STANDARD HAZARD MITIGATION PLAN UPDATE FOR THE GREAT STATE OF OKLAHOMA

FEBRUARY 10, 2014

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State of Oklahoma Adoption Resolution

ALBERT ASHWOOD
State Director

MARY FALLIN
Governor

STATE OF OKLAHOMA
DEPARTMENT OF EMERGENCY MANAGEMENT

HAZARD MITIGATION PLAN ADOPTION

The 2014 State of Oklahoma Standard Hazard Mitigation Plan is hereby adopted.

The State of Oklahoma will continue to comply with all applicable federal laws and statues during the periods for which it receives grant funding, in compliance with 44 CFR §13.11(c), and will amend this plan whenever necessary to reflect changes in state or federal laws and statues as required in 44 CFR §13.11(d).

The State will also continue to pursue Enhanced State Hazard Mitigation Plan status (44 CFR §201.5) in the near future by showing improved performance in application development, historic preservation and basic grants management while continuing our dedication to risk reduction for the citizens of Oklahoma.

ALBERT ASHWOOD, Director
Oklahoma Department of Emergency Management
Governor's Authorized Representative

2/4/14
Dated

Chapter One: Introduction

Each section of this Plan Update from the period of prior approval through September 30, 2013 was analyzed and reviewed by the planning team and revisions were recommended. As a result of this review of Chapter One, changes include:

-Updated maps and graphics
-Updated weather and seismic events
-Revision of passages to conform to policy changes
-Removal of portion of State Administrative Plan
-Updated demographic, economic and industrial data
-Inclusion of pertinent data from Local and Tribal plans

1.1 Introduction

The previous Oklahoma State Hazard Mitigation Plan for The Great State of Oklahoma was approved in 2011. This document is the 2014 update of the 2011 Oklahoma Plan and will be referred to as "the State Plan." It is a strategic planning guide in fulfillment of Public Law 106-390 known as the Disaster Mitigation Act of 2000 (known as "DMA 2000"), an amendment to the Robert T. Stafford Disaster Relief and Emergency Assistance Act. DMA 2000 was enacted to streamline the administration of disaster relief, and to control the federal cost of disaster assistance.

1.1.1 Purpose

The escalating cost of emergency relief aid has prompted FEMA to shift its priorities from disaster response to mitigation. As part of this new national strategy, some federal funding programs are conditional upon the State having an approved state hazard mitigation plan. The purpose of this Plan is to fulfill the federal requirements for Oklahoma to be eligible for the following programs provided by the Federal Emergency Management Agency (FEMA):

- Pre-Disaster Mitigation Program (PDM)
- Post-disaster assistance through the Hazard Mitigation Grant Program (HMGP)
- Community Rating System Floodplain Management Planning (CRS)
- Flood Mitigation Assistance Program (FMA) which, as of 2012 includes the following:
  Severe Repetitive Loss Program (SRL)
  Repetitive Flood Claims Program (RFC)

Additionally, this State Plan ensures that all jurisdictions within the state of Oklahoma are eligible for FEMA *Public Assistance* grants following a presidential disaster declaration for the following categories:

Category A:	Debris Removal
Category B:	Emergency Protective Measures
Category C:	Roads and Bridges
Category D:	Water Control Facilities
Category E:	Buildings and Equipment
Category F:	Utilities
Category G:	Parks, Recreational Facilities, and other Facilities
Category H:	Fire Management Assistance

This State Plan addresses all natural hazards that have been identified as a threat to the State of Oklahoma, per the requirement of the federal regulations cited above. The State of Oklahoma Emergency Operations Plan (EOP) addresses the response to terrorism and other man-made hazards.

Another purpose of this plan is to provide the framework and guidance for an all-hazard approach to mitigation. This process will encompass the following actions:

1. Access the ongoing hazard mitigation activities in the State of Oklahoma;
2. Identify and assess the hazards that pose a threat to citizens and property;
3. Evaluate additional mitigation measures that should be undertaken;
4. Outline a strategy for implementation of mitigation measures.

1.1.2 Scope

The scope of this Plan is statewide. To be as effective and complete as possible, the Oklahoma Hazard Mitigation Plan incorporated information regarding specific hazards and risk assessments from local plans. This State Plan incorporates data from 142 FEMA-approved local and tribal plans covering 454 jurisdictions which were reviewed and summarized.

The resources of the State agencies, Oklahoma Climatological Survey, and Oklahoma Geological Survey, were found to exceed the local jurisdictional resources. The State gathered data and disseminated that information to all pertinent local jurisdictions to analyze and apply as needed to their local plans.

Separate from the State Plan are *local* hazard mitigation plans. Local mitigation plans must be approved by FEMA in order for counties, towns, and local jurisdictions to be eligible for FEMA mitigation grants. Local mitigation plans must be reviewed, updated and submitted to the State Hazard Mitigation Officer, and then re-approved by FEMA every five years to remain valid. Indian tribal governments may prepare hazard mitigation plans as well. Tribal mitigation plans follow a similar process but tribal entities have the option to be a grantee or sub-grantee to FEMA. If a tribe chooses to be a grantee, it will submit its plan directly to FEMA Region VI. Once approved by FEMA, the tribal plan will allow the tribal government to apply through the State, as a sub-grantee, for any FEMA mitigation project grants.

1.1.3 Authority

The current requirements, reflected in Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5165, enacted under Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390), provide new and revitalized approaches to mitigation planning. Section 322, in concert with other sections of the Act, provides a significant opportunity to reduce the nation's disaster losses through mitigation planning. The Act emphasizes the need for tribal, state, and local entities to closely coordinate mitigation planning and implementation efforts. This Mitigation Plan has also been prepared in accordance with 44 CFR §201.4.

1.1.4 Funding

Funding for the Plan update was provided by HMGP Management Costs from FEMA, through the Oklahoma Department of Emergency Management (OEM).

1.1.5 Strategy and Goals

In order to minimize the destruction and devastation resulting from disasters, the State of Oklahoma developed this Hazard Mitigation Plan to guide all levels of government, business and the public, and to establish goals to be achieved through implementation of specific hazard mitigation measures. In addition to the daily oversight of Pre-Disaster Mitigation provided by Oklahoma Emergency Management, the State Hazard Mitigation Team will play a key role relative to general oversight, reviewing goals, and objectives, and developing Pre-Disaster Mitigation implementation plans. The strategy of the State of Oklahoma is to utilize mitigation programs to attain sustainable conditions under which Oklahomans can fulfill social, economic and other requirements of present and future generations.

Each natural hazard that is identified will be addressed and eliminated where possible through the implementation of the HMGP, PDM, and FMA programs and grants. The approach of the strategy will be all-hazards, relating to the entire state, with a specific focus on prioritizing and mitigating those hazards statewide (overview of local plans) and developing the criteria for the State Plan pursuant to section 322 of the Stafford Act. The plan is intended to promote increased coordination among state agencies and local officials and to integrate hazard mitigation management capabilities and programs into everyday government functions. The primary goals of the plan are to:

- Protect public health and safety
- Eliminate severe repetitive loss properties
- Eliminate repetitive loss properties
- Improve government recovery capability
- Provide **pre-** and **post**-disaster recovery guidance
- Reduce losses and damage to property and infrastructure
- Preserve natural and historic resources in vulnerable areas
- Preserve the environment
- Focus on cost-effective mitigation measures that provide the best benefit to communities.

The key measures to implement these goals include:

- Enhanced communication between tribal, state, federal agencies and local governments to facilitate post-disaster recovery and pre/post-disaster mitigation;
- Coordination of federal, state, local, and private resources to enhance the preparedness and mitigation processes;
- Ensuring consistency between federal and state regulations;
- Providing protection from hazards for critical facilities;
- Supporting of legislation to protect hazardous areas from being developed.

1.1.6 Point of Contact

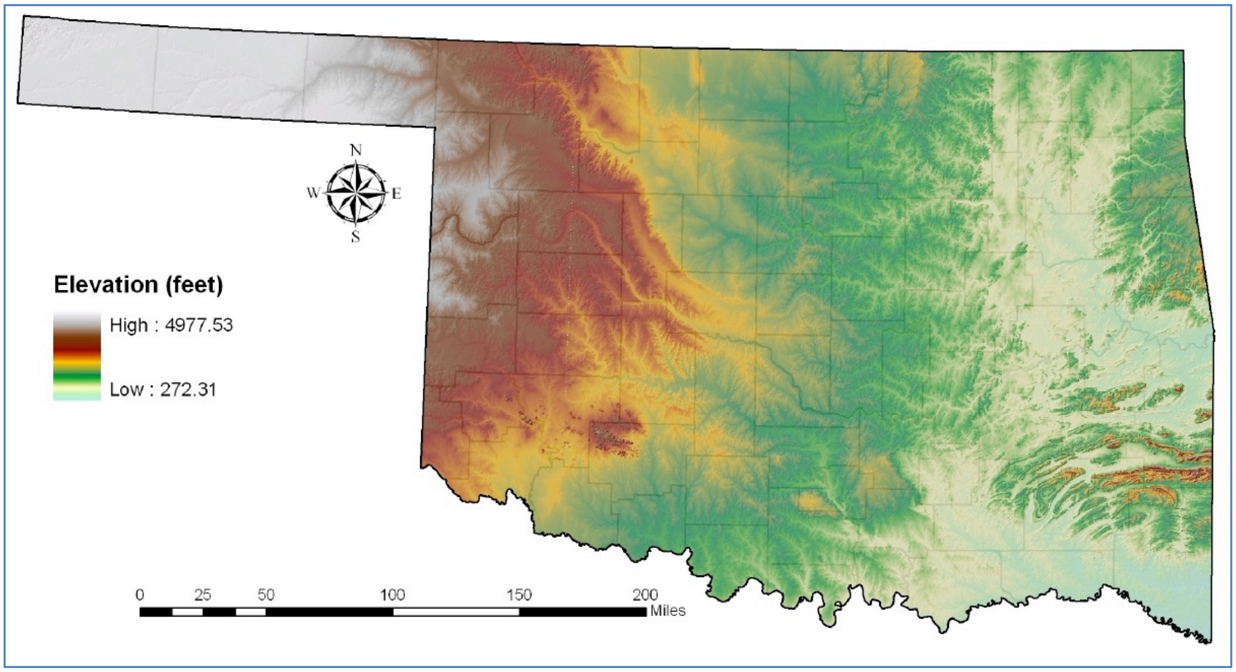
Oklahoma Emergency Management is the primary point of contact for information regarding this plan.

