## 6.5.5 Thunderstorms

### 6.5.5.1 Hazard Identification

#### Description of the Thunderstorm Hazard

According to the National Weather Service, more than 100,000 thunderstorms occur each year, though only about 10 percent of these storms are classified as "severe." Although thunderstorms generally affect a small area when they occur, they are very dangerous because of their ability to generate tornadoes, hailstorms, strong winds, flash flooding, and damaging lightning. While thunderstorms can occur in all regions of the United States, they are most common in the central and southern states because atmospheric conditions in those regions are most ideal for generating these powerful storms.

Thunderstorms are caused when air masses of varying temperatures meet. Rapidly rising warm moist air serves as the "engine" for thunderstorms. These storms can occur singularly, in lines, or in clusters. They can move through an area very quickly or linger for several hours.

Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a "bolt" when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder. On average, 80 people are killed each year by lightning strikes in the United States.

#### Severity of the Thunderstorm Hazard

Thunderstorms affect relatively small areas. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. However, despite their small size and relatively short duration, all thunderstorms are potentially very dangerous. Of the estimated 100,000 thunderstorms that occur each year in the United States, about 10 percent are classified as severe. People most at risk from thunderstorms are those who are outdoors, especially under or near tall trees; in or on water; or on or near hilltops.

A severe thunderstorm is issued when weather conditions are favorable for the development of severe thunderstorms. If the thunderstorms are forecast to be such that there is a significant risk that they may produce severe weather a severe thunderstorm watch is issued. In the United States, the Storm Prediction Center (a national guidance center of the National Weather Service) issues watches for areas likely to produce severe thunderstorms. The watch boxes are usually issued in the format of x miles north and south, or east and west, or either side of a line from y miles direction of city, state, to z miles another direction of another city, state. For example: "50 miles either side of a line from 10 miles northeast of Columbia, South Carolina to 15 miles south-southwest of Montgomery, Alabama". ("Either side" means perpendicular to the center line.) When displayed on a map, they are usually shown as either a blue or yellow outline, depending on the source. In addition, a list of all counties included in its area of responsibility is now issued by each NWS forecast office for each watch.

A severe thunderstorm warning is issued when trained storm spotters or a Doppler weather radar indicate a strong thunderstorm is producing dangerously large hail or high winds, capable of causing significant damage. In the United States, it does not account for lightning or flooding. In the U.S., the National Weather Service defines a severe thunderstorm as having large hail being at least 1 inch, high winds as being 58 miles per hour or greater, producing tornadoes, or any combination of the three. Prior to January 2010, the size in which hail in a severe thunderstorm would be considered severe was ¾ of an inch; public complacency due to overly frequent issuances of severe thunderstorm warnings and recent studies stating that hail does not produce damage until it reaches one inch in diameter caused the upgrade. A severe thunderstorm warning means there is significant danger for the warned area. Occasionally, severe thunderstorms can and do produce a tornado without warning. While not all severe thunderstorms produce tornadoes, they can produce serious wind damage as severe as a tornado. Generally, but not always, a severe thunderstorm watch will precede a warning.

Lightning, a component in all thunderstorms, causes an average of 80 fatalities and 300 injuries each year. Most lightning fatalities and injuries occur when people are caught outdoors in the summer months during the afternoon and evening.

One method of profiling the severity of lightning is to show the Lightning Activity Level (LAL). The LAL is a number, on a scale from 1 to 6, which reflects frequency and character of cloud-to-ground (cg) lightning. Information about each level can be found in Table 6.5.5.1-1 below.

**Table 6.5.5.1-1**
**Lightning Activity Level**

| Cloud and Storm Development | Areal Coverage | Counts cg / 5 min | Counts cg / 15 min | Average cg / min |
|---|---|---|---|---|
| No thunderstorms | None | - | - | - |
| Cumulus clouds are common but only a few reach the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga but light rain will occasionally reach ground. Lightning is very infrequent. | <15% | 1-5 | 1-8 | <1 |
| Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent. | 15% to 24% | 6-10 | 9-15 | 1-2 |
| Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent. | 25% to 50% | 11-15 | 16-25 | 2-3 |
| Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense. | >50% | >15 | >25 | >3 |
| Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.) | >15% | - | - | - |

The entirety of the planning area has experienced the thunderstorm hazard, and can expect to do so again in the future.

