

**CHAPTER THREE  
SECTION 3.7  
HAZARD PROFILE-HAIL**

**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

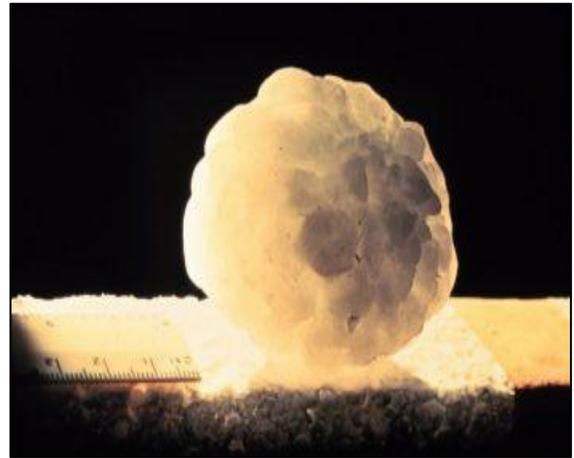
**TECHNOLOGY CENTERS**

Gordon Cooper Technology Center

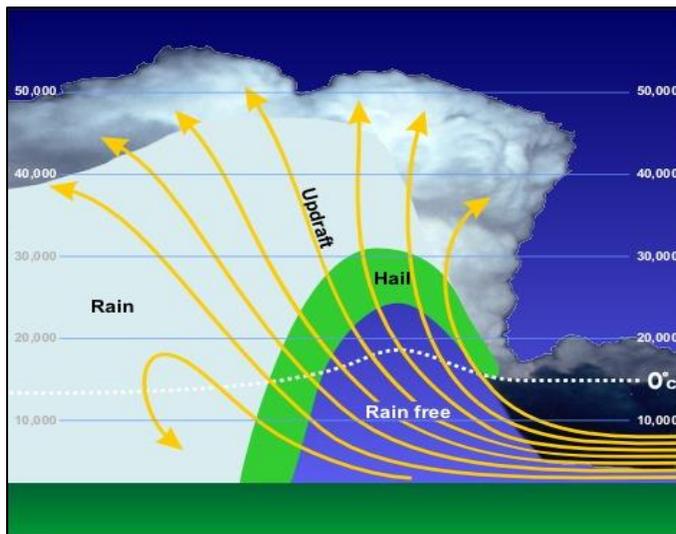
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## HAIL

Hail forms in storm clouds when super cooled water droplets freeze on contact with condensation nuclei, such as dust. The storm's updraft blows the hailstones to the upper part of the cloud. The updraft dissipates and the hailstones fall down, back into the updraft, and are lifted up again. The hailstone gains an icy layer and grows increasingly larger with each ascent. Once a hailstone



becomes too heavy to be supported by the storm's updraft, it falls out of the cloud. This movement up and down inside the cloud, through cold the warmer temperatures, causes the droplet to add layers of ice and become quite large, sometimes round or oval shaped and sometimes irregularly shaped. The size ranges from smaller than a pea to as large as a softball and larger, and can be very destructive to buildings, vehicles and crops. Hail



is the most expensive by product of thunderstorms. Oklahoma crop losses due to hail average approximately \$2.5 million per year in loss claims alone – not including property / casualty claims. Hail damage to automobiles, roofs, windows, and farm crops is staggering. Large hail is also a threat to small mammals and it kills many birds. Large hail is generally one inch in diameter or larger and can cause a great deal of

damage. Large hailstones can fall at speeds faster than 100 mph. The National Weather Center uses a network of Nexrad Doppler radars to detect hail. Hail size and probability can be estimated from radar data by a computer by different algorithms.

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## LOCATION

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All participating jurisdictions, school districts and Gordon Cooper Technology Center and the unincorporated area of Pottawatomie County (Refer to Table 1-1) are subject to hailstorms. Usually associated with severe thunderstorms, all structures, wildlife, livestock, and the entire population is subject to hail damage.