Bill Penka, State Hazard Mitigation Officer/Chair (SHMO)
P.O. Box 53365
Oklahoma City, OK 73152-3365
405-521-3072

1.2 Jurisdiction Description

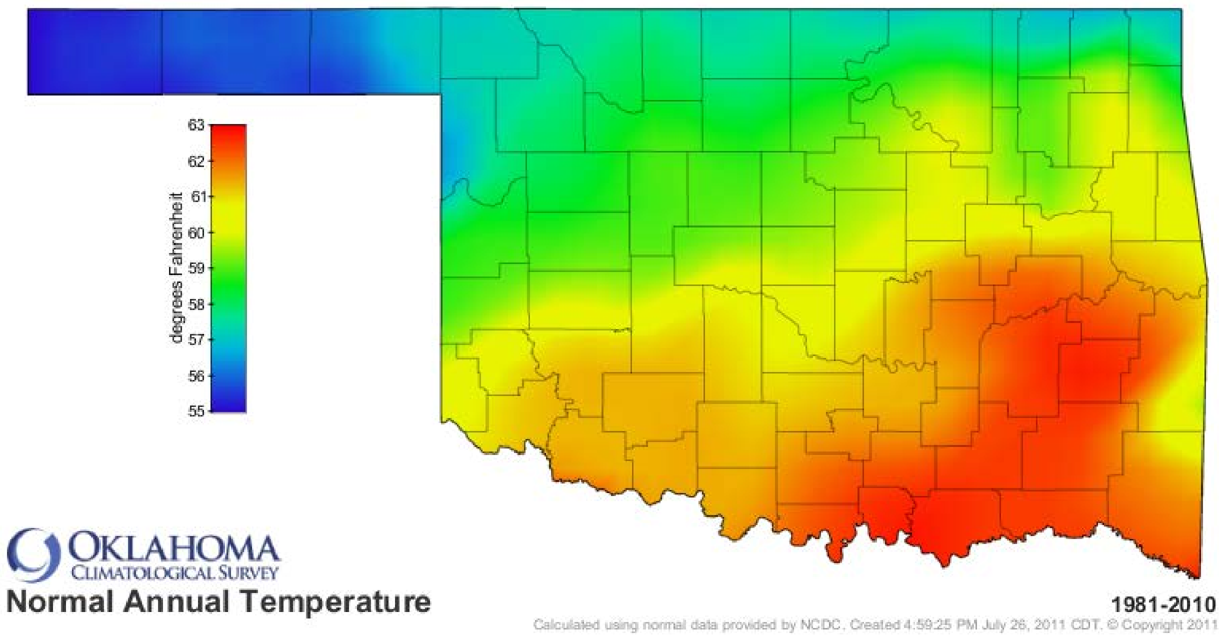
1.2.1 Oklahoma's climate: an overview

Oklahoma is located in the Southern Great Plains. Of the 50 states, it ranks 20th in size, with an area of 69,903 square miles, about 1,224 of which are covered by water. The terrain is mostly plains, varying from nearly flat in the west, to rolling in the central and near east. The plains are broken by scattered hilly areas that include the Wichita Mountains in the southwest and the Arbuckle Mountains in the south central part of the state. The Ouachita Mountains dominate much of the southeast, with peaks rising up to 2,000 feet above their base. Extreme northeastern counties are part of the Ozark Plateau which is marked by steep, rocky, river valleys between large areas of hills and rolling plains. The western tip of the panhandle features part of the Black Mesa complex, a fractured terrain featuring large mesas overlooking seasonal creek and riverbeds. Elevations range from 287 feet above sea level where the Little River exits in southeastern Oklahoma, to 4,973 feet on Black Mesa near the New Mexico border.



Source: 2013 Oklahoma Climatological Survey

Oklahoma lies entirely within the drainage basin of the Mississippi River. The two main rivers in the state are the Arkansas, which drains the northern two-thirds of the state, and the Red, which drains the southern third and serves as the state's southern border. Principal tributaries of the Arkansas are the Verdigris, Grand (Neosho), Illinois, Cimarron, Canadian, and North Canadian. The Washita and Kiamichi serve as the Red's principal tributaries in Oklahoma, with the Little River flowing into the Red after it crosses into Arkansas.

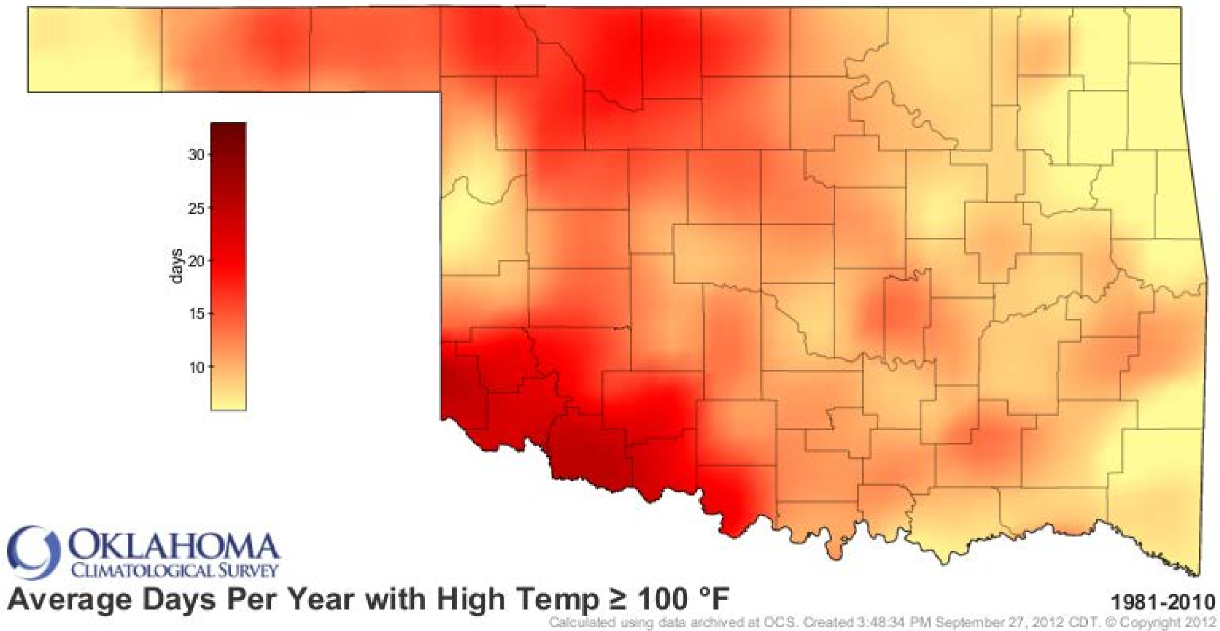


This series of maps shows the result of a thirty year average 1981 thru 2010 of weather statistics for the state of Oklahoma. This is not the latest historical data but a thirty year average for the purpose of leveling the peaks and valleys. These maps will be updated in 2021 after 2020 data is compiled so a new thirty year average can be compiled for the period of 1991 thru 2020.

1.2.1.1 Temperature

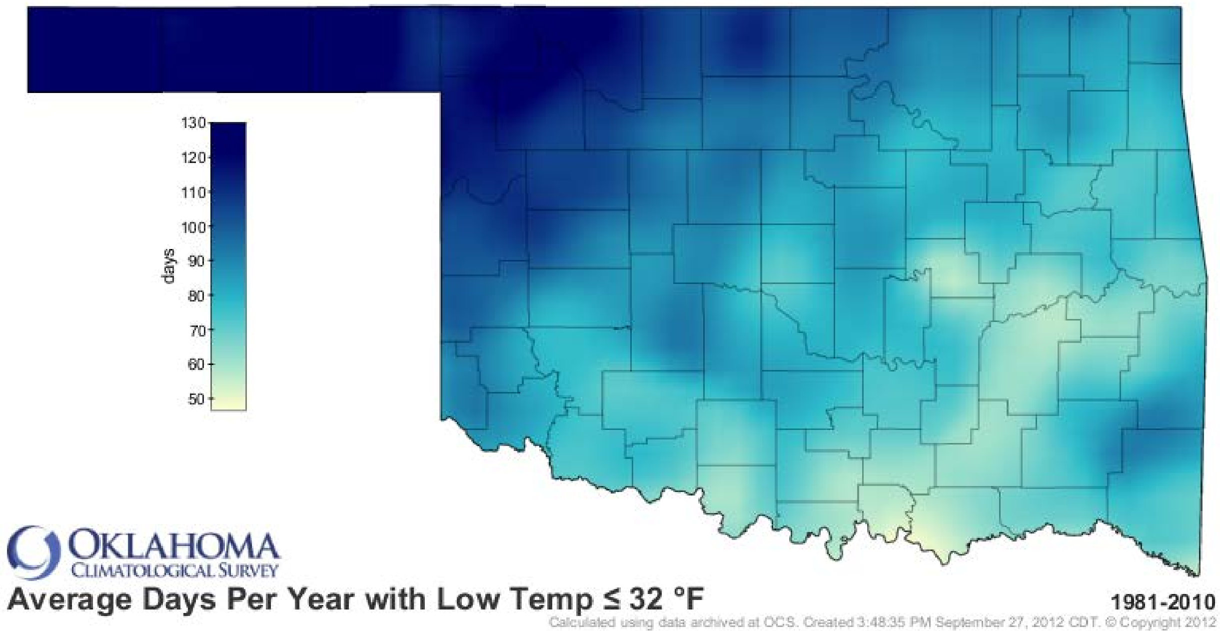
The mean annual temperature over the state ranges from 62° F along the Red River to about 58° F along the northern border. Temperatures of 90° F or greater occur, on average, about 60-65 days per year in the western panhandle and the northeast corner of the state. Temperatures of 100° F or higher occur frequently from May through September, and very rarely in April and October. The western half of the state, excluding most of the panhandle, averages 15+ days of triple-digit temperatures, ranging from about 35 in the southwest corner, to 25 in the northwest area. Years without 100° F temperatures are rare, ranging from about one of every seven years in the eastern half of the state to somewhat rarer in the west.

According to Oklahoma Climatological Survey records, the highest temperature ever recorded in Oklahoma was 120° F, which occurred in 1936.



Temperatures of 32° F or less occur, on average, about 60 days per year in the southeast. The lowest temperature on record is -27° F, originally set at Vinita on February 13, 1905, and tied at Watts on January 18, 1930, was broken February 11, 2011, with a temperature of -31° F in Nowata.