## Impact to People and Property from the Thunderstorm Hazard

Injuries and deaths from high winds are just as common as those from lightning. Most incidents occur when trees or tree limbs are pushed over by the wind onto houses or vehicles. Vehicles are sometimes pushed off roads by the wind as well.

Thunderstorms are a common occurrence in the entire planning area, and can particularly impact utilities and transportation routes through heavy rainfall, stormwater runoff, downed trees and lightning strikes. Mobile homes and their occupants are particularly vulnerable to damage from thunderstorms. Lightning can cause significant damage to critical facilities and equipment, particularly the contents.

## Occurrences of the Thunderstorm Hazard

According to the National Climatic Data Center, the geographic area of the planning area experienced at least 628 thunderstorm wind events from 1950 through 2009 (Table 6.5.5.1-2). These events caused one death and a total of approximately $37,744,000 in property damage (NCDC, 2010).

**Table 6.5.5.1-2**
**Thunderstorm Activity in the AACOG Region (1950-2009)**

| County | # of Recorded Thunderstorms Wind Events 1950—2009 | Total Property Damage Recorded | Deaths |
|---|---|---|---|
| Atascosa | 54 | $1,205,000 | 0 |
| Bandera | 28 | $575,000 | 0 |
| Bexar | 159 | $5,349,000 | 1 |
| Comal | 39 | $5,423,000 | 0 |
| Frio | 29 | $546,000 | 0 |
| Gillespie | 34 | $1,070,000 | 0 |
| Guadalupe | 179 | $6,783,000 | 0 |
| Karnes | 18 | $215,000 | 0 |
| Kerr | 21 | $1,220,000 | 0 |
| Medina | 60 | $14,355,000 | 0 |
| Wilson | 33 | $1,003,000 | 0 |
| **TOTAL** | **628** | **$37,744,000** | **1** |

Source: National Climatic Data Center

The following section describes some notable thunderstorm events that have occurred in the planning area since 2000. Note that this list is not exhaustive, but is intended to be illustrative only.

10/12/2001 - Comal, Kerr, and Medina Counties

Severe thunderstorms affected several counties, causing a total of $2.6 million in property damage. In Comal County, trees were blown down with widespread damage to the roofs and windows of homes just west of New Braunfels. In Kerr County, winds caused widespread damage in and around the city of Kerrville and five aircraft were damaged or destroyed at the Kerrville Airport. In Medina County, the damage at Hondo was due to the combination of a large tornado, severe downburst winds and large hail. Severe downburst winds (estimated in excess of 100 miles an hour), struck first, followed by heavy rain, then hail to the size of golf balls, and finally, just in front of the tornado, winds began to calm. Wind damage began 2 miles northwest of the Hondo Airport, continued across the downtown area, and ended 5 miles southeast of the center of town. This damage was characterized by large limbs knocked from trees, trees uprooted, roofs and winds torn from homes and businesses, and power lines knocked down.

03/19/2002 - Atascosa, Bexar, Guadalupe, Medina, and Wilson Counties

Severe thunderstorms affected several counties, causing 27 injuries and a total of $3.4 million in property damage, $400,000 in crop damage.

- High winds in Bexar County damaged roofs, propelled hail into homes and cars, and knocked over power poles. The flying debris injured approximately ten persons. The greatest devastation was in southwest Bexar County just northeast of the town of Lytle. Emergency management and Red Cross officials estimated 50 mobile homes and houses severely damaged or destroyed, with minor damage to another 100 mobile homes and houses.
- High winds across Guadalupe County caused widespread damage to homes, trees and outbuildings. Near Zorn, the high winds took sections of roofs off homes, and rolled and damaged several homes and mobile homes. One mobile home had been rolled over a truck and was completely destroyed.
- Across Eastern Medina County, wind damage was widespread, with road signs blown down, trees knocked over, roofs damaged and large limbs were taken out of trees. Over a dozen people were injured as glass, broken from house and vehicle windows, was propelled by the gusty winds.
- Severe winds, estimated as high as 60 mph, caused spotty damage across much of Wilson County, where trees and tree limbs were blown down, roofs were damaged, and outbuildings were blown over.

