

TORNADOS – Hazard Description

What is a tornado?

(from the Federal Emergency Management Agency)

Tornadoes are nature's most violent storms. Spawned from powerful thunderstorms, tornadoes can cause fatalities and devastate a neighborhood in seconds. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long. Every state is at some risk from this hazard.

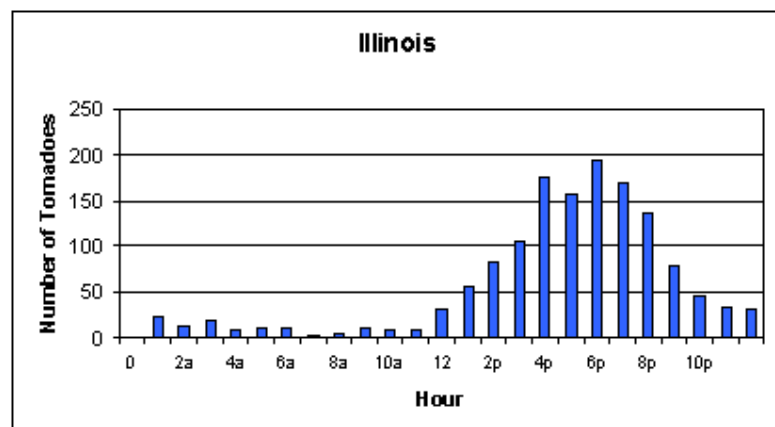
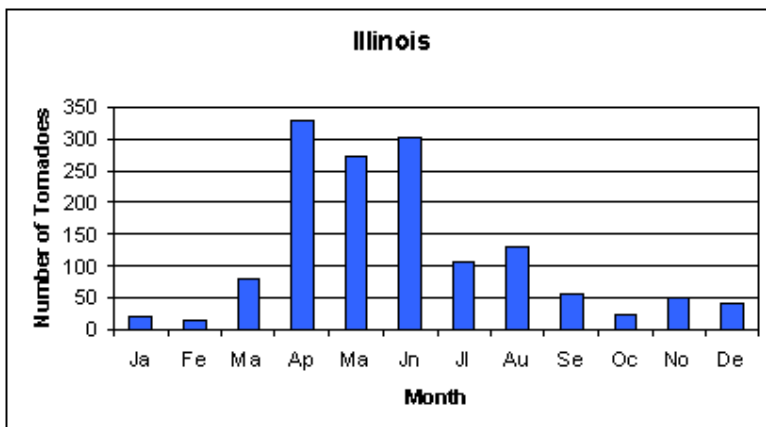
Some tornadoes are clearly visible, while rain or nearby low-hanging clouds obscure others. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible.

Before a tornado hits, the wind may die down and the air may become very still. A cloud of debris can mark the location of a tornado even if a funnel is not visible. Tornadoes generally occur near the trailing edge of a thunderstorm. It is not uncommon to see clear, sunlit skies behind a tornado.

The following are facts about tornadoes:

- They may strike quickly, with little or no warning.
- They may appear nearly transparent until dust and debris are picked up or a cloud forms in the funnel.
- The average tornado moves southwest to northeast, but tornadoes have been known to move in any direction.
- The average forward speed of a tornado is 30 MPH, but may vary from stationary to 70 MPH.
- Waterspouts are tornadoes that form over water.
- Tornadoes are most frequently reported east of the Rocky Mountains during spring and summer months.
- Peak tornado season in the southern states is March through May; in the northern states, it is late spring through early summer.
- Tornadoes are most likely to occur between 3 p.m. and 9 p.m., but can occur at any time.

Figure 1-1 Previous Illinois Tornado Occurrences
(from: Illinois State Water Survey)



How are tornados rated?

The classification system used for tornados is the Fujita Scale, which is based on wind speed and damage caused. The original scale is shown in Figure 1-2. On February 1, 2007 an Enhanced Fujita Scale was implemented, although it would not apply to the historical data shown for Sangamon County in Figure 1-4.