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## EXTENT

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Hail usually lasts an average of 10 to 20 minutes but may last much longer in some storms and is usually in relatively small coverage areas. Hail causes \$1 billion on damage to crops and property each year in the U.S. Even small hail can cause significant damage to young and tender plants. The peak period in Oklahoma for hailstorms, is late spring and early summer, which also correlates to the severe thunderstorm season in Oklahoma. The peak periods for hailstorms, late spring and early summer, coincide with Oklahoma's most critical agricultural seasons for wheat, corn, barley, oats, rye, and fruit trees. Pottawatomie County has large ranching and farming areas that would be negatively affected by hailstorms.

The Torro Hail scale shown in **Table 3-21** describes the levels of hail possible and damage that results. Officials in Pottawatomie County and its participating jurisdictions, the school districts and Gordon Cooper Technology Center consider anything in the magnitude of H2 or higher on this scale significant due to crop losses and the economic hardship it creates for farmers and ranchers.



<b>Table 3-20 COMBINED NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION ( NOAA ) / TORNADO AND STORM RESEARCH ORGANIZATION (TORRO) HAILSTORM INTENSITY SCALE</b>				
Size Code	Intensity Category	Typical Hail Diameter	Approximate Size	Typical Damage Impacts
H0	Hard Hail	Up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33-0.60	Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60-0.80	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80-1.20	Nickel to Quarter	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	1.2-1.6	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6-2.0	Silver Dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0-2.4	Lime or Egg	Aircraft bodywork dented, brick walls pitted
H7	Very Destructive	2.4-3.0	Tennis Ball	Severe roof damage, risk of serious injuries
H8	Very Destructive	3.0-3.5	Baseball to Orange	Severe damage to aircraft bodywork

**Table 3-20 COMBINED NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION ( NOAA) / TORNADO AND STORM RESEARCH ORGANIZATION (TORRO) HAILSTORM INTENSITY SCALE**

Size Code	Intensity Category	Typical Hail Diameter	Approximate Size	Typical Damage Impacts
H9	Super Hailstorms	3.5-4.0	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	4+	Softball and up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Once the size of hail rises to H4-H5 magnitude it becomes disastrous to equipment that is parked outside due to insufficient cover. Pottawatomie County and municipal officials consider any hail exceeding this level as a major event warranting warning to the public.

## PREVIOUS OCCURRENCES

There are numerous hail events produced by severe thunderstorms that occur in Pottawatomie County each year. Between 2000 and 2013, the NCDC has recorded 119 hail events that have impacted communities in Pottawatomie County. In the interest of space, the following table only reports events with hail one inch or greater are listed:



**Table 3-21 POTTAWATOMIE COUNTY HAIL STORM HISTORY  
2000-2012  
(Only events with 1 inch hail or greater are profiled)**

Date	Location	Description
22 October 2011	Asher Wanette	<p><b>1.50-1.75</b> - A potent storm system moved southeast through the central Rockies, with warm, moist air moving north through Oklahoma. Thunderstorms first developed over north-central Oklahoma, but became more widespread further south as the evening progressed. Strong instability and wind shear allowed for the thunderstorms to become organized, with some supercell storms producing very large hail and damaging winds. Storms produced hail up to baseball size. The storms continued to develop and move southeast, eventually moving into southeast Oklahoma.</p>
12 August 2011	Shawnee Pink Earlsboro	<p><b>1.75</b> - Very hot temperatures contributed to a very unstable atmosphere over all of Oklahoma, with thunderstorms developing by mid-afternoon. The thunderstorms first formed over parts of central and south-central Oklahoma, and drifted northeast. A larger complex of storms developed over southern Kansas and moved southeast into Oklahoma. More widespread severe weather occurred with this complex, as it organized over Oklahoma. Several locations reported wind gusts over 60 mph, some of which caused damage.</p>
12 May 2011	Earlsboro	<p><b>1.00</b> - The same storm system that produced widespread heavy rainfall and sporadic wind damage on the 11th continued to move east through Kansas. The cold front/dry line moved east during the afternoon, lying over the eastern quarter of Oklahoma by peak heating. Thunderstorms developed from central into southeast Oklahoma, with a few of them becoming severe with large hail. The largest hail stones ranged from half-dollar to ping pong ball size, although most of the thunderstorms produced around nickel to quarter size. The storms weakened shortly after sunset.</p>

