

**CHAPTER THREE
SECTION 3.9
HAZARD PROFILE-LIGHTNING**

AFFECTED JURISDICTIONS

COMMUNITIES

- Unincorporated Pottawatomie County
- Town of Asher
- Town of Bethel Acres
- Town of Brooksville
- Town of Earlsboro
- Town of Johnson
- City of Maud
- Town of Macomb
- City of McLoud
- Town of Pink
- City of Shawnee
- Town of St. Louis
- City of Tecumseh
- Town of Tribbey
- Town of Wanette

PUBLIC SCHOOL DISTRICTS

- Asher Public Schools
- Bethel Public Schools
- Dale Public Schools
- Earlsboro Public Schools
- Grove School
- Macomb Public Schools
- Maud Public Schools
- Macomb Public Schools
- McLoud Public Schools
- North Rock Creek School
- Shawnee Public Schools
- South Rock Creek School
- Tecumseh Public Schools

TECHNOLOGY CENTERS

- Gordon Cooper Technology Center

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LIGHTNING



Lightning is a result of electrical charges accumulating at the base of the clouds until Lightning is discharged. Thunderstorms occur when moist air near the ground becomes heated, especially in the summer, and rises, forming cumulonimbus clouds that produce precipitation. Lightning is almost always a part of a Thunderstorm. Air in the path of the lightning expands as a result of being heated, causing thunder.

The sound produced by the electricity passing rapidly through the atmosphere causes thunder.

There are four forms of lightning, as shown in the pictures on the below and on the following page:

1) Cloud to Sky

2) Intra-Cloud

3) Inter-Cloud

4) Cloud to Ground

Cloud to Sky Lightning is a discharge jumping from a cloud into the surrounding sky. Other forms of lightning contain elements of Cloud to Sky lightning in the forks which extend from the main strike.



Intra-Cloud Lightning is the most common form of lightning, in which oppositely charged centers within the same cloud ignite and cause a bright flash within the same cloud.





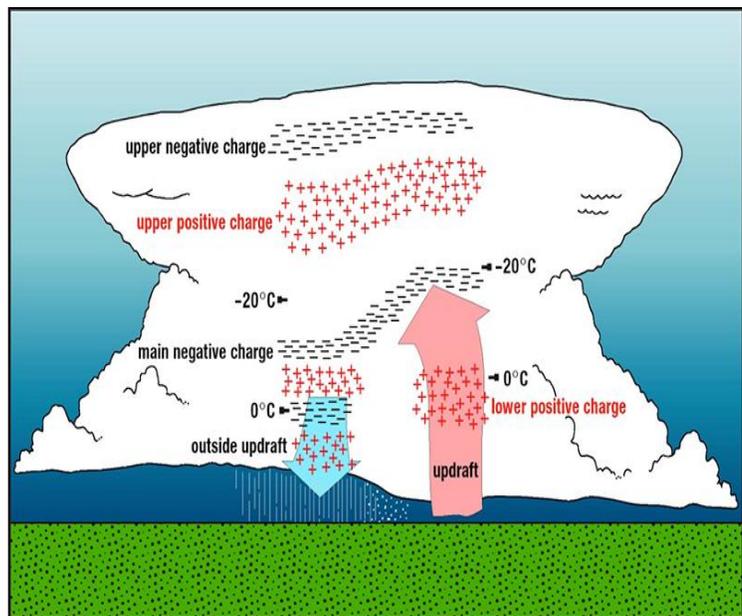
Inter-Cloud Lightning is lightning which occurs between oppositely charged areas of different clouds.

Cloud to Ground Lightning is the most dangerous form of lightning, in which the negatively charged bottom of the cloud travels to the positively charged ground below, or whatever object is highest, including the top of a building or a tall tree. It is not the most common form of lightning, but it is the most recognized. It is possible for positive charges to flow from higher parts of the thundercloud to the ground, though this more rare.



All types of lightning are dangerous, and Pottawatomie County and jurisdictional officials consider any lightning event as a concern. Lightning is a thunderstorm's number two killer each year in the U.S. Hazards associated with lightning include the following:

Direct Strike: This is the most dangerous hazard, wherein the person or structure is a direct path for lightning currents to seek ground. The magnitude of the current



determines its effects. The typical amperage of 20kA acting on a ground of 10 ohms creates 200,000V. A large strike can attain 150kA levels.

Side Strike: This hazard results from the breakup of the direct strike when an alternate path offers some resistance to current flow, a potential strike above ground develops and the person or structure's resistance to ground becomes the alternate path of conduction.