Figure 1-2 Original Fujita Scale (from: Illinois State Water Survey)

Scale	Wind Speeds	Typical Damage
F-0	40-72 mph	tree branches broken
F-1	73-112 mph	mobile homes pushed off foundation
F-2	113-157 mph	considerable damage, mobile home demolished, trees uprooted
F-3	158-205 mph	roofs and walls blown down, cars thrown
F-4	207-260 mph	well-constructed buildings leveled
F-5	261-318 mph	massive destruction, autos thrown as far as 100 meters

Figure 1-3 Comparison of Fujita Scale and Enhanced Fujita Scale

Fujita Scale			Enhanced Fujita Scale	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85
1	73-112	79-117	1	86-110
2	113-157	118-161	2	111-135
3	158-207	162-209	3	136-165
4	208-260	210-261	4	166-200
5	261-318	262-317	5	Over 200

The extent of previous occurrences of tornados in Sangamon County.

Figure 1-4 Tornados Reported in Sangamon County from January 1, 1950 – December 1, 2007
(from: National Climatic Data Center and National Weather Service*)

Year	Date	Time	Magnitude	Deaths	Injuries	\$Property Damage
1954	3/12/1954	6:00 PM	F1	0	0	250K
1957	5/13/1957	11:00 AM	F1	0	0	0
	6/14/1957	2:00 PM	F4	2	50	2.5M
1960	6/23/1960	2:50 AM	F2	0	0	250K
1961	5/14/1961	10:10 PM	F1	0	0	250K
1962	5/26/1962	5:30 AM	F2	0	0	3K
1963	4/22/1963	5:30 PM	F3	1	5	250K
1964	4/2/1964	6:45 PM	F2	0	0	25K
1973	6/16/1973	9:58 PM	F0	0	0	0
1975	8/14/1975	5:58 PM	F2	0	0	25K
	11/29/1975	11:20 PM	F1	0	1	250K
1977	8/6/1977	3:25 - 4:10 PM	6-F0, 9-F1, 1-F2, 1-F3	0	0	3.8M
1978	7/26/1978	3:30 PM	F?	0	0	250K
1980	7/10/1980	5:00 AM	F2	0	0	250K
1981	6/8/1981	8:40 PM	F0	0	0	0
1985	7/14/1985	11:44 PM	F0	0	0	25K
1986	5/16/1986	4:20 - 4:25 PM	2-F0	0	0	0
1988	5/8/1988	5:18 PM	F2	0	0	250K
1990	6/2/1990	4:30 PM	F1	0	0	25K
	6/20/1990	12:15 AM	F1	0	0	25K
1996	4/19/1996	5:32 PM	F0	0	0	250K
	5/27/1996	9:45 PM	F0	0	0	0
1998	6/29/1998	4:30 - 4:36 PM	2-F0	0	0	130K
1999	4/8/1999	7:53 PM	F0	0	0	0
2000	4/20/2000	8:05 AM	F0	0	0	0
	5/12/2000	3:30 PM	F0	0	0	0
	6/20/2000	6:44 PM	F0	0	0	1K
2003	3/19/2003	1:25 PM	F0	0	0	0
	5/9/2003	6:40 PM	F0	0	0	0
	5/10/2003	6:53 - 6:58 AM	3-F0	0	0	45K
	6/11/2003	5:20 - 5:22 AM	2-F0	0	0	0
2004	5/23/2004	6:27 PM	F0	0	0	0
	5/24/2004	11:09 PM	F1	0	0	0
	8/26/2004	5:09 PM	F0	0	0	0
2006	3/12/2006*	8:00 - 8:32PM	1-F1, 3-F2	0	0	unknown
	4/2/2006*	5:46 - 6:13 PM	1-F0, 6-F1	0	0	Unknown
2007	9/6/2007*	5:28 PM	F0	0	0	0

The locations affected by tornados.

Tornados can and have occurred throughout the County. The paths of the tornados recorded from 1950 – 2005 are shown in Figure 1-5 and the paths of the 2006 tornados are shown in Figure 1-6 and Figure 1-7.

