the roof on the Disney school and damage 3 other homes.

Apr. 23rd-1967...A severe thunderstorm formed over the northwest portion of the city of Springfield, MO spawning a tornado. The weather service office measured a wind gust of 63 mph as the tornado moved through the center of the city. Nearly 1000 homes and businesses were destroyed with one fatality and 9 injuries reported.

May 4th- 2003...Three tornadic supercell thunderstorms formed over southeast Kansas and moved across the Missouri Ozarks, spawning 13 tornadoes. This was a very rare event for this part of Missouri since many of the tornadoes experienced across this area are short lived small tornadoes.



This event surpassed the December 17-18, 2002 tornado event in both loss of lives and property damage, and exceeded tornado events that occurred over the past 100 Years for this part of Missouri. The hardest hit locations included Battlefield, Stockton and Pierce City. 14 tornadoes resulted in extensive damage and 24 deaths. Several of the tornadoes tracked long distances ranging from 15 to 80 miles.

Jul. 17th-1998...Severe thunderstorms that developed late in the morning caused 70 mph wind gusts south of Warsaw, MO and in Camden County.

Nov. 11th-1911...A high of 80 and low of 13 were recorded on the same day in Springfield. A cold front, ahead of a very cold airmass, moved through the Ozarks making temperatures fall rapidly.

Nov. 29th-1991...An F4 tornado that developed 3 miles north of Nixa tracked southeast for 10 miles to Springfield and lifted over east Springfield. Extensive damage to homes and businesses was reported. 2 deaths and 64 injuries were directly related to the tornado.

Dec. 17-18th-2002...At approximately 1118 pm a tornado struck near Chesapeake Mo. The F2 tornado hit the Lucky Lady trailer park in addition to 1 home northeast and 3 homes southwest of the trailer park. The tornado resulted in 1 fatality and 15 injuries.

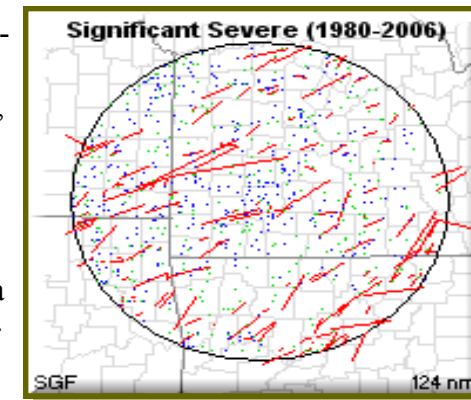


Overview of Weather Hazards in Southwest Missouri & Extreme Southeast Kansas

From 1961 to 2008, 522 tornadoes were reported in the 37 counties that WFO Springfield is responsible for, with an average of 11 occurring each year. There were 71 fatalities from these tornadoes, or near one and a half each year. Tornadoes occurred during every month of the year and at every hour of the day. The majority of these tornadoes are weak, but the occurrence of strong and violent storms is always a possibility and cannot be discounted.

The Ozarks experiences between 50 and 70 thunderstorm days a year. During any given storm, large hail, damaging winds and microbursts are possible. The Ozarks go through three severe thunderstorm seasons during the course of the year. The spring season is the period that supercell thunderstorms are most common, next comes summer as large clusters of storms move across the region, mainly during the overnight hours. Finally fall sees the return of supercells and tornadoes, squall lines and training storms (thunderstorms that form and move over the same area).

The region is affected during the course of any year by flooding, drought, heat and cold extremes and winter storms. Heat extremes and flooding have caused the greatest number of fatalities in the area. Winter storms affect the region in many forms. Ice storms, heavy snow and extreme cold have occurred across the area. Freezing rain is the typical form ice storms in the Ozarks take. Ice storms have deposited 2 to 3 inches of ice during their duration causing power outages, tree damage, and traffic problems.