**Table 3-21 POTTAWATOMIE COUNTY HAIL STORM HISTORY  
2000-2012  
(Only events with 1 inch hail or greater are profiled)**

Date	Location	Description
<p><b>22 April 2011</b></p>	<p><b>Tecumseh Pink</b></p>	<p><b>1.25 - 2.75</b> - A cold front moved slowly southeast before stalling near the I-44 corridor. A dry line stretched just ahead of the front, lying from near Lawton southward into northern Texas, with warm, moist air present ahead of it. By early evening, thunderstorms had developed ahead of these boundaries, just south and east of the Oklahoma City metro area. Large hail was reported with several of the thunderstorms.</p> <p>The development of the low-level jet added to the already sufficient wind shear for supercell thunderstorms, but also aided the low-level rotation in some of the thunderstorms. A couple of short-lived tornadoes were reported over Garvin and McClain counties, with some damage reported. The storms continued to develop through the evening hours, with many of them moving over the same areas. The drought that was in place was helped by the welcome rainfall, although a few areas reported brief flash-flooding. Up to baseball-size hail was reported 2 miles south of State Highway 9 and 2 miles east of Highway 102.</p>
<p><b>14 April 2011</b></p>	<p><b>Johnson Tecumseh Shawnee</b></p>	<p><b>1.00</b> - A dry line moved quickly east before slowing to the east of I-35 in Oklahoma. Dew point temperatures reached the middle 60s east of the dry line, with bone-dry conditions advection in on the back side of the dry line. The cap that was in place was all but erased by mid-afternoon and thunderstorms quickly developed over eastern Oklahoma. The wind shear in place was more than sufficient for rotating thunderstorms, with most storms becoming supercells. Very large hail and wind damage was common early in the thunderstorm life cycle.</p>

**Table 3-21 POTTAWATOMIE COUNTY HAIL STORM HISTORY  
2000-2012  
(Only events with 1 inch hail or greater are profiled)**

Date	Location	Description
<p><b>19 May 2010</b></p>	<p><b>St. Louis Macomb</b></p>	<p><b>1.75</b> - By mid-afternoon a large storm system with a well-defined front was located from west-central into central Oklahoma, just north of the Oklahoma City metro area. Two thunderstorms developed near and along the front, one over Roger Mills and Dewey counties, and the other over northern Blaine county.</p> <p>Another thunderstorm developed further east along the dry line later in the afternoon, and the storm eventually produced a tornado west of Prague in Lincoln county. Additional severe thunderstorms developed across southern Oklahoma, but the main impact was large hail and very heavy rainfall.</p> <p>Damage was widespread and significant in and around the Oklahoma City metro area. Numerous vehicles were heavily damaged or even totaled by the large amounts of damaging hail. Numerous buildings suffered roof, window and structural damage, and trees and vegetation were shredded by the large hail. Hail drifts reached several feet deep over some areas. As the storm continued southeast, it continued to produce hail near golf ball size.</p>
<p><b>16 May 2010</b></p>	<p><b>Shawnee</b></p>	<p><b>1.00</b> - Thunderstorms developed by mid-afternoon in northwest Oklahoma near a warm front. A long-lived supercell became organized over Major County and moved southeast, leaving a swath of large damaging hail in its wake.</p> <p>Baseball size hail was reported west of Fairview, with softball size hail west of Okeene. As the storm moved southeast, the coverage of hail increased, with numerous reports of golf ball size - and a few baseball size - hail from near Kingfisher to northwest Oklahoma City. The</p>

**Table 3-21 POTTAWATOMIE COUNTY HAIL STORM HISTORY  
2000-2012  
(Only events with 1 inch hail or greater are profiled)**