05/17/2002 - Bexar County

Severe thunderstorm winds damaged 16 cars and knocked over fences in the northwest part of San Antonio, near I-10 and Callaghan Road. The area of damage was very limited in extent, covering only about a square mile. Severe thunderstorm winds also damaged property of the Animal Defense League on Wurzbach Parkway in northeast San Antonio. Fences were knocked down and roofs were taken off buildings. Approximately $450,000 in property damage resulted from this thunderstorm.

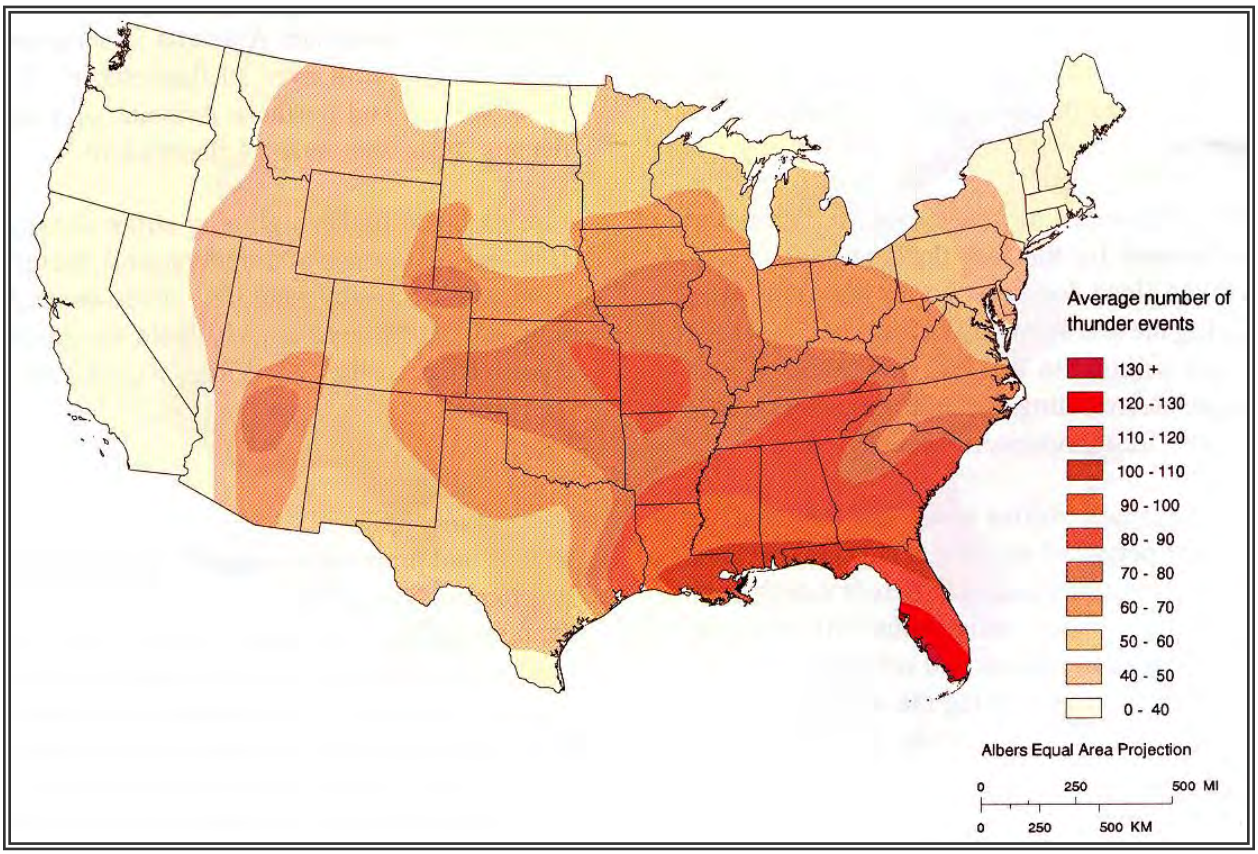
06/01/2005 – Gillespie County

Severe thunderstorm winds were clocked in excess of 70 knots in Gillespie County. Property damage in excess of $300,000 was reported.

## Probability of Future Occurrences of the Thunderstorm Hazard

The National Weather Service collected data for thunder days, number and duration of thunder events, and lightning strike density for the 30-year period from 1948 to 1977. Figure 6.5.5.1-1 illustrates thunderstorm hazard severity based on the annual average number of thunder events from 1948 to 1977.

**Figure 6.5.5.1-1**
**Annual Average Number of Thunder Events**




Source: Federal Emergency Management Agency

As illustrated in the figure above, the planning area experiences an average of 40-60 thunderstorm days per year. There is no reason to expect that this number will decrease in the future; therefore, the probability of a future occurrence is high.

## Location and Extent of the Thunderstorm Hazard

The locations of past occurrences of thunderstorms have not been mapped because of the large number of past events. Based on past occurrences, it can be expected that the entire region is at risk to future thunderstorms.

### 6.5.5.2 Risk Assessment

This subsection of the Plan Updates provides estimates of future thunderstorm losses, i.e. risk. Each of the loss calculations is based on best available data, but they must be considered estimates because highly detailed engineering was not performed as part of this planning process.