Figure 1-5 (from: National Weather Service)

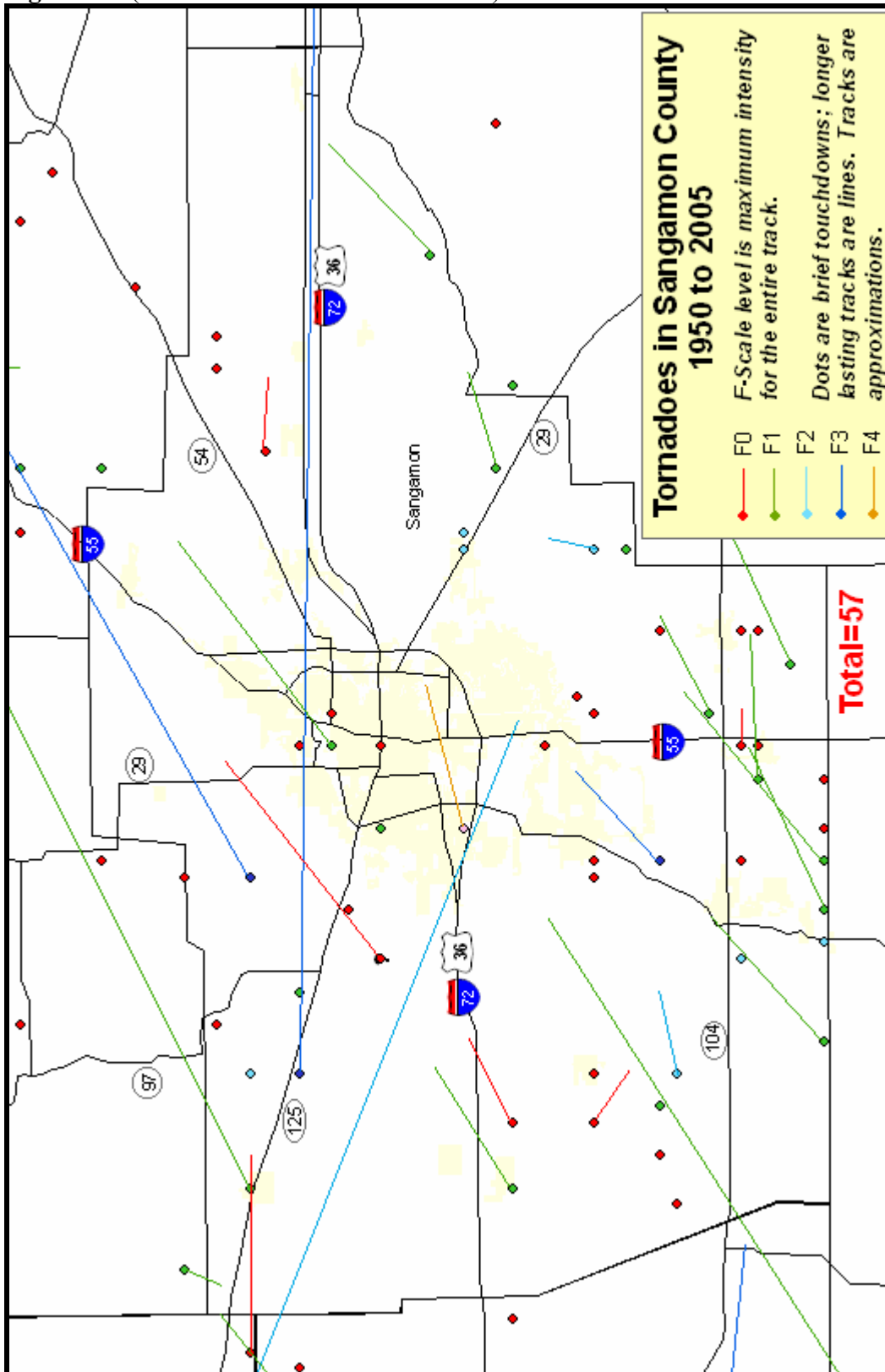


Figure 1-6 (from: National Weather Service)

