UofA UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE

Agriculture and Natural Resources

FSA1024

Tornado Safety

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Tornadoes can be deadly. With good warning systems, you can be alerted before the tornado is visible. This additional time makes tornado survival more likely. During bad weather, you must be alert and tune in for warnings. If a tornado should strike, well-made plans for emergency shelter can overcome this disaster and bring you, your family and your community through without personal injury.

What You Can Do Before the Storm

- Develop an emergency storm plan for all family members whether at home, work, school or outdoors.
- Teach children their county and neighboring counties because storm alerts are given by counties. Keep highway maps in several convenient locations to follow storm movements given by weather bulletins.
- Conduct frequent storm drills.
- Have a NOAA Weather Radio All Hazards with a battery backup and warning alarm to receive warnings.
- Listen to TV or radio for weather updates.
- If your activity is outdoors, listen to the latest forecasts and take necessary precautions (possibly delaying activities until the danger is past) during threatening weather.

If a Tornado Warning Is Issued or Threatening Weather Approaches

- Move to a previously designated safe area, preferably a basement.
- If an underground shelter or "safe room" is not available, move to an interior room or hallway on the lowest floor. Crouching under a

Know the Difference Between a Tornado Watch and a Tornado Warning

TORNADO WATCH…Tornadoes are possible in your area. Remain alert for approaching storms. Listen to NOAA Weather Radio All Hazards, commercial TV or radio for weather information.

TORNADO WARNING…A tornado has been sighted or indicated by weather radar. If you may be in the path of the storm, move to a previously designated safe area.

Tornado watches and warnings are issued as soon as the conditions are identified. Use the available time, once you note a warning, to prepare for one of nature's most destructive storms. Stay informed about the approaching storm.

Sometimes tornadoes develop so rapidly that advance warning is not possible. Remain alert for signs of an approaching tornado.

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Doppler Radar

Do you know that new Doppler radar units can detect tornadoes that are forming? Doppler radar measures wind speeds and the direction of air currents within storms. This capability really enhances identification because a tornado is simply a violently rotating column of air, a pendant from a cumulonimbus (thunderstorm) cloud. Several years ago radar gave only rainfall intensity and "storm conditions." Doppler radar capabilities improve the accuracy and timeliness of National Weather Service bulletins.

Doppler radar units are located at National Weather Service offices in Little Rock and Fort Smith, Arkansas; Memphis, Tennessee; Tulsa, Oklahoma; Jackson, Mississippi; Shreveport, Louisiana; and Springfield, Missouri.

sturdy desk or rugged furniture is advisable if it is located near a central wall. Place pillows or blankets over your head and upper body for extra protection.

- Stay away from doors and windows.
- Do not try to outrun a tornado in your vehicle. Instead, leave it immediately.
- If caught in a vehicle, your best option is to buckle your seat belt and try to drive to the closest sturdy shelter.
- Taking shelter under highway overpasses is very dangerous.
- If you see flying debris while you are driving, pull over and park.
- The following options should be used only as a last resort, taking into account your specific circumstances:
  a) Stay in your vehicle with the seat belt on; put your head down below the windows, covering with your hands and a blanket if possible.
  b) If you can safely get noticeably lower than the level of the roadway, get out of the car and lay in a ditch or depression, covering your head with your hands.

If a tornado strikes, watch out for fallen power lines. Stay out of damaged areas until power is disconnected to avoid accidental electrical shock.

Arkansas Statistics

Tornadoes occur in many parts of the world. However, three-fourths of the world's tornadoes occur in the United States. These violent storms occur most frequently east of the Rocky Mountains during the spring and summer months. Arkansas is located in the lower Mississippi Valley where warm, moist air flowing northward from the Gulf of Mexico interacts with cool, dry air spreading southward and eastward from the Great Plains.

During the 60 years from January 1, 1950, through December 31, 2010, a total of 1,897 tornadoes have struck Arkansas. Records show that they can occur any day of the year and any time of day. Tornado preparation requires constant vigilance.