Weather in the Ozarks

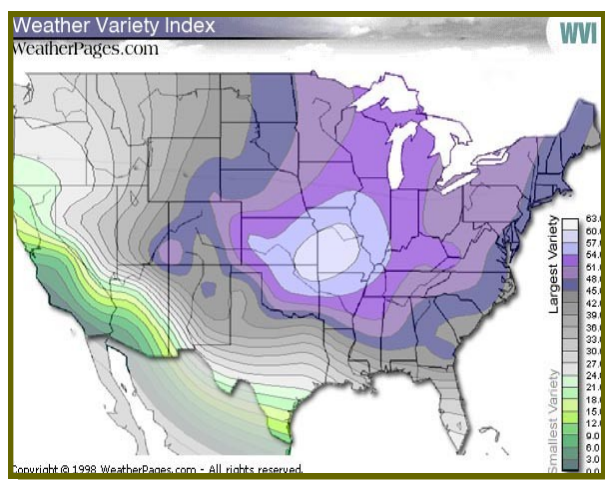
Tornadoes by county for the Springfield County Warning Area from 1950 to 2008

County	F0/1	F2	F3	F4	F5	County	F0/1	F2	F3	F4	F5	County	F0/1	F2	F3	F4	F5
BARRY	20	7	1	0	0	DOUGLAS	8	6	1	0	0	OREGON	9	4	2	1	0
BARTON	23	1	3	1	0	GREENE	19	10	3	1	0	OZARK	21	2	2	1	0
BENTON	18	2	4	0	0	HICKORY	8	1	1	0	0	PHELPS	15	4	2	0	0
BOURBON,KS	10	5	0	0	0	HOWELL	20	11	3	1	0	POLK	16	3	0	0	0
CAMDEN	15	6	1	0	0	JASPER	30	5	4	1	0	PULASKI	9	4	1	0	0
CEDAR	10	2	3	0	0	LACLEDE	9	6	1	0	0	SHANNON	11	1	1	0	0
CHEROKEE,KS	28	5	2	1	0	LAWRENCE	11	2	3	0	0	ST.CLAIR	13	2	2	0	0
CHRISTIAN	19	2	1	1	0	MARIES	4	3	0	0	0	STONE	10	3	0	0	0
CRAWFORD,KS	19	11	3	1	0	McDONALD	11	5	0	0	0	TANEY	6	1	0	0	0
DADE	11	2	2	0	0	MILLER	22	3	0	0	0	TEXAS	14	8	1	2	0
DALLAS	7	1	1	0	0	MORGAN	11	7	0	0	0	VERNON	20	1	6	0	0
DENT	8	1	1	0	0	NEWTON	30	5	1	2	0	WEBTSE	19	7	2	0	0
												WRIGHT	10	4	0	1	0

Historical information for Benton County, Missouri

Severe Weather in Benton County

In 2000, a private company looked at 277 cities across the United States. They rated each city on variations in temperature, precipitation and other factors. Of all the cities in their study Springfield, Missouri rated number one as the city with the most variable weather in the U.S.

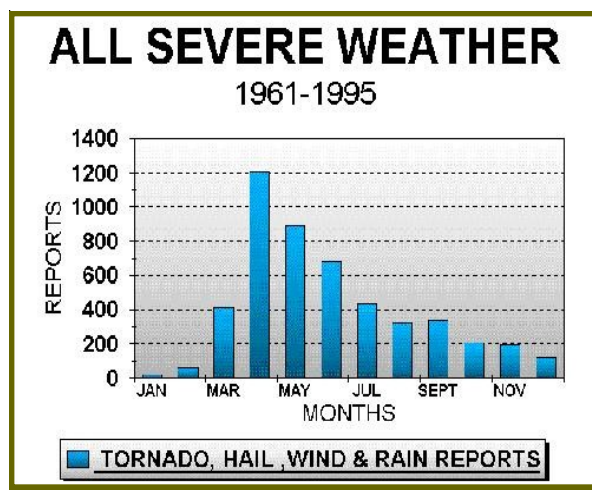


From www.weatherpages.com

Benton County Missouri is located on the Ozark Plateau along the eastern edge of tornado ally. Because of its location Benton County is subjected to severe thunderstorms, heavy rainfall, winter storms, flooding, ice storms, droughts, tornadoes and other wind storms.

When does severe weather occur ?

Severe weather in the Ozarks can occur in any month of the year. While the months of April through June are the peak severe weather season, there is a secondary peak from September to November.



Severe thunderstorms in Benton County have dropped hail up to 2" in diameter, created winds in excess of 90 miles an hour and rainfall rates greater than 2" in an hour. While southwest Missouri receives nearly 11 tornadoes a year, Benton County averages an event every 2 1/2 years.

Number of Tornadoes in Benton Co. (1950 to 2008)

F1	F2	F3	F4	F5
18	2	4	0	0
75%	8%	17%	0%	0%

During the winter season Benton County averages 20 inches of snow. With the most snow in one season at 40.3 inches, falling during the 1923 to 1924 winter season. Ice storms also affect the county during the winter season causing significant damage to homes, trees and utilities.