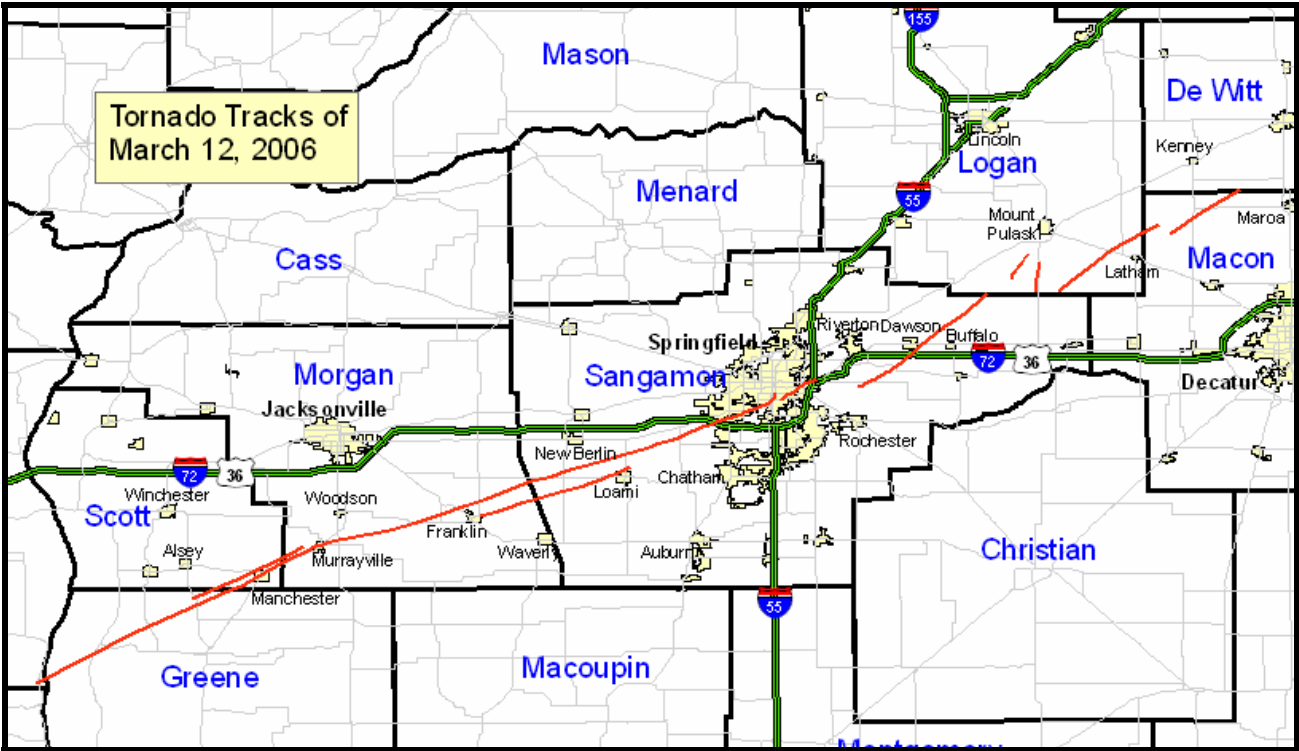
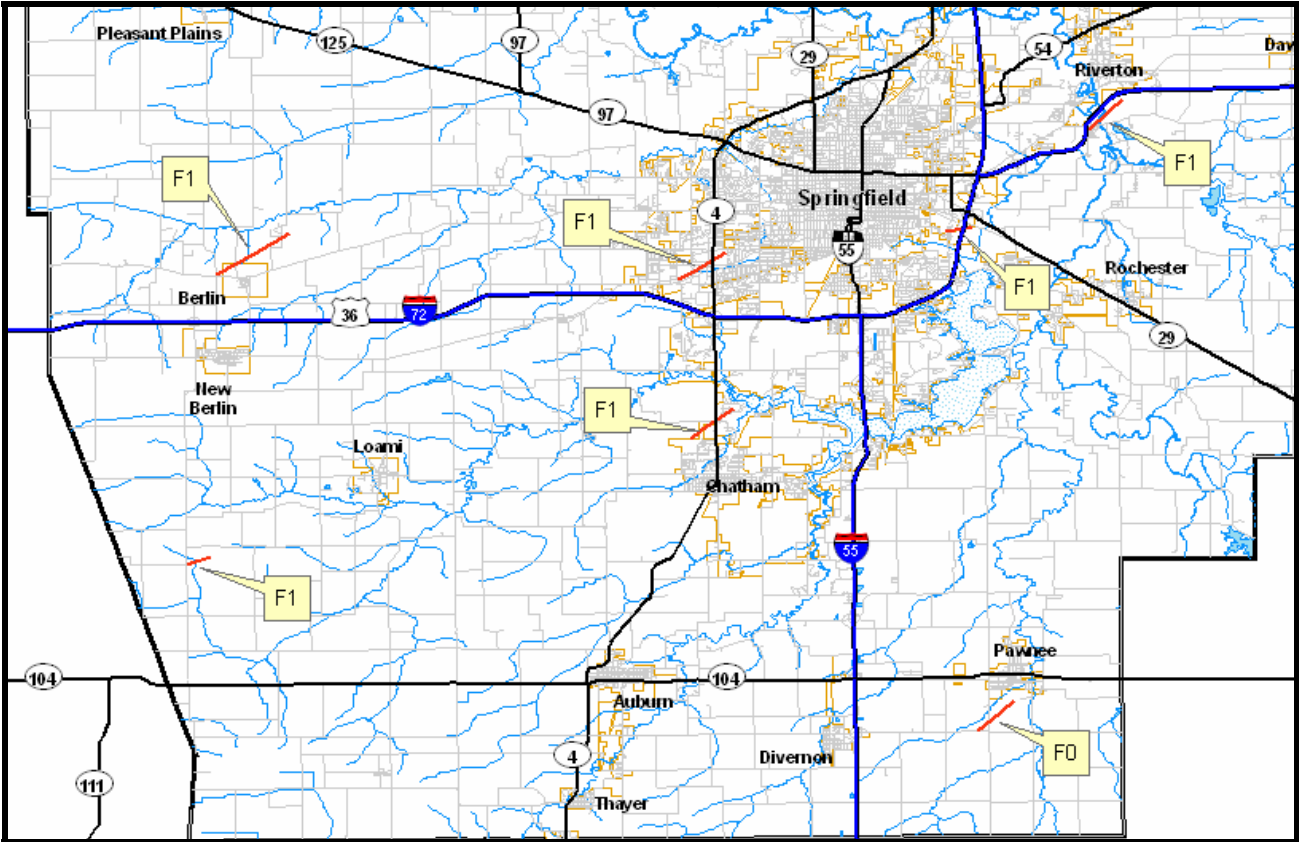