Table 1. Some Notable Arkansas Tornadoes

Date	Location	Deaths	Injuries
March 8, 1909	Sheridan to Northeast of Brinkley	58	633
January 3, 1949	Hopewell–Warren	57 *	402 *
April 10, 1929	South of Batesville (Independence Co.), North of Centerville (Jackson Co.)	23	59
March 21, 1952	Searcy–Judsonia–Kensett–Bald Knob	57	346
March 21, 1952	Hazen–Cotton Plant–Marked Tree	40	274
May 15, 1968	Jonesboro	34	350
December 14, 1987	West Memphis	6	200
April 21, 1996**	Fort Smith to Rudy	2	89
March 1, 1997	Southeast of Bryant to Prothro Junction	15	220
March 1, 1997	Hope to East of Malvern	6	113
February 4 and 5, 2008	Atkins (Pope Co.) to Clinton (Van Buren Co.), Mountain View (Stone Co.) and Highland (Sharp Co.)	14	175
December 31, 2010	Cincinnati (Washington Co.)	4	10

***Total of 58 deaths and 439 injuries in Arkansas and Louisiana.**
****Produced $300 million damage.**

Table 2. Tornado Occurrences by Month, 1950-2010*

Yrs.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
50-59	9	20	33	33	24	9	6	2	2	3	11	4
60-69	6	16	30	35	44	9	7	5	4	1	9	2
70-79	10	14	26	83	39	19	12	8	11	5	20	18
80-89	4	1	13	57	29	9	5	0	3	12	17	34
90-99	76	6	54	43	36	24	13	2	10	12	18	6
00-10	13	43	28	92	124	4	12	0	33	31	56	42
Total	**118**	**100**	**184**	**343**	**296**	**74**	**55**	**17**	**63**	**64**	**131**	**106**

***National Weather Service Records**

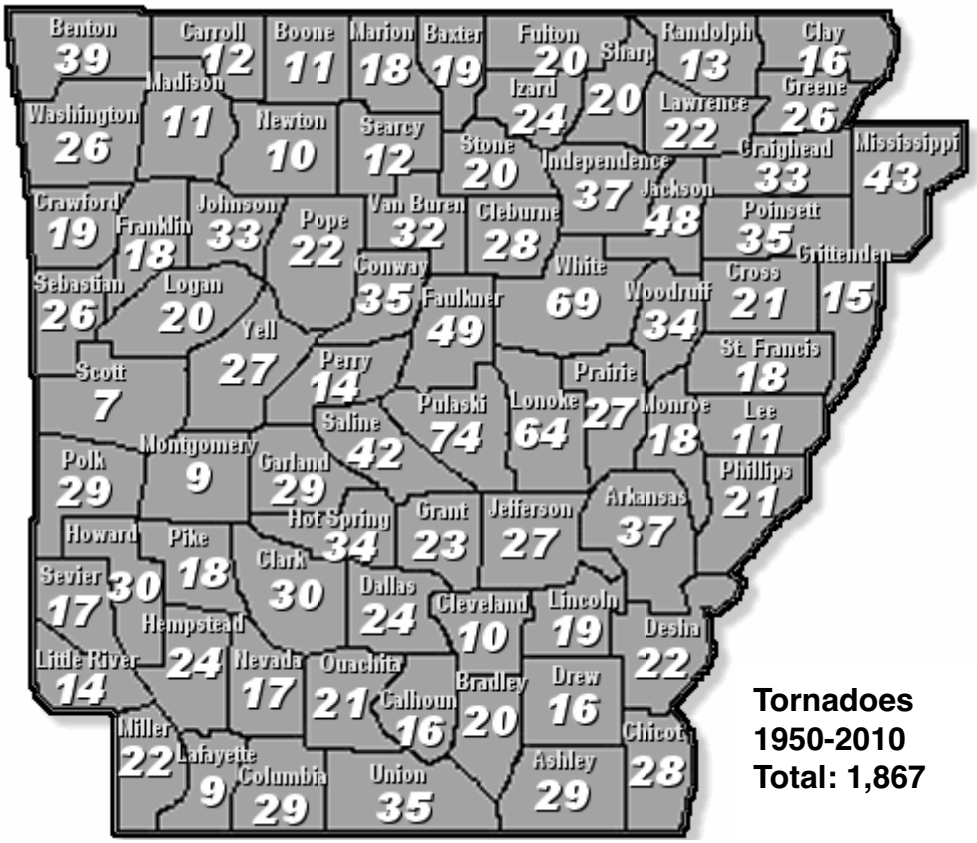
While tornadoes in Arkansas normally occur during the spring and fall months, they can occur in any month. A total of 68 tornadoes occurred in January 1999. This set a national record for the greatest number of tornadoes in the month of January. During 1999, 107 tornadoes were sighted, setting a new record for Arkansas. Lately, in 2010, a total of 33 tornadoes struck in Arkansas.