Dam Failure

Dams in Benton County

Benton County contains 21 dams. While the majority of these dams are small and used primarily for storm water management, irrigation and recreation, some are a part of local reservoirs. Most of the dams in Benton County are of earthen construction with Truman Dam the only concrete construction dam. There have been no recorded failures.

Where are they Located

- Stelling-Junge Lake Dam: Cole Camp Creek, Warsaw
- Peebels Lake Dam: Ross Creek, Warsaw
- Wray Lake Dam: Cole Camp Creek, Warsaw
- Kyle Lake Dam: Indian Creek, Warsaw
- Tatge Lake Dam: Little turkey Creek, Warsaw
- Gatliff Development Dam: Osage River, Warsaw
- Karr Lake Dam: Cole Camp Creek, Lincoln
- Harry S. Truman Dam: Osage River, Warsaw
- Streett Creek Dike: Streett Creek, Warsaw
- Timber Line Lake Dam: Cole Camp Creek, Lakeview Heights
- Tatge Lake Dam: Osage River Tributary, Warsaw
- Lake Placid Dam: Big Buffalo Creek, Lakeview Heights
- Rekus Lake Dam: Williams Creek, Lincoln
- Jackson Keller Trust Dam: Cooney



- Creek, Lakeview Heights
- Mirror Lake #1 Dam: South Grand River, Warsaw
- Mirror Lake #2 Dam: South Grand River, Warsaw
- Hayes, William Lake Dam: Osage River Tributary, Lakeview Heights
- Moss Lake Dam: Indian Creek, Lincoln
- Bockelman Lake Dam: Big Buffalo Creek, Lakeview Heights
- Carlson Lake Dam: Deer Creek, Edwards

Most of the dams in Benton County are less than 100 feet high. Many are located on private land and fall under private ownership.



Heat, Drought and Wildfires



Excessive heat is the leading cause of weather fatalities in the nation. With the variability of the weather in southwest Missouri, it is not surprising that excessive heat impacts Benton county on almost a yearly basis.

Benton County averages 19 days a year with temperatures at or above 95 degrees. July and August are the two warmest months, which average 7 days at or above 95 degrees.

Years with above average summer heat

Year	Days 95* +	Days 100* +	Days in a row
1909	48	17	22
1913	79	51	20
1925	49	19	13
1934	78	58	17
1954	72	50	15
1980	59	32	19
Normal # of Days	19	7	▲ Above 95*

pany excessive heat. Benton County has gone through dry periods and drought. The latest droughts occurred in 1999 and 2000 when well below normal rainfall and high temperatures combined to produce drought conditions.

Longest periods without rainfall in Benton County

- 50 days: 3 Dec 1955 ~ 21 Jan 56
- 37 days: 3 Sept 1979 ~ 9 Oct 79
- 31 days: 21 Aug 1954 ~ 20 Sept 54
- 30 days: 5 Oct 1944 ~ 3 Nov 44
- 30 days: 9 Oct 1950 ~ 7 Nov 50
- 30 days: 2 Jan 1966 ~ 31 Jan 66

While no major wildfires have affected Benton County, small grass fires do pose a hazard.

A twenty year study by the Missouri Department of Conservation, from 1970 to 1989 determined that over 2200 fires occurred during that time in the Clinton fire district which includes Cass, Bates, Vernon, Johnson, Henry, St. Clair, Benton and Hickory counties. This represented nearly 4% of the wildfires in the state with over 49,000 acres burned.

There are numerous ways wildfires can be started, but when dealing with weather related phenomenon, namely lightning, only 0.8% of the wildfires in the Clinton fire district were the result of lightning.

Drought and wildfires can, and often do accom-

Tornado Information

Benton County lies at the eastern edge of tornado ally and receives on average 2 tornadoes every three years. From 1950 to 2002 Benton county recorded 18 tornadoes from F0 to F3 in strength. The strongest tornado, an F3, passed across the county on the evening of March 15th, 1982. Along its 14 mile track it caused 2.5 million dollars in damage and injured 1.