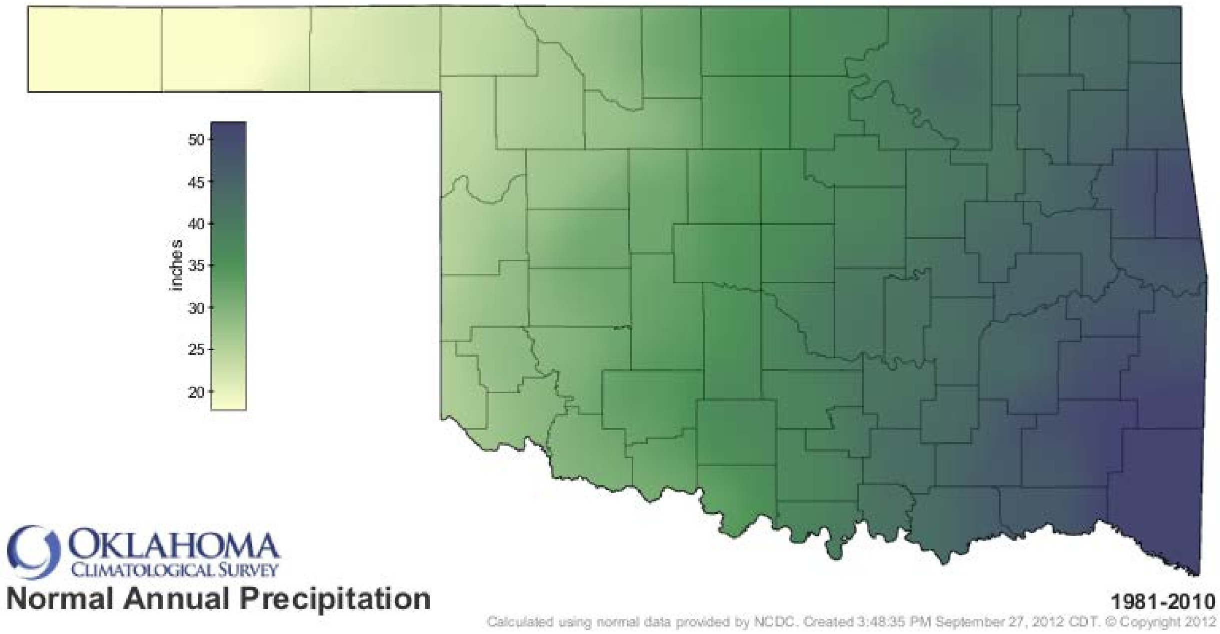
Frozen soil is not a major problem, nor much of a deterrent to seasonal activities. Its occurrence is rather infrequent, of very limited depth, and of brief duration. The average maximum depth that frost penetrates the soil ranges from less than three inches in the southeastern corner of the state to more than 10 inches in the northwestern reaches. Extreme frost penetration ranges from about 10 inches to nearly 30 inches in the panhandle.

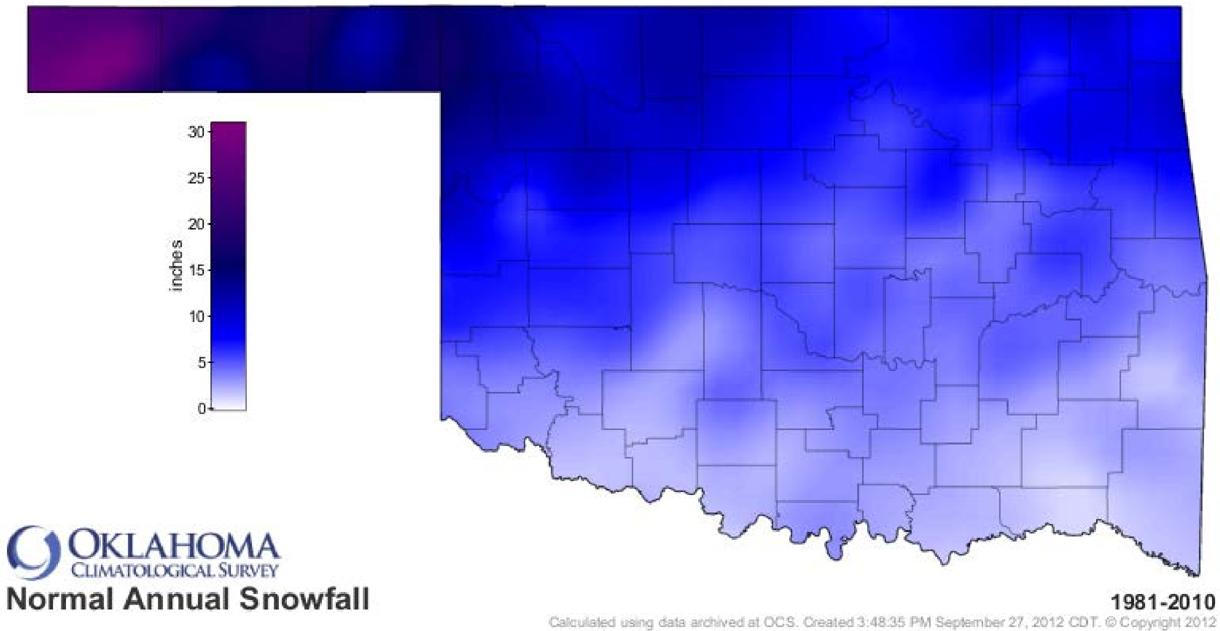


1.2.1.2 Precipitation

Although precipitation is quite variable on a year-to-year basis, average annual precipitation ranges from about 17 inches in the far western panhandle to about 56 inches in the far southeast. The greatest annual precipitation recorded at an official reporting station was 84.47 inches at Kiamichi Tower in the southeast in 1957. The least annual rainfall occurred during 1956, when Regnier, in the extreme northwestern panhandle, observed 6.53 inches.

Excessive rainfall occurs at times. Amounts of ten inches or more in 24 hours, while rare, have been recorded. The highest official rainfall in a 24-hour period is 15.68 inches at Enid on October 11, 1973. Amounts up to 20 inches in a day have also been reported from non-standard sources.


50
45
40
35
30
25
20
inches
OKLAHOMA
CLIMATOLOGICAL SURVEY
Normal Annual Precipitation
1981-2010
Calculated using normal data provided by NCDC. Created 3:48:35 PM September 27, 2012 CDT. © Copyright 2012



Snowfall remaining on the ground more than a few days is an uncommon occurrence in northwestern Oklahoma, quite rare in central Oklahoma, and almost unheard of in the southeast. The record for the most snowfall within a 24-hour period is 27 inches reported in Spavinaw on February 8, 2011.

Freezing rain is a distinct wintertime hazard in Oklahoma. The resulting ice cover can down power lines and limbs, causing millions of dollars in damages and widespread power outages. These events make automobile travel very treacherous, especially on secondary roads, where the hazard can last several days. Significant icing events occur with nearly the same frequency as heavy snow events, especially in the southeastern half or so of the state. While ice accumulation is usually less than an inch, storms that deposit several inches can occur once or more per decade. The consecutive winters of 2000-01 and 2001-02 each featured a major ice storm that deposited more than three inches of ice in 24 hours across much of southeast and central Oklahoma. Two damaging ice storms affected Oklahoma in 2007. The first, in January, affected primarily southern and eastern Oklahoma. The latter, in December, was most severe in central and northeastern Oklahoma. Although ice accumulation in the latter event was generally one inch or less, it caused extensive damage to trees that subsequently took down power lines, knocking out power to more than 600,000 customers.

1.2.1.3 Floods

Floods of major rivers and tributaries may occur during any season, but they occur with greatest frequency during those spring and autumn months associated with greatest rainfall. Such floods cost many lives and property damage in the first 50 years of statehood, but flood prevention programs have reduced the frequency and severity of such events. Flash flooding of creeks and minor streams remains a serious threat, especially in urban and suburban areas, where development and removal of vegetation have increased runoff. See the following map depicting lakes and waterways throughout the State of Oklahoma.

RED AND ARKANSAS RIVER BASINS
AND MAJOR TRIBUTARIES

1.2.1.4 Drought

Drought is a recurring part of Oklahoma's climate cycle, as it is in all the plains states. Almost all of Oklahoma's usable surface water comes from precipitation that falls within the state's borders. Therefore, drought in Oklahoma is tied almost entirely to local rainfall patterns (i.e., the influence of upstream events on drought is very small). Western Oklahoma tends to be slightly more susceptible to drought because precipitation there tends to be more variable (percentage-wise) and marginal for dry land farm applications.

Drought episodes can last from a few months to several years. Those that last a few months can elevate wildfire danger and impact municipal water use. Seasonal droughts can occur at any time of the year, and those that resonate with crop production cycles can cause billions of dollars of damage to the farm economy. Multi-season and multi-year episodes can severely impact large reservoirs, stream-flow and groundwater.

Since modern climatological record-keeping began in the late nineteenth century, the state has seen five major multi-year and multi-regional drought events. These occurred in the late 1890s, from 1909-18, 1930-40, 1952-58, and 2005-06 and, to a lesser extent, 1962-72. Each of these episodes contained at least one year of above-normal rainfall. The drought of the 1930s is associated with the Dust Bowl of the Great Plains, when socio-economic conditions, agricultural practices and drought forced the largest emigration of Oklahomans in state history. It is yet to be determined if the drought of 2008-2013, while at times more severe than any on record, will be as extensive as these other events.

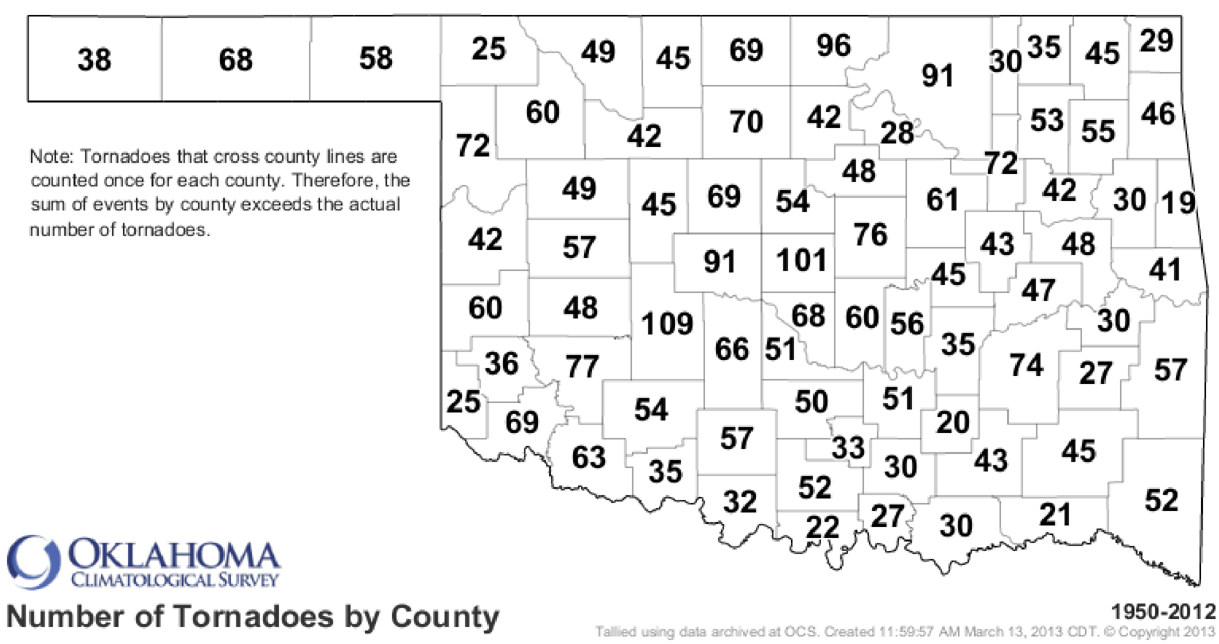
The agricultural impact of drought is increasingly mitigated on a farm-by-farm and year-by-year basis through irrigation of crops, mostly with fossil water. This practice dominates much of the panhandle and some of the rest of western Oklahoma.