Tornadoes occur with greater frequency during late afternoon to late evening, according to the National Weather Service records. In Arkansas, five in the afternoon is the time of the maximum tornado incidence.

The greater tornado frequency during afternoons and evenings can largely be explained from patterns of increased instability in the atmosphere. This air instability results from a buildup of heat near the earth's surface on warm afternoons. After sunset the layer of heated air near the earth's surface begins to cool. This usually restores more atmospheric stability and reduces the threat of tornadoes.

Any period of unseasonably warm and humid conditions should prompt you be cautious because of the possibility of a tornado. Monitor weather bulletins and watch the sky during approaching thunderstorms. Violently moving clouds indicate high air velocities, which may develop into a tornado.

Figure 1. Number of Tornadoes in Each County From 1950-2010 According to National Weather Service Records



Tornadoes 1950-2010 Total: 1,867

Note: Table 2 showing tornadoes by month reflects the actual number of tornadoes that occurred in Arkansas. If a tornado traveled through more than one county, it is shown only once in the table. In contrast, the map showing tornadoes from 1950 through 2010 (Figure 1) reflects tornadoes by county. For example, if a tornado traveled through three counties, it would be counted three times on the map, once for each county it affected. As a result, the total number of tornadoes indicated on the map is larger than that shown in Table 2.

Tornadoes have killed a total of 367 and injured 5,019 in Arkansas from January 1, 1950, through February 21, 2011 (*http://www4.ncdc.noaa.gov*). A "killer" tornado is a tornado that causes the death of at least one person. The worst killer storms in the state's history occurred March 21, 1952. That day three tornadoes killed 111 persons and injured an additional 772. In recent years, an average of four Arkansans has died from tornadoes each year.

Tornado Severity

Tornado intensity is now measured according to the Enhanced Fujita Scale (EF-scale), which is based on damage to structures.

Table 3. Enhanced Fujita Scale for Tornado

EF Number	Intensity	Three-Second Gust (mph)
0	Gale	65-85
1	Weak	86-110
2	Strong	111-135
3	Severe	136-165
4	Devastating	166-200
5	Incredible	Over 200

Note: The Enhanced F-scale still is a set of wind estimates (not measurements) based on damage.

In April 2009, an F3 tornado hit Mena, Arkansas, killing three people, injuring two dozen and damaging or destroying more than 100 buildings.

Tornado Variability

Recognizing conditions that may develop into tornadic winds is the first major step in avoiding this cruel disaster. Weather broadcasts can help avert tragedy. Be prepared to find suitable protection. Flying debris from tornadoes causes most deaths and injuries. Most tornado damage is probably caused by winds of 125 mph or less; however, maximum wind speeds may exceed 200 mph. The most damaging storm occurred in the Fort Smith-Van Buren areas on April 21, 1996, with associated costs around $300 million.

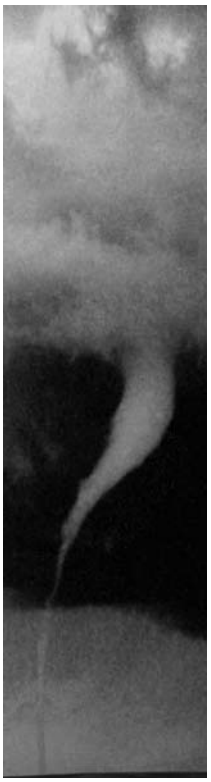
Surface winds in connection with developing tornadoes are usually from the southwest. Sixty-four percent of the tornadoes in Arkansas move from the southwest to the northeast, but tornadoes can come from any direction. Some tornadoes have stopped their forward movement, turned and looped back across their path. Their average speed of advance is 30 mph, but a few move as fast as 70 mph.

The diversity of their approach patterns and speed demands alertness, especially after a tornado warning has been issued for your area. Refrain from driving to locate family or friends. Make phone calls to notify those who may have missed the tornado warning broadcast, but keep an alert eye on the sky.

Tornado Identification

Violent storms associated with low barometric pressure can spawn a tornado. Strong winds in the lower few thousand feet of the atmosphere may be noted by cloud movements. The storm cells develop from an elevation of 20,000 to 40,000 feet. Rotation of air (cloud movement) usually starts with a circulation near 20,000 feet and builds up and down.

Tornadoes often form near a thunderstorm's updraft. Often surface winds of 25 to 35 miles per hour are noted near a developing tornado. Small clouds will rise quickly into the larger cloud layer. Near a tornado, the barometric pressure drops rapidly. The characteristic funnel may drop down, loop and appear to dissipate at times.