#### Methodology and Limitations

After discussion and review of the best available data regarding this hazard, and in consideration of the potential impacts of this hazard to the planning area, the EMC determined that the risk assessment should be limited to a qualitative analysis. At the time of this update, insufficient data exists to quantify the planning area's risks from and exposure to this hazard.

**Qualitative**

Each participating jurisdiction was asked to provide a qualitative risk assessment ranking regarding the thunderstorm hazard. (For definitions of these rankings, please see Table 6.4-1, earlier in this section.) The results of this assessment are presented in the table below.

**6.5.5.2-1**
**Qualitative Risk Assessment Results – Thunderstorm**

| Jurisdictions Ranking Hazard as Low | Jurisdictions Ranking Hazard as Moderate | | Jurisdictions Ranking Hazard as High | |
|---|---|---|---|---|
| City of Stockdale | Bandera County<br>City of Bandera<br>Bexar County<br>City of Balcones Heights<br>City of Leon Valley<br>City of San Antonio<br>City of St. Hedwig<br>City of Terrell Hills | City of Von Ormy<br>Gillespie County<br>City of Fredericksburg<br>Karnes County<br>City of Karnes<br>City of Kenedy<br>City of Runge<br>City of Falls City<br>City of Devine<br>City of La Vernia<br>San Antonio River Authority | Atascosa County<br>City of Charlotte<br>City of Christine<br>City of Jourdanton<br>City of Lytle<br>City of Pleasanton<br>City of Poteet<br>City of Alamo Heights<br>City of Converse<br>City of Helotes<br>City of Kirby<br>City of Live Oak<br>City of Somerset<br>City of Universal City<br>City of Windcrest<br>Comal County<br>City of Garden Ridge | City of Bulverde<br>City of New Braunfels<br>Frio County<br>City of Dilley<br>City of Pearsall<br>Guadalupe County<br>City of New Berlin<br>City of Schertz<br>City of Seguin<br>Kerr County<br>City of Ingram<br>City of Kerrville<br>Medina County<br>City of Castroville<br>City of Hondo<br>City of Natalia<br>Wilson County |

## Risk Assessment Conclusions

The majority of the participating jurisdictions ranked the thunderstorm hazard as a high or moderate impact. It is worth noting that all buildings and facilities can be considered at risk from this hazard.