Development of water supplies has aided community resiliency, helped in large measure by the Oklahoma Water Resources Board's Financial Assistance Program. Upgrades to municipal and rural water district water/wastewater systems over the previous two decades allowed communities, which previously may have run dry under such circumstances, to more effectively manage their water supplies during the most recent drought.

1.2.1.5 Severe Weather

Thunderstorms occur, on average, about 55 days per year in the east, decreasing to about 45 days per year in the southwest. Late spring and early summer are the peak seasons for thunderstorms, averaging about eight per month per location during these seasons. For the southeastern two-thirds of the state, thunder occurs most often in May. June is the peak month for much of the remainder of the state, while the western panhandle observes the most thunder in July. General thunderstorms are quite common in the summer, but tend to be less organized storms of relatively short duration. These storms can produce locally heavy rain and some hail. Severe weather can occur at any time of day, but the maximum frequency for severe weather is from mid-afternoon to sunset.

1.2.1.6 Tornadoes



Tornadoes are a particular hazard, in that the frequency of occurrence per unit area is among the greatest in the world. Since 1950, an average of 54 tornadoes has been observed annually within the state's borders.

Tornadoes can occur at any time of year, but are the most frequent during springtime. April, May and June represent the months of peak occurrence with these three months accounting for about three-fourths of the observations. May's average of 20 tornado observations per month is the highest. The winter months each average less than one tornado per month. About 80 percent of tornadoes are observed between noon and midnight Central Standard Time, with the peak hours being between 4 pm and 8 pm.

Most of Oklahoma's tornadoes travel from the southwest to the north and east. Although the annual number of tornadoes striking Oklahoma is increasing, the proportion of those ranking among the most severe has actually been declining. Improved technology and recording practices have improved counts and documentation of those at the weaker end of the spectrum, thus accounting for the increase in overall number. However, the number of significant tornadoes (those rating as F2 intensity or greater) has declined, particularly since 1982. In fact, the years with the greatest numbers of significant tornadoes were 1960 and 1961, with 49 and 41, respectively. Declining death tolls and the occurrence of fewer significant tornadoes does not necessarily mean Oklahoma is becoming less at risk. As the tornadoes of May 3, 1999, and May 20 and 31, 2013 demonstrate, one event can forever impact the lives of many Oklahomans.

1.2.1.7 Earthquakes

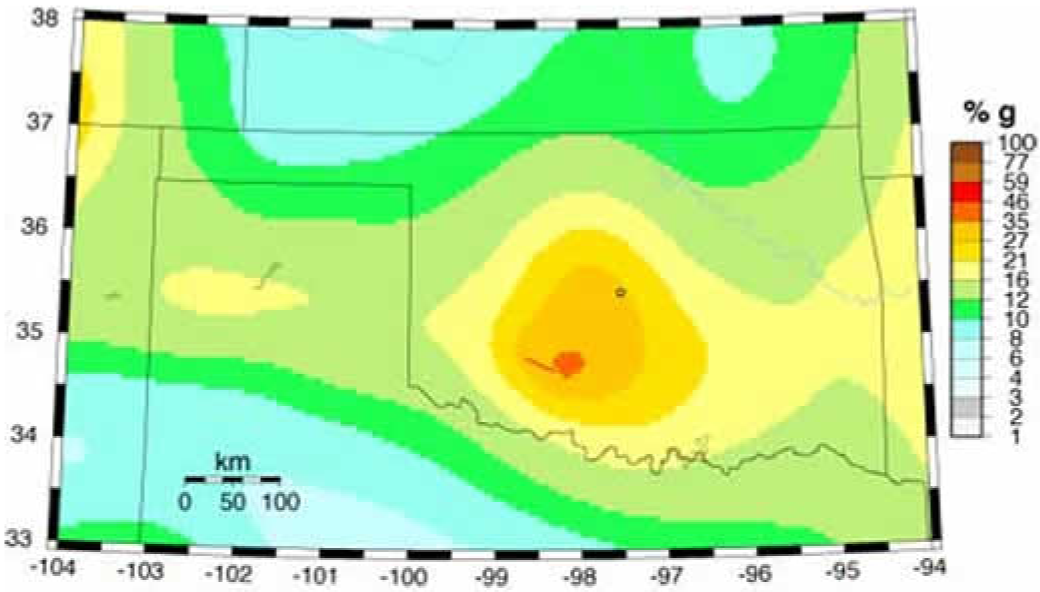
While the New Madrid (southern Missouri area) earthquakes of 1811 and 1812 were felt in Oklahoma, the earliest documented earthquake in Oklahoma occurred October 22, 1882 at Fort Gibson, Indian Territory. The largest instrumentally recorded earthquake in Oklahoma occurred near on April 9, 1952 in El Reno in Canadian County. This earthquake had a magnitude of 5.7 and caused damage to the State Capitol Building in Oklahoma City. Its effects were felt as far away as Austin, Texas and Des Moines, Iowa.

The Oklahoma Geological Survey has been operating seismic stations in partnership with volunteers since 1961. Since 1977, more than 1,800 earthquakes have been detected in Oklahoma. On average, there are about 50 measurable earthquakes each year in Oklahoma with only a few strong enough to be felt. 2009 was an active year for seismic activity in Oklahoma with 43 felt earthquakes, 27 of which occurred in Oklahoma County. 2010 was an exceptionally active year with 103 felt earthquakes statewide, of which 65 occurred in Oklahoma County.

On November 5, 2011, the state experienced its highest magnitude earthquake on record of 5.7 in the Prague area of Lincoln County, according to Oklahoma Geological Survey. Only minor injuries were reported, but many citizens reported cracks in their homes and damage to chimneys and roofs.

For a complete list of significant earthquakes in Oklahoma, please visit the United States Geological Survey (USGS) Oklahoma History:

http://earthquake.usgs.gov/earthquakes/states/oklahoma/history.php



USGS hazard map for Oklahoma, showing the potential level of shaking associated with possible earthquakes in Oklahoma. This map is based on current understanding of past earthquakes and where earthquakes are likely to occur in the future. This map shows the amount of shaking that has a 1 in 50 chance of occurring in the next 50 years. Shaking is expressed as a percentage of g, or the acceleration of gravity, with reds indicating more shaking than blues. The red line in southwestern Oklahoma represents the Meers fault, which has had a recent earthquake (1,200-1,300 years ago) rupture to the surface.

Earthquakes occur in response to forces which build up over long time when two bodies of rock slide past each other. This slip can be large for big earthquakes (10's of meters) or as small as a millimeter. Earthquakes generally occur on pre-existing weaknesses in the rocks called faults. By far, the majority of the world's earthquakes occur on or near the boundaries of tectonic plates. Large earthquakes tend to be concentrated at plate tectonic boundaries where forces and faults are much larger. Generally, away from plate boundary settings, earthquakes will be smaller with magnitudes generally less than 6.5. Small earthquakes (magnitudes 5 or less) occur nearly everywhere in the world. These types of earthquakes can cause damage and loss of life, but damage is usually moderate and closely concentrated around the epicenter, where the earthquake occurred. Oklahoma earthquakes generally occur at shallow depths ranging from about 5 to 15 kilometers (3-10 miles) depth.

Oklahoma has a great number of faults of varying sizes, but they are not expected to generate very large earthquakes. The Meers fault in Southwestern Oklahoma had an earthquake about 1,200 years ago, which ruptured to the surface and caused about 3 to 5 m of slip.

Earthquake hazard is the unavoidable risk that an earthquake will disrupt daily activities or cause loss of property or life. Most damage associated with earthquakes is caused by waves generated during the earthquake. Estimates can be made for the chances of how much shaking will occur due to all possible earthquake sources. These estimates use recorded earthquakes and mapped faults to define possible sources and how often these earthquakes occur. Oklahoma has a greater earthquake hazard than the rest of the mid-continent, but the hazard is still less than that for the New Madrid Seismic Zone to the east or the North America-Pacific plate boundary of the Western U.S.

1.2.1.8 Other Climatic Features

The climate of Oklahoma is continental, as is all of the Great Plains. Summers are long and usually quite hot. Winters are shorter and less rigorous than those of the more northern plains states. Periods of extreme cold are infrequent, and those lasting more than a few days are rare.

Annual average relative humidity ranges from about 60 percent in the panhandle to just over 70 percent in the east and southeast. Average annual lake evaporation varies from 48 inches in the extreme east to 65 inches in the southwest, numbers that far exceed the average yearly rainfall in those areas. Evaporation and percolation preclude use of about 80 percent of Oklahoma's precipitation.

Prevailing winds are southerly to southeasterly throughout most of the state during the spring through autumn months. These prevailing winds veer to south-to-southwest in far western Oklahoma, including the panhandle. March and April are the windiest months, while July August and September are the calmest.

Source: Oklahoma Climatological Survey

1.2.2 Population Growth

In 1910, shortly after Oklahoma became a state, its population was 1,657,155. The population increased each year until the 1930's when it reached a total of 2,396,040. Between 1930 and 1950, however, the population decreased. Oklahoma was hit both by the national economic depression and the drought that created the Dust Bowl in the 1930's. Since that troublesome time however, Oklahoma population has been steadily increasing.

In 2000 the average population density per square mile was 50.3 and has increased to 54.7 according to the 2010 census.

In 2006 approximately 67.7% of Oklahomans lived in areas defined as urban, and the rest lived in rural areas. The 2010 census indicated the urban population had fallen slightly to 66.24%. The State's two largest cities are Oklahoma City (the capital) and Tulsa.

Oklahoma Population Statistics

US Census 2010 Total Population	**- 3,751,351**
US Census 2008 Total Population	**- 3,642,361**
US Census 2006 Total Population	**- 3,579,212**
US Census 2000 Total Population	**- 3,450,654**
US Census 1990 Total Population	**- 3,145,576**
US Census 1980 Total Population	**- 3,025,487**

1.2.3 Economy

The main elements of Oklahoma's economy include agriculture, oil and gas exploration, mining, cattle, and tourism.

Agriculture is an important industry in the State of Oklahoma. Historically, cotton was the leading cash crop, but this has been succeeded by wheat. Other leading crops include hay, peanuts, sorghum, and soybeans.

Livestock and livestock products make up the majority of Oklahoma's yearly farm income. Most of the state's cattle ranches are concentrated in the Panhandle and northern portions of Oklahoma. Poultry and hogs are also significant sources of income, and are raised primarily in the eastern half of the state. The cattle industry is the largest agricultural industry in Oklahoma.