If a funnel is sighted, take shelter immediately. Tornadoes can reach you within a few minutes. Other funnels can spawn directly overhead.

Tornadoes may "mature" in a classic fashion. However, be aware that violent storm cells can cause two or more circulations. It is important to have a good view of the entire sky to avoid being surprised by another funnel obscured behind a ridge, buildings or a row of trees.

Any time you are observing a storm, be alert to the potential of being struck by lightning. Anyone standing near a tree or house that projects above the landscape during violent weather risks being in the deadly path of lightning discharge. Any vertical projections, especially metal structures, can readily attract a fatal electrical current.

Tornadoes occur all over Arkansas. It is important to have a tornado plan and to review it annually. If changes in a community warning system have occurred or a better shelter is now available nearby, take advantage of the new opportunities. Steps to survive a tornado are simpler and more important than earthquake precautions.

Disaster Plans

Follow these basic steps to develop a family tornado disaster plan:

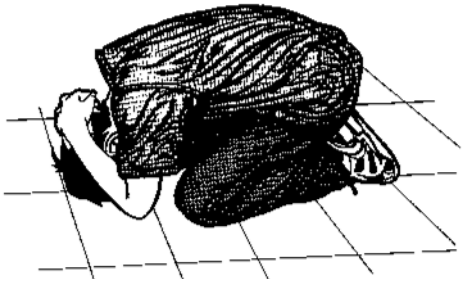
- Find out if your community has tornado warning sirens. Learn your community's warning signals and evacuation plans. Locate the safest areas in your home. To be better prepared for a tornado, contact your local National Weather Service office, local Office of Emergency Management, American Red Cross chapter or county Cooperative Extension office to determine what they can provide.
- Meet with your family to create a plan. Discuss the tornado warning measures available to you. Point out the safest areas in your home to assure that everyone knows where to go for shelter. A storm cellar or safe room offers the best protection. Funds to assist in the construction of safe rooms may be available from the Arkansas Department of Emergency Management (*www.adem.arkansas.gov*).
- Practice emergency drills and maintain your plan. Ask questions to make sure each family member remembers the meeting place. Assemble in the assigned tornado shelter. Remind each one to use the telephone only if there is no immediate danger and then only to notify other family members of the violent weather concern or tornado watch. Post emergency phone numbers and safety rules by the telephone. Teach children how and when to call 911 or the local emergency medical service number.
- Improve your plan. (a) Review the emergency phone numbers posted by the telephones. (b) Install fire extinguishers and make other safety improvements to your house. (c) Teach your family how to use a fire extinguisher and how and when to turn off water, gas and electricity. (d) Review basic safety measures and/or enroll in CPR and first aid classes. (e) Maintain supplies in your home to meet your emergency needs for at least three days. Assemble a disaster supply kit with items needed for an evacuation. Store these supplies in sturdy, easy-to-carry containers such as backpacks or duffel bags.
- Protect valuable records. Maintain a safety deposit box for family and business papers that cannot be replaced. Review specific wind and flood damage protection provided by your insurance policy. Prepare records that will help verify losses for insurance, tax or federal disaster declarations.
- Test and recharge (as needed) your fire extinguishers according to the manufacturer's instructions.
- Replace stored water every six months.

School Disaster Plans

(Hospitals, nursing homes and other institutions should develop similar plans.)

- Develop a severe weather action plan and have frequent drills.
- Assign responsibility for activating the severe weather plan. This includes assuring severe weather is continually monitored with NOAA Weather Radio All Hazards and local TV/radio.
- Make sure several leaders know how to turn off electricity and gas in the event the school is damaged.
- Each school structure should be inspected and tornado shelter areas designated by a registered engineer or architect. Schools without safe rooms or basements should use interior rooms and hallways on the lowest floor and away from windows.
- If the primary power for the school's alarm is electricity, provide a charged-battery backup or have a compressed air horn or megaphone to activate the alarm during power outages.

- Have provisions for disabled students and those in portable classrooms.
- Move students quickly into interior rooms or hallways on the lowest floor. Have them assume the tornado protection position with their heads against the wall.



Tornado protection position

- Lunches, classes or assemblies in large, free-span cafeterias or auditoriums should be delayed if severe weather is anticipated.
- Keep children at school beyond regular hours if threatening weather is expected. Children are safer at school than in a bus or car. Students should not be sent home early if severe weather is approaching.