Conducted Strike: This hazard occurs when lightning strikes a conductor and introduces a current into an area some distance from the ground strike point. Unprotected connected equipment is damaged and personnel injured if they become an indirect path in the completion of the ground circuit.

Structure Voltage Gradient: Current passing through two or more structures creates momentary voltage differentials. Poor interconnect bonding may cause a completed circuit potential difference. A grounded person touching an ungrounded object creates the same hazard, for example, and completes the electrical circuit, sometimes with fatal consequences.

Induced Effects: Lightning can induce electric and magnetic fields coupling into structures and into wiring. Magnetic coupling is transformer action, and the common laws for transformers prevail.

Streamer Conductor: The streamer hazard occurs when a lightning leader influences the electric behavior of objects on the earth. Even streamers that do not become part of the main channel can contain significant amounts of current. Streamer current exposure can affect people and sensitive electronics.

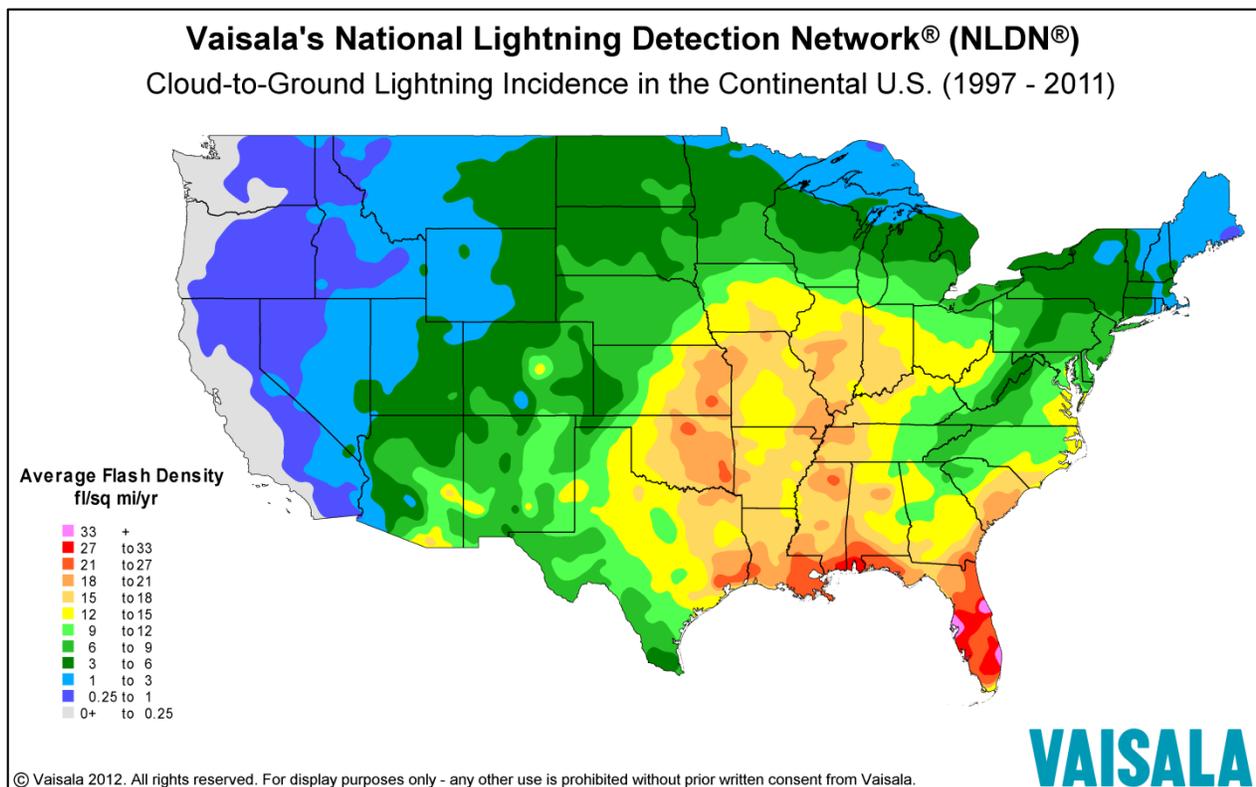
The National Lightning Safety Institute has provided some facts about lightning:

- An individual's risk of being killed by lightning is 1:28,500 per exposed individual.

- Nine out of ten people struck by lightning survive the event but nearly 25% of these survivors suffer long term psychological or physiological trauma.
- The best defense against lightning is preparedness.
- The average lightning strike contains 20,000 amps
- Lightning's heat exceeds 50,000 degrees F. or three times hotter than the surface of the sun. Its' speed is 90,000 miles per second (one hundred million feet per second). The average thickness of a bolt is 1-2 inches.
- There is more than \$2 billion damage annually in the USA from lightning.