Mineral wealth is great throughout the state. Petroleum, including oil and natural gas, has been a major income-producing product for Oklahoma since 1888 when the first oil well was drilled. The State also mines large deposits of gypsum, iodine, coal, granite and limestone.

Each year, millions of out-of-state visitors visit Oklahoma to enjoy the state's 57 state parks, Indian villages, and historic sites. Numerous reservoirs through the state provide many recreational opportunities for tourists.

Although during the twentieth century and into the twenty-first, Oklahoma's economy has been based on agriculture, manufacturing has always played a role. Oklahoma has been most widely known for its extractive industries, particularly coal, lead and zinc, and petroleum, but under the heading of "manufacturing," defined as the creation of "value added" products, a considerable number of industries have successfully operated since the late nineteenth century. The availability of raw materials has stimulated some of these.

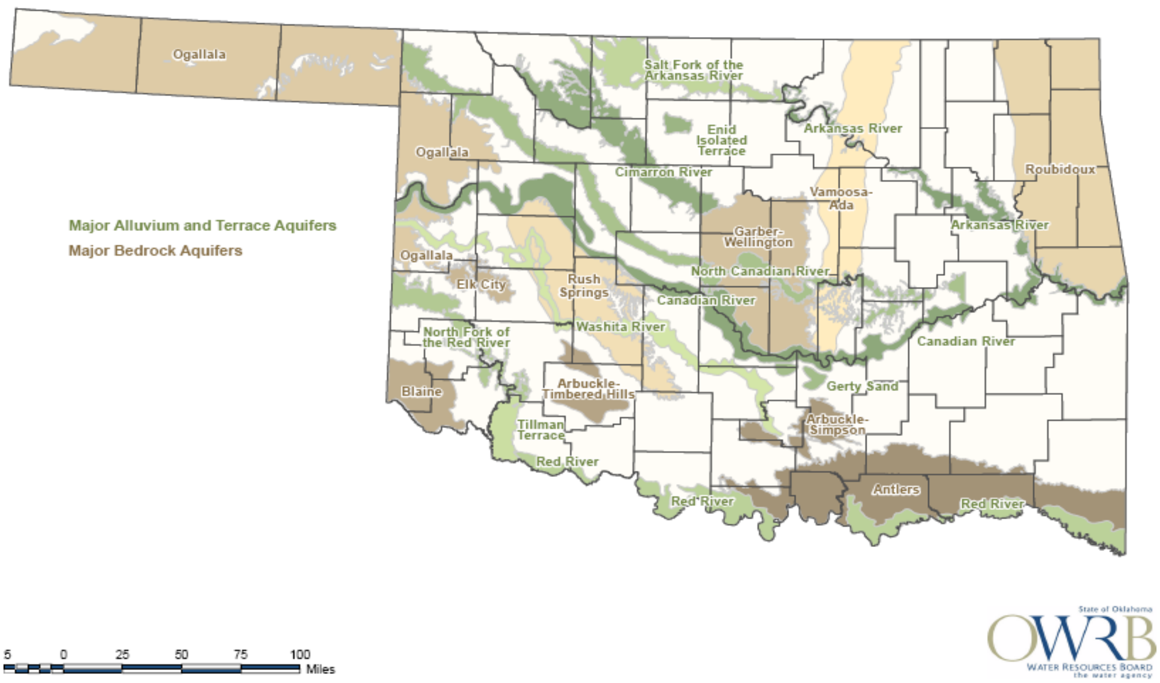
In 2007 the annual value of Oklahoma's agricultural production was $5,806,061,000. Of this amount, crops were responsible for $ 1,187,625,000 and livestock and poultry products for $4.6 billion. Wheat had become by far the main commercial crop, leading hay, cotton, sorghum, peanuts, and soybeans by a large margin. By the late twentieth century, Oklahoma usually ranked either second, third, or fourth in the nation in winter wheat production.

While the number of farms and the farm population declined sharply after World War II, agriculture continued to be a major factor in Oklahoma's economy. Farming not only supplied food and fiber for state, national, and world needs, it furnished the raw materials for processing and manufacturing industries that provided consumer goods and non-farm employment. Forests cover 17 percent of Oklahoma's total land area.

Many large dams are used to utilize the water of the Arkansas and Red river systems as a source of energy for electricity. Among Oklahoma's largest hydroelectric dams are Tenkiller Dam on the Illinois River, Denison Dam on the Red River, Keystone Dam on the Arkansas River and Pensacola Dam on the Grand River. In central and western Oklahoma, steam plants using coal or gas generate most of the power. The large western lakes serve as sources of water supply for cities, for irrigation and for recreation. In the state as a whole, 96 percent of electricity is generated in plants burning coal or natural gas, and the remainder comes from hydroelectric facilities.

The state is beginning to harness its seemingly limitless wind energy to generate electricity. As of this Plan Update, Oklahoma is ranked #6 in the nation for production of electricity by wind power, and can meet nearly 14% of the State's electrical demand through renewal wind energy. (Source: Oklahoma Association of Electric Cooperatives, and Oklahoma Gas & Electric Company)

Since a large part of Oklahoma's land area is rural and not served by municipal water systems, aquifers play a large part in Oklahoma's water resources by providing water for the many wells found in rural and urban areas. Following is a map showing the aquifers.



Oklahoma had 3,240 miles of railroad track in 2010. Clinton, El Reno, Enid, Oklahoma City, McAlester, Tulsa, Holdenville, Durant and Muskogee are important railroad centers. In 2010 Oklahoma was served by 12,867 miles of highways. Of those, 930 miles were part of the Federal interstate highway system. Interstates 40 and 44 are the principal east-west routes; Interstate 35 bisects Oklahoma going north to south. The State has three commercial airports: Will Rogers World Airport in Oklahoma City, Tulsa International Airport in Tulsa, and Fort Sill Regional Airport in Lawton. Underground pipelines transporting petroleum and natural gas crisscross the state with a major pipeline crossroads in the center of the state.

1.2.4 Future Development

Since 1950, Oklahoma's population has gradually increased, and by 2010 it had reached 3,751,351. This figure represents an increase of almost 1 percent over 2000. Population densities generally decline from east to west across the state, and the highest densities are found in the metropolitan areas.   Nationally, Oklahoma is ranked 20th in area and 28th in population.

The State of Oklahoma does not have adopted ordinances regulating areas of population growth or future development per se. Oklahoma agencies representing the state under authority granted to them by legislation adopt rules/regulations regarding Storm Water Management or Stream Water Management. Storm Water Management is addressed under the Federal National Pollution Discharge Elimination System (NPDES) program of the U.S Environmental Protection Agency (EPA).

The Oklahoma Department of Environmental Quality (DEQ) administers the NPDES program. It has adopted rules, and established general and individual permits to require and enforce storm water management. Two basic types of storm water management are addressed. One is primarily aimed at sediment control and requires anyone disturbing one acre of ground or more to obtain a general permit and to use Best Management Practices. The other addresses storm water runoff from certain industrial areas. As part of the program, communities with a population of 10,000 or more must have a storm water management program in place (usually includes ordinances) that meets the conditions of the DEQ general permit, or an individual permit issued by DEQ.

The water quality of streams in Oklahoma is described in terms of beneficial uses as defined by narrative descriptions and specific constituent numbers by the Oklahoma Water Quality Standards promulgated by the Oklahoma Water Resources Board. DEQ and the other state environmental agencies are required to protect the water quality of Oklahoma streams and lakes by implementing the Water Quality Standard (WQS) in administering their various regulatory responsibilities. For instance, when DEQ issues a wastewater discharge permit, the limits placed on that discharge are based on the WQS for the body of water that will receive the discharge. The beneficial uses of that body of water cannot be adversely impacted by the discharge.

Areas of future growth and development, as they relate to known hazard areas, are managed at the local level. Of the 77 counties in Oklahoma, over half have adopted rules/regulations for zoning management, subdivision management, land use plans, or have Floodplain Boards in place. Additionally, a large percentage of the cities/towns over 1,000 in population have and enforce building and zoning requirements and have procedures in place for enforcing these requirements. Existing local policies and programs are discussed in greater detail in Chapter Four, under *Local Capability Assessment.*

1.2.5 Growth Trends

The Oklahoma economy has enjoyed tremendous growth since the most recent national recession of 2009 and 2010. The State continues to build on more than seven years of a broad-based economic expansion prior to 2009, fueled in part by a revived energy sector, and has outperformed the nation in both job creation and income growth. As of this Plan Update, Oklahoma also continues to enjoy an unemployment rate below the national average, according to the Oklahoma Department of Commerce.

However, economic growth is rarely distributed evenly statewide, and state totals often mask disparities in economic performance across the various regions of the state. Differences in industry mix can generate vastly different results in terms of job and income growth at the local level, and often the state's overall performance, relative to the nation, is determined by a relatively small number of industries or geographic areas within the state.

Chapter Two: Planning Process

Requirement 44 CFR §201.4(b)(1) [The State Plan must include] ***a demonstration of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated.***

Each section of this Plan Update from the period of prior approval through September 30, 2013 was analyzed and reviewed by the planning team and revisions were recommended. As a result of this review of Chapter Two, changes include:

-Updated graphics
-Inclusion of additional plans and authorities
-Updated technical data provided by Oklahoma Climatological Survey
-Inclusion of additional disaster events
-Updated State Hazard Mitigation Team listing (SHMT)
-Inclusion of additional positions to the SHMT as a result of statutory changes

2.1 Existing Plans and Programs

FEMA policy requires that the State describe how its mitigation planning process is integrated with other ongoing state planning efforts, per 44 CFR § 201.4(b). Below is a list of current plans that were reviewed and integrated, into the State Hazard Mitigation Plan.

2.1.1 State Emergency Operations Plan

This plan assigns responsibilities to designated state departments, agencies, commissions, boards and volunteer organizations in the event of a disaster. The EOP directs Oklahoma state departments and agencies to provide guidance, relief and assistance to local communities to mitigate, prepare for, respond to, and recover from the effects of a disaster. The EOP written expressly for the welfare and safety of the people of Oklahoma to provide citizens them with the opportunity to be better prepared for, and to quickly recover from disaster.

2.1.2 State Hazard Mitigation Administrative Plan

The purpose of this Plan is to establish a functional organizational structure, define the roles and responsibilities, and outline the management procedures that OEM will use to administer the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), Repetitive Flood Claims Program (RFC), Severe Repetitive Loss Program (SRL) and the Pre-Disaster Mitigation Program (PDM). Per 44 CFR § 206.437, this plan was last updated October 29, 2012.

2.1.3 State Drought Plan

The Oklahoma Drought Management Plan was implemented in response to severe drought conditions which occurred in 1995-96. Its purpose is to provide appropriate response actions for districts, cities, counties, state agencies and the federal government should a serious drought occur, and to mitigate the effects of drought in Oklahoma. The plan describes and suggests primary lines of authority and responsibility, and points out request procedures for state or federal assistance. It is recommended that this plan be utilized in conjunction with the State EOP.