Do not remain in auditoriums, cafeterias, gymnasiums or other structures with wide, free-span roofs because they offer no protection from tornado-strength winds.

NOAA Weather Radio

Weather information can be received 24 hours a day from NOAA Weather Radio All Hazards. In Arkansas, this is a joint effort between the National Weather Service and the state. The latest weather information is broadcast all day and all night, including severe weather details.

Special radio receivers are available at radio shops, electronics stores, department stores and discount stores. Many multiband radios and scanners can also receive these frequencies.

Some radio receivers have a "warning alarm" feature for severe weather watches or warnings that allows the National Weather Service to automatically turn on the radio, day or night. This warning alarm is tested each Wednesday between 11 a.m. and noon. If bad weather is occurring or is forecast, the test is postponed until the next good weather day.

Community Preparedness

A warning coordination meteorologist (WCM) is located at the National Weather Service office in Little Rock. The WCM assists officials at all levels of state and local government as well as private individuals. The WCM provides severe storm spotter training to local Office of Emergency Management personnel, HAM radio operators and local groups. The WCM also presents severe weather preparedness programs at school assemblies and civic meetings. To contact the

Table 4. NOAA Transmitter Locations and Assigned Frequencies (mhz) Serving Arkansas

Location	Frequency
Broken Bow, OK	162.45
Cherokee Village	162.475
Dyersburg, TN	162.50
El Dorado	162.525
Fayetteville	162.475
Fort Smith	162.55
Fountain Hill	162.475
Grove, OK	162.50
Gurdon	162.475
Harrison	162.525
High Peak	162.425
Iverness, MS	162.55
Jonesboro	162.55
Little Rock	162.55

Location	Frequency
Marvell	162.525
Memphis, TN	162.475
Mena	162.40
Morrilton	162.475
Mountain View	162.45
Mount Ida	162.425
Russell	162.40
Russellville	162.525
Springdale	162.40
Star City	162.40
Texarkana	162.55
Wardell, MO	162.525
Yellville	162.50

WCM, write to the National Weather Service Forecast Office, 8400 Remount Road, North Little Rock, Arkansas 72118; 501-834-0308.

Arkansas Department of Emergency Management personnel help prepare for and recover from disasters, including tornadoes. Contact your local Emergency Management coordinator or the Arkansas Department of Emergency Management (501-683-6700) to obtain information.

The University of Arkansas Division of Agriculture, Cooperative Extension Service, offers educational programs on tornado safety through 4-H, Extension Homemaker clubs or programs for the general public. If you would like an educational program on tornado safety, contact your county Extension office.

Tornado Safety Locations

Homes With Basements

Seek refuge near a basement wall in the most sheltered and deepest part of the basement below ground.

Homes Without Basements

Take cover in the smallest room with stout walls under heavy furniture or a tipped-over, sturdy, upholstered couch or chair near the center of the house. The first floor is safer than the second or third. Don't take time to open or close windows; get away from them and go to a safe area immediately. Construction of a storm cellar is particularly advisable for those in homes without basements.

Mobile Homes and Modular Buildings

Abandon mobile homes. Arrange for use of a convenient safe area in advance should violent weather occur. Consider basements, a storm cellar or safe room, the ground floor of a sturdy structure or a nearby culvert or deep ditch.

Factories, Auditoriums and Other Large Buildings With Wide, Free-Span Roofs

These buildings are particularly vulnerable to tornadic wind damage due to the large roof expanse upon which wind forces act and the distance between roof-supporting walls. Basements of these buildings offer reasonably good protection. Smaller interior rooms at ground level or nearby sturdy buildings are options, depending on their construction and the urgency for shelter. Pre-select and mark designated safe areas. Hold tornado safety drills. Train building employees to direct occupants to designated safe areas. Trained spotters should assume their posts as soon as conditions become threatening.

Office Buildings

The basement or an interior hallway on a lower floor of an office building is safest. Upper stories are unsafe. If there is not time to reach one of the lower floors, a small room with stout walls (closet or bathroom) or an inside hallway provides some protection against flying debris. Otherwise, getting under heavy furniture must do. Select and mark designated safe areas in office buildings. Train employees to direct occupants to designated areas.

Note: The Arkansas Department of Emergency Management and some local fire departments maintain a current set of criteria or specifications for a "safe room." Following these construction guidelines closely will provide a sturdy safe room if a storm cellar or basement is not accessible during a tornado warning.

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