Historical Tornadoes of Benton County

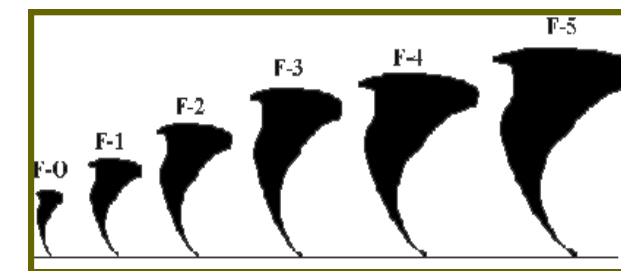
- May 15, 1943 (F3) 2 inj, 1 dead
- May 28, 1954 (F2) 0 inj, 0 dead
- Apr 20, 1973 (F2) 0 inj, 0 dead
- Apr 20, 1973 (F4) 3 inj, 0 dead
- Apr 20, 1973 (F3) 0 inj, 0 dead
- Mar 15, 1982 (F3) 1 inj, 0 dead

For the Record Benton County

- Has experienced one F4 tornadoes.
- No F5 tornadoes
- Most recent Tornado Jan 7, 2008 (F0)
- 1 deaths and 11 injuries since 1880.

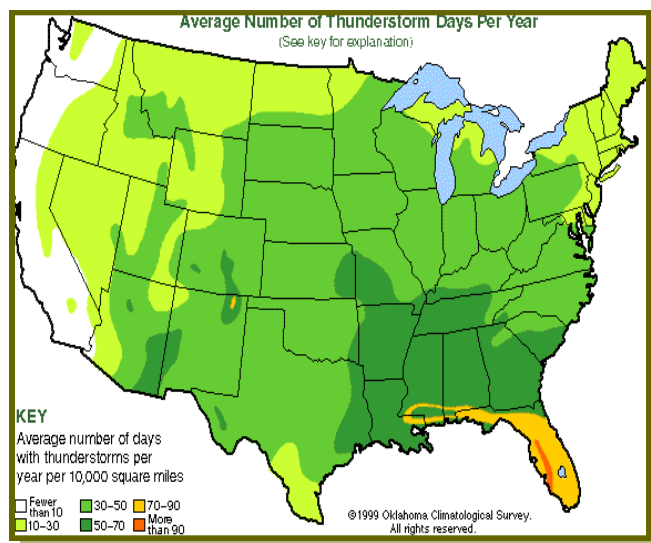


An F3 tornado touched down north of Decaturville and resulted in the deaths of three individuals in residences along Highway 5 southeast of Camden-ton. The tornadic storm earlier produced a deadly tornado in northern Dallas County then moved across the northwest corner of Laclede County before again producing a tornado to the southwest of Camden-ton near Tunnel Dam Road.



- **F-0:** 40-72 mph, chimney damage, tree branches broken
- **F-1:** 73-112 mph, mobile homes pushed off foundation or overturned
- **F-2:** 113-157 mph, considerable damage, mobile homes demolished, trees uprooted
- **F-3:** 158-205 mph, roofs and walls torn down, trains overturned, cars thrown
- **F-4:** 207-260 mph, well-constructed walls leveled
- **F-5:** 261-318 mph, homes lifted off foundation and carried considerable distances, autos thrown as far as 100 meters.

Severe Hail, Lightning, Wind and Winter Weather



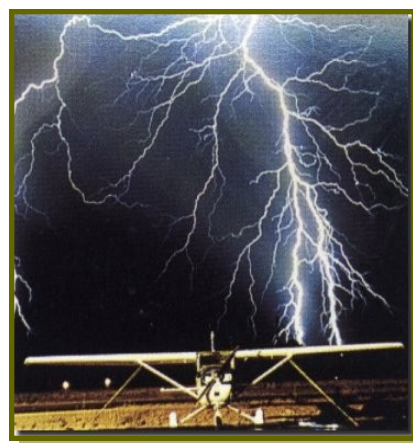
Average number of thunderstorm days per year.

Thunderstorms occur in the Ozarks on the average of 50 days per year.

April and May are the two most active hail months in the Ozarks. There is also evidence of a minor secondary peak in September. The greatest number of hail reports over 2 inches occur in the months of April, May and June with the largest report being 2.00 inches in diameter in Benton county on June 18, 1998. Hail can cause considerable damage to homes, vehicles, and crops.

Severe thunderstorm winds are defined by the NWS as convective wind gusts that reach or exceed 50 knots (58 mph). June is the most active month with April a close second. In general, the most active period for damaging wind events occurs from April to August. This is due in part to the shift from supercell thunderstorms to large clusters of storms and squall lines. The highest wind gust recorded in Benton county reached 92 mph and occurred in 2003 on the 12th of March. Since 1964 high winds have caused around \$784,000.00 in damages.