2.1.4 Fire Management Plan

The purpose of this plan is to establish an effective system for the coordinated response to fire suppression during emergency or disaster situations. The Department of Agriculture is the coordinating agency with the federal government for assistance provided with the National Response Plan's (NRP) Emergency Support Function (ESF) #4, Firefighting, in such areas as detecting and suppressing wildland, rural and urban fires resulting from, or occurring coincidentally with, a catastrophic earthquake, significant natural disaster or other event requiring federal response assistance.

2.1.5 Oklahoma Comprehensive Water Plan

Developed by the Oklahoma Water Resources Board, this plan serves as a resource guide for informed decision making regarding regional water use and management. A current edition of the plan may be accessed through this link:

http://www.owrb.ok.gov/supply/ocwp/pdf_ocwp/WaterPlanUpdate/draftreports/OCWP%20Executive%20Rpt%20FINAL.pdf

2.1.6 Oklahoma's Uniform Building Code

The State of Oklahoma adopted statewide building construction codes in 2009. As a result, a new state agency, the Oklahoma Uniform Building Code Commission (OUBCC), was created for the purpose of reviewing and adopting minimum building codes for residential and commercial construction to be used by all entities within the state. These minimum building codes are created utilizing the review and adoption of existing codes by reference through the Oklahoma Secretary of State's Office of Administrative Rules.

The OUBCC created technical committees comprised of volunteers from throughout the construction industry. These committees held public meetings where they reviewed the codes, heard from the public, and reviewed written requests for changes to the codes. Each committee then presented their In the state as a whole, 96 percent of electricity is generated in plants burning coal or natural gas, and the remainder comes from hydroelectric facilities. process to adopt the codes. Included in these codes is ***FEMA 320*** which sets forth standards for safe room construction.

2.1.7 Oklahoma Floodplain Management Act

The Oklahoma Floodplain Management Act, Title 82, O. S. 2001, §1601-1618, as amended, was passed by the State Legislature in 1980 and revised several times. In approving the Act, the Legislature recognized the need for a united effort between local and state government to combat recurrent flood damages. The Act establishes a state and local partnership to reduce flood damages through sound floodplain management.

The State of Oklahoma recognized the personal and economic hardships caused by flood disasters, and recognized that it had become uneconomical for the private insurance industry to make flood insurance available to those in need of protection. Therefore, the Act paved the way for each community to implement wise floodplain management and thereby participate in the National Flood Insurance Program. This participation allows those citizens who need low-cost flood insurance to purchase it through the federal program. The act also addresses the need for the preservation and restoration of the natural resources and functions of the floodplains. Flood insurance through the NFIP becomes available when floodplain boards adopt floodplain regulations in compliance with certain requirements.

2.1.8 FEMA Programs and Other Funding Sources

The Federal Emergency Management Agency (FEMA) was established by Congress in 1979 to consolidate the nation's emergency planning and response functions under one agency. FEMA's mission is to "Reduce the loss of life and property and protect our institution from all hazards by leading and supporting the nation in a comprehensive, risk-based emergency management program of mitigation, preparedness, response and recovery." FEMA, through its Region VI office in Denton, Texas, is the responsible party for reviewing this Plan for compliance. FEMA provided technical assistance and helped facilitate its acceptance through ongoing review and feedback.

FEMA is the primary partner in Oklahoma's hazard mitigation planning process. With the support of FEMA Region VI Technical Assistance, OEM has facilitated FEMA's approval of over 146 local hazard mitigation plans during 2011, 2012 and 2013. While the number of jurisdictions having approved plans has increased, the total number of plans has *decreased* during this planning period because of OEM's encouragement of multi-jurisdictional county plans.

FEMA-sponsored programs related to hazard mitigation are detailed below, including:

- **HMGP** - Hazard Mitigation Grant Program
- **PDM** - Pre-Disaster Mitigation Competitive Grant Program
- **FMA** - Flood Mitigation Assistance
- **RFC** - Repetitive Flood Claims
- **SRL** - Severe Repetitive Loss Grant Program
- **NFIP** – National Flood Insurance Program

2.1.8.1 HMGP

Eligible applicants for FEMA's Hazard Mitigation Grant Program (HMGP) funding include: state and local governments, tribes, and certain non-profit organizations. Objectives for project funding include prevention of loss of lives and property due to disasters; implementation of state or local hazard mitigation plans; enabling mitigation measures to be implemented during the immediate recovery of a disaster; and, providing funding for previously identified mitigation measures that benefit the disaster area.

Types of projects that may be funded are: structural hazard control; retrofitting; acquisition and relocation of repetitive loss properties; and development of state and local standards to protect and substantially improve structures from disaster damage. See ***Appendix A*** for the 5% set-aside Initiative and the 7% Planning Initiative.

The HMGP is designed to reduce the vulnerability to risk through a coordinated all-hazards approach to mitigation activities, with a heavy emphasis on planning. This focus on planning includes updating plans; implementing the measures identified in all-hazard mitigation plans; developing local mitigation plans; developing state legislation; and adopting local ordinances.

2.1.8.2 PDM

The **Pre-Disaster Hazard Mitigation** program came about through the *Disaster Mitigation Act of 2000* when Congress approved creation of a national program to provide a funding mechanism that was not dependent on a presidential disaster declaration. This authorization is in Section 203 of the Stafford Act, 42 USC 5121-5206, as amended by Section 102 of *the Disaster Mitigation Act of 2000*.

FEMA has long been promoting disaster-resistant construction and retrofit of facilities in order to reduce potential damages due to a hazard event, in order to reduce loss of life, human suffering, economic disruption, and disaster costs to federal taxpayers.

Although the overall intent is to reduce vulnerability before the next disaster threatens, the bulk of the funding for such projects actually has been delivered through a post-disaster funding mechanism known as the Hazard Mitigation Grant Program. This program has successfully addressed the many hazard mitigation opportunities uniquely available following a disaster; however, funding of pre-disaster projects has been more difficult, particularly in states that have not experienced major disasters in the past decade.

At a time when disaster response and recovery were the main topics, emphasis was shifted to prevention. In an effort to address pre-disaster mitigation, FEMA piloted a program from 1997-2001 entitled “Project Impact” and selected the cities of Tulsa, Miami, Durant and Lawton as “Project Impact” cities. In addition to funding, FEMA fostered a partnership approach with elected officials, disaster personnel, business leaders and non-profit groups in order that they could address local mitigation issues and develop specific mitigation objectives. After “Project Impact” ended, these public/private partnerships remained active and the overall mission continued.

2.1.8.3 FMA

Flood Mitigation Assistance is a state-administered cost-share program through which states and local communities can receive grants for flood mitigation planning, flood mitigation projects, and technical assistance. Similar to the Hazard Mitigation Grant Program, FMA provides 75% funding assistance to states and communities for flood mitigation planning and activities to fund cost-effective measures that reduce or eliminate the long-term risk of damage to buildings, manufactured homes, and other NFIP-insurable structures, and it is not disaster dependent. In Oklahoma, the 25% local share is absorbed by the local, city or county government, and one-half of the 25% (or 12.5% of the total grant) share must be a “hard match.”

- FMA is part of the National Flood Insurance Act of 1968, Sections 1366 and 1367 as amended by Sections 553 and 554 of the National Flood Insurance Reform Act (NFIRA) of 1994.

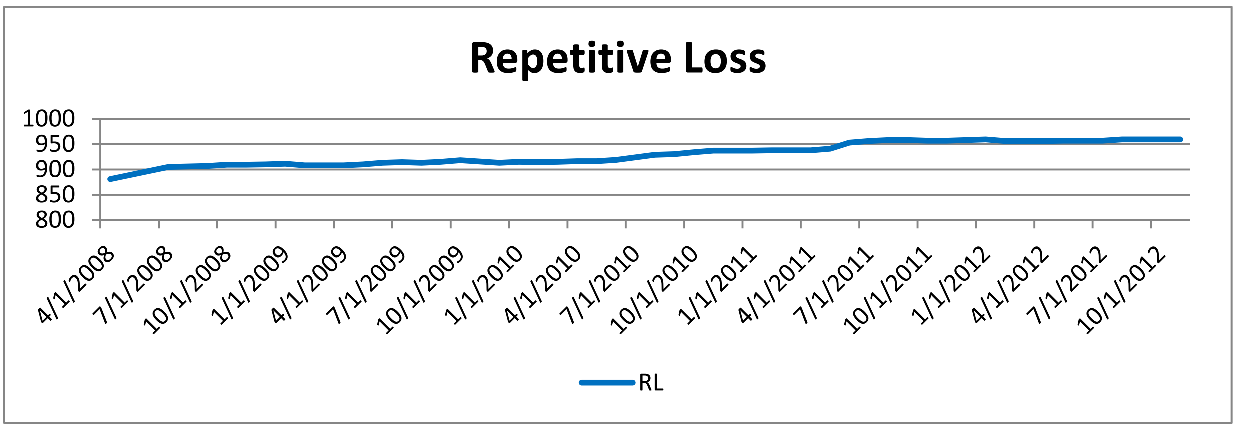
- Goals of the program include: Reduce the number of repetitively damaged structures and associated claims against the National Flood Insurance Fund; and encourage long-term comprehensive mitigation planning.

2.1.8.4 RFC

The **Repetitive Flood Claims** program provides mitigation grants for structures insured under the National Flood Insurance Program (NFIP) located in a state or community that cannot meet the requirements of the Flood Mitigation Assistance (FMA) program. The long-term goal of the RFC grant program is to reduce or eliminate claims under the NFIP through mitigation activities that are in the best interest of the National Flood Insurance Fund (NFIF).

2.1.8.5 SRL

The **Severe Repetitive Loss** grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the National Flood Insurance Act of 1968 to provide funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures insured under the National Flood Insurance Program (NFIP).