LOCATION

All participating jurisdictions, school districts and Gordon Cooper Technology Center and the unincorporated area of Pottawatomie County (Refer to Table 1-1) are vulnerable to lightning. Hundreds of thunderstorm events take place across Oklahoma each year. Most bring welcome precipitation but the lightning that accompanies them occasionally causes damage, injury, or death.



EXTENT



All participating jurisdictions, County officials, school district officials and Gordon Cooper Technology Center officials consider all events which contain lightning to be serious events and warrant evasive actions. Flash density of .25 per year is considered at major. Cloud-to-ground lightning peak currents and electric fields are dependent on

the polarity the lightning discharge.

For negative cloud-to-ground lightning, first return strokes have an average peak current of 30 kA and an electric field peak of 6 V/m at 100 km. Peak currents and fields for negative subsequent strokes are, on average, half of the respective values for negative first strokes.

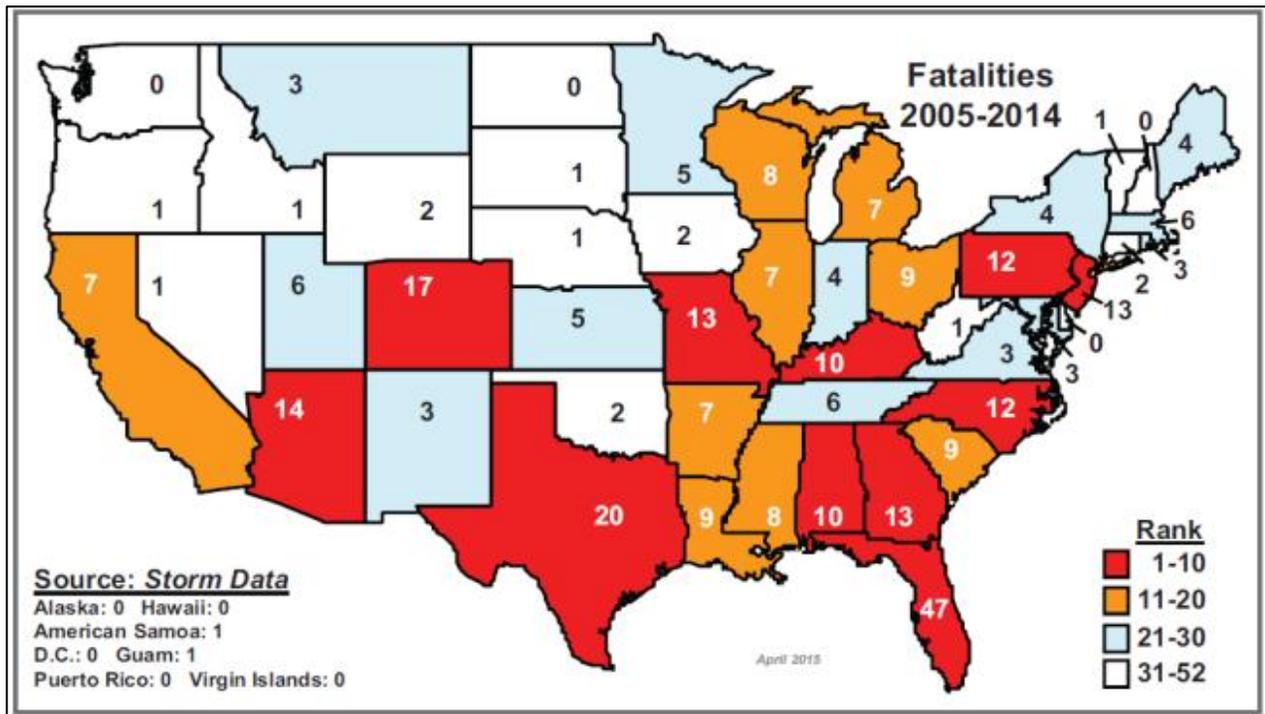
For positive cloud-to-ground lightning the average peak fields and currents are roughly a factor of two greater than those for negative first strokes.