With any thunderstorm, lightning will be present and the safest place to be is indoors. In August of 2002, four people were killed near Willard in Greene County during a funeral. As a thunderstorm moved into the area, the victims sought shelter under a tree.



Nationally, Missouri ranks 27th in Lightning fatality rate, 44th in injuries and 38th in property damage related to lightning. During the period from 1960 to 1994, the total number of lightning casualties in Missouri was 165. This is nearly five casualties per year in the state.

Winter weather across the Ozarks comes in many forms. Freezing rain or drizzle, sleet and snow are common occurrences during the winter season. In the past the Ozarks have had up to 54 inches of snow, Sleet storms that produced inches of sleet and ice storms that laid a covering of one to two inches of ice on most surfaces. While the immediate impact of these storms is to travel, winter storms cause hundreds of thousands of dollars in damages across the region on a near yearly basis.

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21 Feb 2001: Sleet, freezing rain and embedded thunderstorms caused ice accumulations from one quarter, up to two inches in places across southwest, central and south central Missouri. The heaviest ice accumulations occurred along and north of Highway 60, and along the I-44 corridor. Howell-Oregon electric cooperative reported numerous power outages due to the ice around the communities of Willow Springs, Birch Tree, Mountain View, Winona, Eminence and Dora.

Flooding

From 1993 to 2002 Flooding has occurred in Benton County in every year. While usually nuisance flooding such as water on city streets, significant flooding has caused numerous problems in the county. During the previous decade, only one injury and no deaths have been attributed to flooding in Benton County. Benton County contains numerous low water crossings.

Typically, flooding in the county is caused by heavy rainfall associated with high rain producing thunderstorms which move very slowly. In towns, rainfall of one to two inches will cause streets and ditches to flood and make some low water crossings impassable. When rainfall rates reach 3 to 4

inches, major flooding can occur, and amounts over four inches creates significant flooding that affects most of the county.

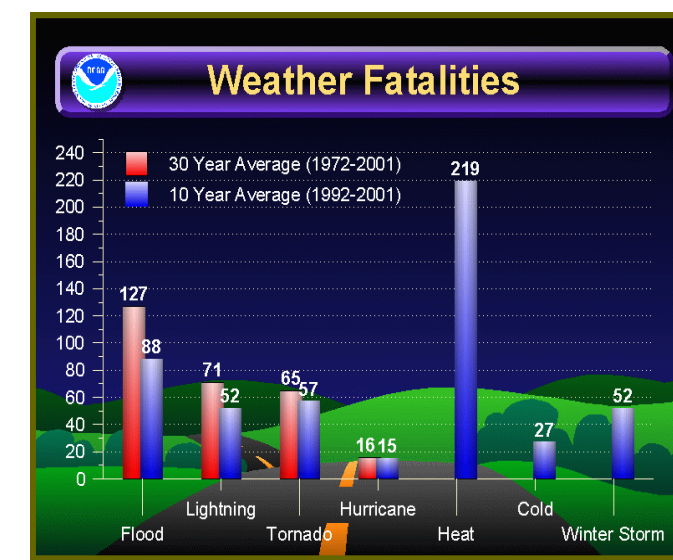


Floods in Benton County

27 June 1999: A complex of thunderstorms produced 3 to 6 inches of rain over portions of central and west central Missouri which led to widespread flooding of low lying areas. The hardest hit area was in northern Benton County where some roads were washed out and damaged.

21 July 1996: Two young women drowned when their car was swept off a flooded low water bridge. The bridge was covered by 2 feet of water. The current took the car about a half-mile downstream.

10 Apr 1994: Several periods of thunderstorms pounded the county with heavy rain and triggered



National Weather Fatality Statistics

widespread flash flooding. Flooding was severe in Warsaw where several houses were evacuated. The Sheriff's Department received reports of flooding in many locations not normally prone to flooding. Several National Weather Service employees could not report to work since the heavy rain flooded so many roads. Flooded roads included Highway 83 south of Warsaw and Highway 7 southeast of Warsaw. On Highway 7 several vehicles stalled on a bridge. One man left his car to find a telephone to call a tow truck. When he returned he discovered his car had been washed away by the strong current.