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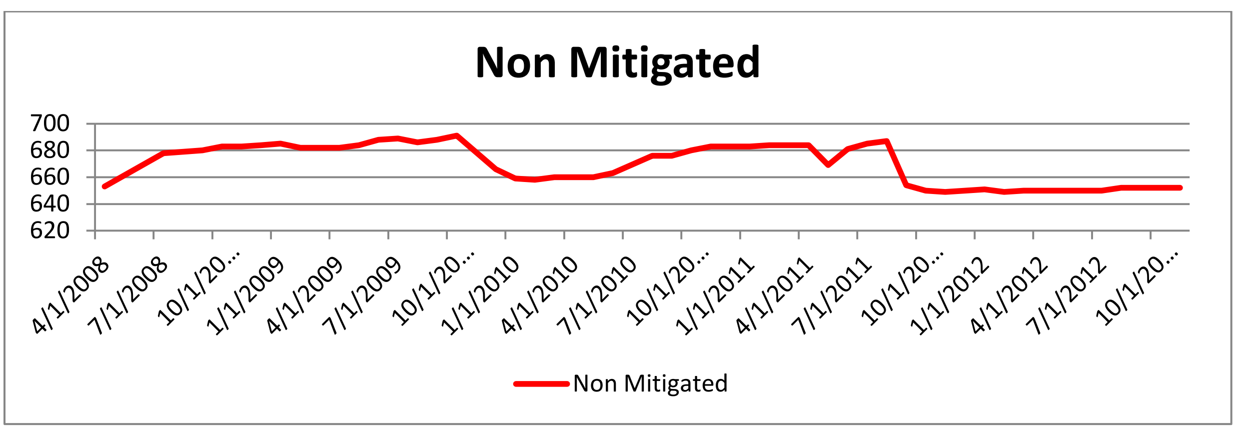

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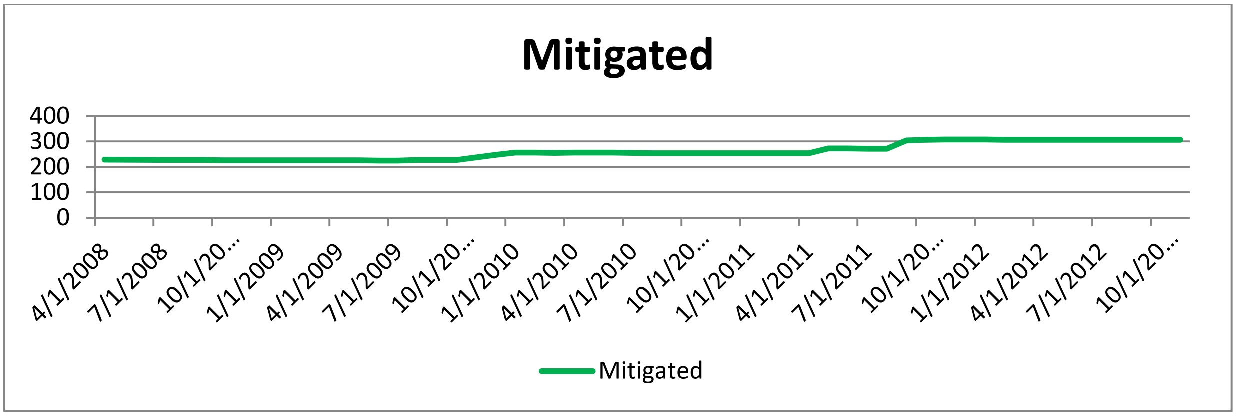


Source: OWRB 1/23/2013

The definition of severe repetitive loss as applied to this program was established in section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a. An SRL property is defined as a residential property which has been covered under an NFIP flood insurance policy for more than thirty days and:

- Has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

For both above conditions, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

While buyouts are not the only mitigation projects considered and undertaken by the State and local governments, they have been the type of project most frequently submitted and approved. OEM's highest priority is to work with local governmental entities to acquire and remove, elevate, relocate or perform minor structural projects only on privately owned residential structures and/or privately owned lots that are located in the floodplain. In addition to the requirements listed above, these projects must also meet the following criteria:

1. The project chosen must independently solve or be a functional part of a solution to a problem that is repetitive or poses a significant risk to health and safety. The proposed solution must be the most practical, effective, cost-effective and environmentally sound alternative among a range of alternatives that contribute to a long-term solution of the problem, rather than temporary or short-term.

2. Local governmental entities (or certain private nonprofit entities) must apply through the State, specifically OEM, to FEMA for approval to perform a project or projects. The applications must specifically identify the properties to be included in the project or projects and must be proven cost-beneficial, in accordance with a determination method that is acceptable to OEM/FEMA and consistent with OMB Circular A-94. This is usually accomplished by using the FEMA benefit cost analysis module.

3. Local governmental/non-profit entities must be in good standing with NFIP (or have not yet been mapped), and otherwise eligible to receive federal funding. Non-federal matches and all other federal grant requirements must be satisfied by the local entity, sometimes with the monetary assistance of local property owners or possibly with assistance from CDBG.

4. Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) projects must be consistent with the overall State Hazard Mitigation Plan. Projects also must conform to 44 CFR Part 9, Floodplain Management and Protection of Wetlands, and 44 CFR Part 10, Environmental Considerations.

5. Only local governmental/non-profit entities may manage projects All projects must be managed in accordance with local, state and federal ordinances, laws and regulations, and not contribute to or encourage development in the floodplain or other hazardous areas. Individual property owners are not eligible to receive federal funds directly as a grantee or sub-grantee and are not authorized to manage grant projects.

Property acquisition is the State's most favored, and usually most cost effective, voluntary option because people and property are totally and permanently removed from the path of flooding and danger. To be eligible to participate, the local governmental/non-profit entity must agree to the following:

1. Offer is based on pre-flood fair market value determined by a State of Oklahoma board-certified appraiser or a post-flood sales contract value;

2. Duplication of Benefits (DOB), Small Business Administration (SBA) loans and private mortgages must be satisfied from proceeds first;

3. The buyout property must be demolished within 90 days of the closing;

4. Local governmental entities, or certain private non-profit entities, must accept all buyout property titles that are officially annotated to comply (in perpetuity) with federal Open Space deed restrictions;

5. The buyout property becomes ineligible for any future federal disaster assistance, except possibly Federal Crop Insurance.

2.1.8.6 **NFIP**

The National Flood Insurance Program was enacted in 1968. Since most homeowners' insurance policies do not cover flood damage, property owners who experienced a flood often found themselves financially devastated and unable to rebuild. The NFIP was formed to fill that gap. To ensure the program did not take on unnecessary risks, one of the key requirements to participate in the program was that communities had to adopt standards for new construction and development. Today, communities wanting to participate in the NFIP must establish minimum floodplain management regulations in their special flood hazard areas and enforce these regulations. After a community joins the NFIP, a policy may be purchased from any licensed property insurance agent or broker who is in good standing in the state of Oklahoma.

Since most counties in Oklahoma lacked proper authority concerning land use regulation necessary to participate in the NFIP, in 1980, the legislature passed the Oklahoma Floodplain Management Act. This legislation enables any county or community in the state to form a floodplain board and enact floodplain regulations to allow participation in the program. The Oklahoma Water Resources Board is the state administrator of this effort.

Participation in NFIP by municipalities, counties, and tribal organizations is voluntary. FEMA and OEM have strongly encouraged jurisdictions to join NFIP. Prior to 2008 there were 52 counties participating, in 2013 there are 55. In 2008 there were 303 municipalities in Oklahoma participating in NFIP, in 2013 there are 392. In 2010 there were two tribal jurisdictions participating in the NFIP program; in 2013 there are four. See ***Appendix B*** for a list of current NFIP participants. NFIP elements include:

2.1.8.7 **The Community Rating System (CRS)**

The CRS is an element of the NFIP. This program is designed to promote the availability of flood insurance; reduce future flood damages; and insure the accurate rating of flood insurance policies. Participating communities may receive credit for proven mitigation measures, thus reducing the cost of flood insurance within their communities. Oklahoma will continue to encourage participation in CRS.

2.1.8.8 **Map Modernization Program**

FEMA's flood hazard maps are essential tools for flood hazard mitigation in the United States. In time, these maps became outdated, and significant areas of the country remain unmapped. To address this problem, the President's budget request for Federal Fiscal Year (FY) 2003 included $351 million for initiating FEMA's national *Map Modernization Program*.

Since 2006, 41 of Oklahoma's 77 counties received effective Flood Insurance Rate Maps (FIRMs). Garfield County was the last FIRM produced in January 2013 which concluded the Map Modernization initiative. The 41 county FIRMs produced under Map Mod covered over 95% of the State's population and over 75% of the square miles in Oklahoma.

The *Map Modernization Program* has evolved to become FEMA's *Risk Map Program*. FEMA and OEM will now address risks with a *watershed* approach instead of by individual counties, as previously studied. As of May 16, 2013, Oklahoma has performed discovery on seven watersheds. Discovery is the procedure where FEMA, OEM, OWRB and its contractor solicit comments related to any risk within their community. Comments are collected and evaluated to produce a report with recommendations on what projects to undertake, when federal money is available for the 75/25 cost program.

2.2 Documentation of the Planning Process

The State of Oklahoma, through the Oklahoma Department of Emergency Management (OEM), is responsible for updating the State Hazard Mitigation Plan.

Existing data within each section of this Plan Update, from the period of prior approval through September 30, 2013, was validated by the appropriate agencies' representative(s) via email communiqué, personal meetings, telephone calls, and published reports. Changes or updates to the data were then submitted to and reviewed by the planning review staff for insertion into the Plan Update. The changes and updates are identified in the box outlines at the beginning of each Section.

2.2.1 Step One: Organization

Rather than form a separate planning committee, OEM elected to use its in-house Hazard Mitigation planning review staff, and the State Hazard Mitigation Team to develop, review, and update the State Hazard Mitigation Plan. These two entities constitute the ***planning team***.

Oklahoma's State Hazard Mitigation Team (SHMT) was established by state law in 1999 (63 O.S. §683.6). It receives no direct funding support, and is under the coordination of the State Hazard Mitigation Officer (SHMO) who may appoint ad hoc committees for the purpose of reviewing or researching issues. The SHMT provides expertise to the Planning Process, including historical perspectives, risk assessments, building codes, land use, transportation, and infrastructure. Currently, the SHMT is comprised of the administrative heads, or their designees, of the following agencies:

Oklahoma State Hazard Mitigation Team		
Agency Represented	**Representative** **Title**	**Email** **Phone**
Oklahoma Department of Emergency Management	**Bill Penka** SHMO	**bill.penka@oem.ok.gov** 405-521-3072
Oklahoma Climatological Survey	**Mark Shafer** Director Climate Services	**mshafer@ou.edu** 405-325-3044
Oklahoma Conservation Commission	**Tammy Sawatzky** Administrative Programs Manager	**tammy.sawatzky@conservation.ok.gov** 405-521-4823
Oklahoma Corporation Commission	**Matt Skinner** Public Information Officer	**m.skinner@occemail.com** 405-521-4180
Oklahoma Department Of Commerce	**Roger Pulley** Regional Development Specialist	**roger.pulley@okcommerce.gov** 405-815-6552
Oklahoma Department Of Environmental Quality	**Monty Elder** Environmental Programs Manager	**monty.elder@deq.state.ok.us** 405-702-9132