Figure 1-7 April 2, 2007 Tornadoes (from: National Weather Service)



Previous occurrences.

Central Illinois is a prime area for tornados. During the time period of January 1, 1950 through December 1, 2007 there were 67 tornados reported during 37 weather events, 7 of which included more than one tornado (see figure 1-4). Sangamon County ranks second in the State, only behind McLean County, for number of tornados during this time period. Sangamon County is fourth in the State for number of tornados per square mile, behind Logan, Macon, and McLean Counties. Following is statistical data related to tornado events.

Figure 1-8 Sangamon County Tornados 1/1/1950-12/1/2007

Time of Day	Number of Events	Number of Tornados
5:00 am – 8:00 am	6	9
11:00 am	1	1
1:00 pm – 2:00 pm	2	2
3:00 pm – 10:10 pm	23	50
11:00 pm – 2:50 am	5	5
TOTAL	37	67

Month	Number of Events	Number of Tornados
January	0	0
February	0	0
March	3	6
April	6	12
May	11	14
June	9	11
July	3	3
August	3	19
September	1	1
October	0	0
November	1	1
December	0	0
TOTAL	37	67

Magnitude	Number of Tornados	Percent of Total
F0	30	45 %
F1	23	34 %
F2	10	15 %
F3	2	3 %
F4	1	1.5 %
unknown	1	1.5 %
TOTAL	67	100 %

The months of April, May and June are the most likely time for weather events that spawn tornados, although in August 1977 one weather event produced 17 different tornados in the County.

Although most of Sangamon County's tornados have been of a lower magnitude, very destructive tornados can and do occur.

Seventy-nine percent of the tornados that occurred from 1950 - 2007 have been of the lower magnitudes, F0 and F1, although up to \$250,000 damage per event has been reported. Fifteen percent have been rated F2, while the remaining 3% were F3 or F4.

Seven times a single weather event produced more than one tornado. In August 1977 seventeen tornados touched down over a 45 minute time period. Three people have been killed and 56 people injured by tornado events since 1950 in Sangamon County.

The most damaging tornado touched down on June 14, 1957 and was rated F4. It caused two deaths, fifty injuries, and \$2.5 million in property damage, including 25 homes that were completely destroyed and 175 homes that were severely damaged.

Probability of future events.