Date	Location	Description
16 May 2010	Shawnee	storm continued southeast through Oklahoma City, causing extensive damage.
8 July 2009	Wanette	<b>1.00</b> - Thunderstorms developed during the early morning hours ahead of an outflow boundary that was produced by thunderstorms in southwest Kansas. A pre-existing outflow boundary was already in place over northern Oklahoma, which aided in the development of precipitation through the afternoon hours. The thunderstorms were mainly confined to the area along and east of Interstate 35, with marginally severe hail and very strong winds reported as the cluster of thunderstorms moved southeast. Wind damage was reported over southeast Oklahoma, with hail up to quarter-size reported farther north.
12 June 2009	County	<b>1.75</b> - On the evening of June 12th, an outflow boundary extended from Norman to Holdenville, with a dry line south of the Red River over western north Texas. A strong cap suppressed thunderstorm development through much of the day, but finally weakened enough by late afternoon and early evening for thunderstorms to develop. Thunderstorms crossed into south central Oklahoma, producing hail up to half-dollar size through mid-evening before weakening. Thunderstorms also formed along the outflow boundary across central Oklahoma.
30 March 2009	Wanette	<b>1.00</b> - A strengthening upper level storm system moved through the central plains during the afternoon, with a cold front pushing southeast into Oklahoma and a dry line set up over west central Oklahoma. A line of thunderstorms developed along the front, and quickly developed southward as the front overtook the retreating dry line, mainly east of Interstate 44. The thunderstorms became severe, with penny to quarter size hail and wind gusts of 50 to 60 mph the main issues. No damage was reported.

**Table 3-21 POTTAWATOMIE COUNTY HAIL STORM HISTORY  
2000-2012  
(Only events with 1 inch hail or greater are profiled)**

Date	Location	Description
<p><b>5 November 2008</b></p>	<p><b>Shawnee Pink</b></p>	<p><b>1.75</b> - Numerous strong to severe thunderstorms developed ahead of a dry line, west of Interstate 35, and moved northeast into central and northern Oklahoma. The thunderstorms became severe and produced large hail and some damaging winds. Several areas reported hail covering ground a couple of inches deep. Two additional rounds of thunderstorms developed by nightfall, with some areas receiving large hail three to five separate times. Some of the hail reached over golf ball size, and this combined with strong winds caused fairly significant roof, window, and fence damage. The dryline and cold front finally moved into eastern Oklahoma by mid-evening, with much cooler temperatures overspreading the region. The hail broke several windows at Shawnee Lake with hail also reported a half of a mile east of Highway 102. Damage was estimated at \$10,000</p>
<p><b>3 April 2008</b></p>	<p><b>Macomb</b></p>	<p><b>1.75</b> - Several factors came into play for a significant severe weather event over the southern half of Oklahoma. An upper level disturbance moved through the central plains, and a cold front moved into the northwest third of Oklahoma by mid -afternoon. An area of surface low pressure developed over far southwest Oklahoma, with a dry line extending to the south of this feature. Thunderstorms developed and quickly become severe, producing very large hail. The storms tracked east during the evening hours, with a line of storms also developing along the cold front that moved southeast.</p>

**Table 3-21 POTTAWATOMIE COUNTY HAIL STORM HISTORY  
2000-2012  
(Only events with 1 inch hail or greater are profiled)**

Date	Location	Description
<p><b>31 March 2008</b></p>	<p><b>Tecumseh</b></p>	<p><b>1.00</b> - A cold front moved from northwest to southeast, entering northwest Oklahoma during the morning hours, and moving into southeast Oklahoma by early to mid-evening. Ahead of the cold front, deep Gulf moisture was in place, with afternoon heating warming temperatures into the 70s. Thunderstorms developed along and ahead of the front, with the strongest storms occurring over southern and southeast Oklahoma. The thunderstorms occurred in two waves, one occurring during the late morning, early afternoon hours, with another wave occurring during the mid to late afternoon hours. The first wave of thunderstorms was mainly a large hail threat. Very large hail was the main threat with the second threat, with strong winds and heavy rainfall another concern. The hail and strong winds also did some damage in the afternoon.</p>
<p><b>8 January 2008</b></p>	<p><b>McLoud</b></p>	<p><b>1.00</b> - A powerful storm system moved toward the southern plains with an unseasonably warm and humid air mass was in place. The cold front continued moving southeast through the evening and overnight hours, with the thunderstorms forming into a squall line by late evening. Large hail to quarter size and gusty winds were the main threats with the thunderstorms, although a period of moderate to heavy rainfall also accompanied the storms. Hail up to quarter size was reported north of I-40 and the US 177 intersection</p>