PREVIOUS OCCURRENCES

Hundreds of thunderstorm events take place across Oklahoma each year. Most bring welcome precipitation but the lightning that accompanies them occasionally causes damage, injury, or death. The following table is the history of lightning strikes as recorded by the NCDC:



Table 3-24 POTTAWATOMIE COUNTY LIGHTNING EVENTS 2000-2012 Data provided by the National Climatic Data Center (NCDC)		
Date	Location	Description
06 Nov 2003	Bethel Acres	Lightning caused a house fire near Bethel Acres on Lake Road. Damage estimate: \$15,000.00
19 May 2003	Shawnee	A house was set on fire due to a lightning strike. Damage estimate: \$10,000.00
09 Jul 2001	Shawnee	Lightning struck a house on 11st Street, causing a small fire in the attic. . Damage estimate: \$1,000.00
09 Mar 2000	Asher	Lightning struck an oil tank battery, igniting a fire. Damage estimate: \$2,000.00



Usually if lightning hits the ground, lightning seldom causes damage but when it does occur, the damage is usually severe.

PROBABILITY OF FUTURE EVENTS

Considering history and location of Oklahoma between the dry, arid southwest and the moist air from the Gulf of Mexico, Pottawatomie County has significant exposure to lightning events. Damage usually occurs to infrastructure, such as power transmission lines and communication towers; however, occasional damage can occur to structures. Early warning research is ongoing through the National Weather Service (NWS) and private organizations to improve notification and threat information to the public.

1. Location of Incident:
40% Unreported.
27% Open fields & recreation areas (not golf).
14% under trees (not golf).
8% Water-related (boating, fishing, swimming...)
5% Golf/golf under trees
3% Heavy equipment and machinery-related
2.4% Telephone-related
0.7% Radio, transmitter, & antenna-related
2. Gender of victims = 84% male; 16% female.
3. Months of most incidents = June: 21%,
July 30%, August 22%.
4. Days of week of most incidents =
Sunday/ Wednesday/ Saturday.
5. Time of day of most incidents = 2 PM to 6 PM.
6. Number of victims = One (91%), two or more (9%).

Property damage and possibly injuries from lightning are anticipated in Pottawatomie County especially during thunderstorms. The probability of future lightning events for Pottawatomie County, all participating jurisdictions, school districts and Gordon Cooper Technology Center is **“HIGHLY LIKELY”**.

VULNERABILITY AND IMPACT

During thunderstorms and particularly severe thunderstorms, people are often injured or killed by lightning. Either they are struck directly or a nearby lightning strike causes injuries to individuals nearby. Lightning is an underrated killer and second only to flood in regard to the number of weather-related deaths in the United States each year. The National Weather Service publication, Storm Data, records only six deaths from lightning strikes in Oklahoma between 1998 and 2008, and ranks the state 27th in the nation.

According to the National Weather Service, lightning causes an average of 62 deaths and 300 injuries nationwide. In Pottawatomie County, lightning has been responsible for starting fires to buildings and displacing occupants through loss of business, employment, and homes all of which displaces the occupants.



Pottawatomie County, its jurisdictions and public schools consider all thunderstorms that produce lightning to be dangerous. Thunderstorms with lightning have damaged buildings and power

supplies, and downed electrical line causing power outages. Large trees often succumb to lightning strikes. Lightning causes thousands of dollars in damages each year to homes, businesses, churches, barns, schools, and other structures. Businesses which are forced to close from power outages lose business, creating an economic impact.



Because of the deadly and destructive force of lightning, Pottawatomie County considers all lightning events serious and cause for added protective measures. Secondary effects from lightning may include, grass fires, explosive steam conditions in masonry, trees, and other

water-bearing objects.

The National Lightning Safety Institute released a 35 year study in 1997 concerning statistics for lightning strikes causing injuries or fatalities.

Schools are very susceptible to lightning during outdoor activities such as sporting

events which often draw large crowds. Students waiting outside for a school bus to arrive are also vulnerable. School buildings and critical computer and electrical/electronic equipment can be damaged/destroyed by an lightning strike causing expensive repair/replacement and loss of critical information.

Public education is important in lessening the effects of lightning by encouraging residents to remain inside or in other protected areas during thunderstorms.

CONCLUSION

Thunderstorms cause billions of dollars of damage throughout the United States every year. Lightning is considered one of the top killers in the United States because it sometimes strikes in advance of the thunderstorm that produced it. At particular risk of thunderstorms are outdoor activities such as fishing, sporting events, and large public events, all of which are readily available in Pottawatomie County. Mitigation projects exist in this plan (see **Chapter Four**) that can help protect and reduce the effects of lightning on the citizens or visitors in Pottawatomie County.



SOURCES

National Lightning Safety Institute

www.lightningsafety.com/

(NCDC) National Climatic Data Center

(www.ncdc.noaa.gov/stormevents/)

Vaisala

(<http://www.vaisala.com>)

National Weather Service

<http://www.lightningsafety.noaa.gov/media.shtml>