The paths, magnitudes, and numbers of tornados are unpredictable over time but with the history of tornado events in Sangamon County the probability of occurrence in any one year is fairly high. As seen in Figure 1-4 above, in the 58 year period from 1950 to 2007, there were 25 years when at least one tornado was recorded in Sangamon County. This indicates a 44% probability that a tornado will hit somewhere in Sangamon County in any given year. There were 7 years when more than one tornado was recorded during the 58 year period. This indicates a 12% probability that more than one tornado will touchdown in Sangamon County in any given year.

Recent tornado experiences in Sangamon County.

The tornados that came through the County in March 2006 were the most recent to cause major destruction and resulted in Presidential Disaster Declaration 1633. The two that came through Springfield and Jerome were rated as F2 and followed a path nearly identical to that of the F4 tornado that hit in 1957.

Although there was substantial property damage in 2006, no deaths or serious injuries were reported. The tornados varied in width from 100 yards to ½ mile. Many homes and businesses were damaged, some completely destroyed. Extensive damage occurred to electrical lines, telephone lines, and cable television lines with service unavailable for several days to over a week in areas hit by the tornados. There were numerous damaged and downed trees which in turn created damage to buildings, fences, utility lines, and vehicles and blocked roadways. Recovery efforts started immediately but with the extensive damage debris removal alone took many months and property owners waited months and in some cases over a year for building repairs to be completed. Some businesses never re-opened.

TORNADOS –Assessing Vulnerability

The magnitudes of tornados in Sangamon County have ranged from F0 – F4 although F5 tornados have occurred in other parts of Illinois so an F-5 tornado is not out of the realm of possibility here. The design wind speed for our area is 250 mph.

There is a high likelihood that a tornado in Sangamon County will be of a lower rating (F0 or F1) although substantial damage has occurred at these magnitudes. Although less likely, tornados of higher intensity have occurred and should be addressed in the calculation of potential damage.

An F4 tornado can cause substantial damage, leveling even well-constructed buildings. According to the Illinois State Water Survey website an F4 tornado can have a path over 1,200 feet wide and over 20 miles long. This would translate to approximately 4.5 square miles of damage.

The first F2 tornado to hit Springfield on March 12, 2006 had already been on the ground for 60 miles, approximately 13 of those miles through an unincorporated area of the County, and then continued for 5.5 miles through the urbanized area, with a width ranging from 900 feet to 2,640 feet.

Using the above information, the damage that could have been caused if the 2006 tornado had been of the magnitude of an F4 tornado is extrapolated as follows.

Unincorporated Area of Sangamon County

13 miles x 1,200 feet (.23 mile) width = 3 square miles or .4% of the entire unincorporated area

.004 x \$1,481,759,364 (total value of buildings in the unincorporated area) = \$5,927,037 if property damaged at 100% of value

Urbanized Area-Springfield

4.5 miles x 1,200 feet (.23 mile) = 1.035 square miles or 2% of the area of Springfield

.02 x \$5,479,316,679 (total value of buildings in Springfield) = \$109,586,334 if property damaged at 100% of value

Urbanized Area-Jerome

1 mile x 1,200 feet (.23 mile) = .23 square mile or 58 % of the area of Jerome

.58 x \$59,679,207 (total value of buildings in Jerome) = \$34,613,940 if property damaged at 100% of value

Total

\$5,927,037 + \$109,586,334 + \$34,613,940 = \$150,127,311 potential property damage at 100% of value

The above "value of buildings" figures are based on the property tax assessment-based market value. Since the damage to buildings caused by the F4 tornado in 1957 was complete or severe this would be a likely scenario for another such occurrence. An F4 tornado is estimated to damage 50% of a structures value. If the structure is a manufactured home, an F4 will result in 100% damage. Fifty percent damage of structures would be \$75,063,655. Since contents value is unknown but would also be destroyed as a result of a powerful tornado event as well as damage to vehicles, it would be conceivable that between \$75.1 and \$150.1 million in property damage could occur if an F4 tornado took the same path as the first tornado that hit Springfield in March 2006.

There is also the expectation that lives would be at great risk. The planning area has a population of 176,440 people (2000 U.S. Census) plus the area attracts tourists from around the world and commuters who travel here to work from nearby counties.

The economic loss to businesses and the community when workplaces are damaged is also a consideration. Businesses can be impacted in the short-term, such as downtime due to power outages, lack of access, and minor damage, or in the long-term if major damage occurs resulting in extended temporary closure or permanent closure.