<b>Table 3-21 POTTAWATOMIE COUNTY HAIL STORM HISTORY 2000-2012 (Only events with 1 inch hail or greater are profiled)</b>		
Date	Location	Description
21 April 2004	Shawnee	1.25 - A major hail storm moved through the Oklahoma City metro on this day primarily affecting the western and northern sides of the city. Hail up to the size of baseballs was observed along with many areas reporting hail on the ground ranging from 3 inches deep to 2 feet deep. The hail damaged numerous structures and vehicles with several people also needing their vehicles towed or dug out of the hail on streets across the city. Damage estimates across the Oklahoma City metro were 100 million dollars. Storms also produced two tornadoes in Ellis county in northwest Oklahoma with no known damage reported. Hail was observed at intersection of Kickapoo and Federal Street.
24 March 2004	Shawnee	2.75 - Several supercell thunderstorms developed during the evening of the 24th, along and just behind a strong cold front that moved through the area. Numerous occurrences of large hail, with the largest hail stone reported to be baseball size, and several areas of significant wind damage accompanied these thunderstorms. Tuttle in Grady County, and Shawnee in Pottawatomie County, were two areas hit hardest by the high wind speeds.

## PROBABILITY OF FUTURE EVENTS

Pottawatomie County property and citizens are susceptible to hail storms and will continue to be at risk. Pottawatomie County experiences several hailstorms a year, some of them causing damage. Damage usually occurs to structural glass, roofs, and vehicles. The PCHMPT considered the probability of future events based on past experience and concluded that severe thunderstorms producing hail would indeed occur in the future. The entire county including Pottawatomie County, all participating jurisdictions, school districts and Gordon Cooper Technology Center is at risk from hail and the probability of future events is “**HIGHLY LIKELY**”.

## VULNERABILITY AND IMPACT

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The strongest hail events tend to be associated with severe thunderstorms, and often do extensive damage to structures, vehicles, and crops, smaller less intense thunderstorms frequently produce smaller hail, H2 size dime or grape size hail (see **Table 3-14, TORRO SCALE**) often causes slight damage especially to crops or vegetation which can cause an economical loss to nearby communities and farmers/ranchers in the area. Hail from H-3 to H-5 can begin to damage vehicles and roofs and occasionally glass. Hail larger than H-5 can be dangerous by severely damaging windows, vehicles, and roofs causing the need for expensive repairs. Hail larger than H-8 can cause holes in roofs, destroy vehicles, and cause extensive structural damage. It can also injure or kill people and animals. In spite of ongoing research and the warning system currently available to the public, people are often injured usually trying to get to adequate shelter. Hail damage, generally to roofs of structures cause roofs to be replaced more frequently than the normal life of roofs costing insurance companies and property owners thousands of dollars. Property owners on occasion have to find temporary housing or a new business location due to the amount of roof damage done to their structure. For businesses, this can result in loss of business and in extreme cases could even affect employee jobs.

At the schools, large windows, roof mounted equipment (HVAC, exhaust fans, sky lights, etc.), students and staff are all vulnerable to hail. Windows and equipment are expensive to repair or replace and students and staff can be injured or loss of life could even occur.



## CONCLUSION

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Oklahoma and Pottawatomie County have a significant exposure to hail events. Early warning research is ongoing through the National Weather Service (NWS/NOAA) and the Oklahoma Climatological Survey to improve warning and threat information to the public.

Government owned property and critical facilities, public and private are vulnerable to hail as is any other property. Damage usually occurs to vegetation, vehicles, and structures. Early warning research is ongoing through the National Weather Service (NWS). New dual polarization technology which sends out a vertical and horizontal pulse is undergoing testing and should be deployed at all Nexrad Radar sites over the next few years allowing for better hail size and probability. Public information is critical to minimize the effects of hail.



An informed public can prevent some damage and in particular injuries or deaths.

## SOURCES

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*National Climatic Data Center (NCDC)*

*[www.ncdc.noaa.gov/stormevents/](http://www.ncdc.noaa.gov/stormevents/)*