Oklahoma State Hazard Mitigation Team		
Agency Represented	**Representative** **Title**	**Email** **Phone**
Oklahoma Department Of Human Services	**Eddie Collins** Human Resources Mgr	**eddie.collins@okdhs.org** 405-522-0585
Oklahoma Department Of Health	**Darrell Eberly** Emergency Manager	**darrelle@health.ok.gov** 405-271-9444 ext. 56161
Oklahoma Department Of Transportation	**Alex Calvillo** Pro. Engineer II	**acalvillo@odot.org** 405-521-2557
Oklahoma Department of Agriculture	**Mark Goeller** Assistant Director	**mark.goeller@ag.ok.gov** 405-522-6146
Oklahoma Department Of Wildlife Conservation	**William Ray** Environmental Biologist	**wray@zoo.odwc.state.ok.us** 405-424-6062
Oklahoma Historical Society	**Catharine Wood** Historical Archeologist	**cwood@okhistory.org** 405-521-6381
Oklahoma Insurance Commission	**John Doak** Insurance Commissioner	**john.doak@oid.ok.gov** 405-295-3710
Association of County Commissioners of Oklahoma (ACCO)	**Gayle Ward** Executive Director	**gaylew@okacco.com** 405-516-5313
Oklahoma Municipal League	**Carolyn Stager** Executive Director	**carolyn@oml.org** 405-528-7515
State Fire Marshal	**David Barnes** Delegate	**dbarnes@oklahomacounty.org** 405-521-3169
Oklahoma Department of Labor	**Diana Jones** Director	**diana.jones@labor.ok.gov** 405-521-6139
U.S Army Corps Of Engineers	**William Smiley** Chief, Emergency Management	**william.e.smiley@usace.army.mil** 918-669-7330
U.S. Dept. of Housing and Urban Development	**William Tolbert** Management Analyst	**william.tolbert@hud.gov** 405-609-8461
Oklahoma Regents for Higher Education	**Pam Boatright** Campus Safety Coordinator	**pboatright@osrhe.edu** 405-225-9100
Cherokee Nation	**Tamara Copeland** Emergency Manager	**tamara-copeland@cherokee.org** 918-822-2764

Oklahoma State Hazard Mitigation Team		
Agency Represented	**Representative** **Title**	**Email** **Phone**
Oklahoma Emergency Management Association	**Trent Myers** President	**civildefense@allegiance.tv** **918-423-5655**
Muscogee Creek Nation	**James D. Nichols** Emergency Management Coordinator	**jnichols@muscogeenation-nsn.gov** 918-732-7891

2.2.2 Step Two: State Agency Involvement

The planning team undertook a number of activities to contact other state agencies during this plan update effort to solicit their input. These activities included meetings, emails and telephone calls to gather data specific to hazards and state programs.

2.2.3 Step Three: Agency and Organization Coordination

According to 44 CFR §201.4(b), the mitigation planning process should involve coordination with other state agencies, as well as appropriate federal agencies, and other interested groups. The SHMT currently represents 16 state agencies, two federal agencies, three trade associations, and one tribal entity. Quarterly meeting agenda items include the status of project applications, NOIs (notices of intent), and current disaster funding. Other topics of team discussion routinely include funding issues and obstacles; changes in regulations and policies; and educational opportunities. Input from team members is invited at each quarterly meeting. The SHMT meetings follow the Oklahoma Open Records Act, and meeting schedules are published on the OEM public website.

Since the adoption and implementation of the Oklahoma State Hazard Mitigation Plan in 2011, Oklahoma has had seven Federal Disaster Declarations, one Emergency Declaration, and 32 Fire Management Assistance Declarations. As a result, Oklahoma has developed a very close working relationship with FEMA.

Since the last plan update period, coordination between OEM and federal, state, local, and voluntary agencies has shown improvement in all elements of activation, communication, logistics, and mitigation planning procedures. FEMA, in particular, has provided additional resources during the past year to assist the State in the Hazard Mitigation Review process.

State departments including the Oklahoma Military, Agriculture, Food & Forestry, Environmental Quality, Public Safety, Health, Insurance, Transportation, Corporation Commission and others are represented at the EOC (Emergency Operations Center) during a disaster, and when a DRC (Disaster Recovery Center) is activated, it is not uncommon to find representatives from federal agencies including FEMA, HUD, SBA, EPA and IRS, working side-by-side with humanitarian volunteers from the American Red Cross and the Salvation Army. Oklahoma's disaster history from 2008 to 2013 is listed below.

2.2.3.1 Disaster Declarations for Oklahoma (1955 to Present)

Number	Date Declared	Presidential Disaster Declarations
4117	5-20-2013	Severe Storms and Tornadoes
4109	4-8-2013	Severe Winter Storm and Snowstorm
4078	8-22-2012	Wildfires
4064	6-14-2012	Severe Storms, Tornadoes, Straight-line Winds, and Flooding
1989	6-6-2011	Severe Storms, Tornadoes, Straight-line Winds, and Flooding
1988	5-27-2011	Severe Storms and Flooding
1985	5-13-2011	Severe Winter Storm and Snowstorm
1970	4-22-2011	Severe Storms, Tornadoes, and Straight-line Winds
1926	7-26-2010	Severe Storms, Tornadoes, Straight-line Winds, and Flooding
1917	5-24-2010	Severe Storms, Tornadoes, and Straight-line Winds
1883	3-5-2010	Severe Winter Storm
1876	2-25-2010	Severe Winter Storm
1846	6-19-2009	Wildfires
1823	2-17-2009	Severe Winter Storm
1820	2-15-2009	Severe Storms and Tornadoes
1803	19-9-2008	Severe Storms, Tornadoes and Flooding
1775	7-9-2008	Severe Storms and Flooding
1756	5-14-2008	Severe Storms, Tornadoes and Flooding
1754	5-9-2008	Severe Storms, Tornadoes and Flooding
1752	5-5-2008	Severe Storms, Tornadoes and Flooding
1735	12-18-2007	Severe Winter Storms
1723	8-31-2007	Severe Storms, Tornadoes and Flooding
1718	8-24-2007	Severe Storms, Tornadoes and Flooding
1712	7-7-2007	Severe Storms, Tornadoes and Flooding
1707	6-7-2007	Severe Storms, Tornadoes and Flooding
1677	2-1-2007	Severe Winter Storm
1678	2-1-2007	Severe Winter Storms
1637	4-13-2006	Severe Storms and Tornadoes
1623	1-10-2006	Severe Wildfire Threat
1465	5-10-2003	Severe Storms and Tornadoes
1452	2-4-2003	Severe Ice Storm
1401	2-1-2002	Ice Storm
1395	10-25-2001	Severe Storms and Flooding
1384	6-29-2001	Severe Storms
1355	1-5-2001	Severe Winter Storm
1349	11-27-2000	Severe Storms and Flooding
1272	5-4-1999	Severe Storms, Tornadoes and Flooding
1066	9-1-1995	Tornado, Flooding
1058	6-26-1995	Severe Storms, Tornado and Flooding
1048	4-26-1995	Explosion at Federal Courthouse in Oklahoma City
1024	4-21-1994	Severe Storms and Flooding
991	5-12-1993	Severe Storms, Tornadoes and Flooding
987	4-26-1993	Severe Storms and Tornadoes
905	5-8-1991	Severe Storms and Tornado
866	5-18-1990	Severe Storms, Tornado and Flooding
794	7-9-1987	Severe Storms and Flooding
778	10-14-1986	Severe Storms and Flooding

Number	Date Declared	Presidential Disaster Declarations
709	5-31-1984	Severe Storms and Flooding
704	5-3-1984	Severe Storms and Flooding
693	10-26-1983	Severe Storms and Flooding
685	6-10-1983	Severe Storms and Flooding
662	6-18-1982	Severe Storms and Flooding
649	11-4-1981	Severe Storms and Flooding
576	4-13-1979	Severe Storms and Flooding
504	6-5-1976	Severe Storms and Flooding
497	4-1-1976	Severe Storms and Flooding
491	12-10-1975	Severe Storms and Flooding
474	7-9-1975	Severe Storms, Tornadoes and Flooding
453	11-26-1974	Severe Storms and Flooding
441	6-10-1974	Severe Storms and Flooding
419	3-22-1974	Heavy Rains and Flooding
409	12-10-1973	Severe Storms and Flooding
404	10-13-1973	Severe Storms and Flooding
392	6-13-1973	Severe Storms, Tornadoes and Flooding
317	1-14-1972	Severe Storms and Flooding
314	9-28-1971	Heavy Rains and Flooding
297	10-14-1970	Severe Storms, Tornadoes and Flooding
241	5-29-1968	Heavy Rains and Flooding
104	7-15-1960	Heavy Rains, Hail, Floods and Tornadoes
95	11-9-1959	Heavy Rains and Flooding
92	7-8-1959	Flooding
74	5-18-1957	Flooding
54	4-7-1956	Tornadoes
35	6-1-1955	Tornadoes and Flooding

2.2.3.2 Emergency Declarations

Number	Date Declared	Emergency Declarations
3316	2-2-2011	Severe Winter Storm
3308	1-30-2010	Severe Winter Storm
3305	6-23-2009	Snow
3280	12-10-2007	Severe Winter Storms
3272	1-14-2007	Severe Winter Storms and Flooding
3219	9-5-2005	Hurricane Katrina Evacuation
3158	12-28-2000	Snow Storm
3118	2-27-1996	Fire Emergency
3115	4-19-1995	Explosion at Federal Courthouse in Oklahoma City
3020	1-18-1977	Urban Fire

2.2.3.3 Fire Management Assistance Declarations

Number	Date Declared	Fire Management Assistance Declarations
5003	8-4-2012	Drumright Fire
5002	8-4-2012	Glencoe Fire
5001	8-3-2012	Luther Fire
5000	8-3-2012	Freedom Fire
2999	8-3-2012	Noble Fire
2998	8-3-2012	Geary Fire
2997	7-30-2012	Fire Grounds Fire Complex
2956	9-3-2011	Ferguson Fire
2953	8-31-2011	Twin Lakes Fire Complex
2954	8-31-2011	Westminster Fire
2951	8-30-2011	63rd and Sooner Road Fire
2948	8-8-2011	Cedar Lane Fire
2947	8-7-2011	Cleveland-Mannford Fire Complex
2946	8-5-2011	265th West Fire
2945	8-4-2011	Coffee Creek Fire
2942	8-2-2011	Anderson Road Fire
2943	8-2-2011	Regency Fire
2944	8-2-2011	Turley Fire
2941	8-1-2011	Mustang Road Fire
2940	7-26-2011	Frankoma-81 Fire
2938	7-15-2011	Edmond Fire
2939	7-15-2011	Falls Creek Fire
2932	6-24-2011	Medicine Park Fire
2890	4-15-2011	Goodyear Plant Fire
2887	4-10-2011	Cleveland Fire
2883	4-6-2011	Jones-Spencer Fire
2879	4-3-2011	Guymon Fire
2874	3-24-2011	Osage County Fire Complex
2872	3-12-2011	Shawnee Fire
2871	3-11-2011	Goldsby Fire
2868	3-11-2011	Harrah Fire
2869	3-11-2011	Midwest City Fire Complex
2812	4-10-2009	Velma Fire
2813	4-10-2009	Mulhull Fire
2808	4-10-2009	Midwest Choctaw Fire
2809	4-10-2009	McClain Fire
2811	4-10-2009	Healdton Carter County Fire
2799	3-5-2009	Taloga Fire
2769	6-5-2008	Gotebo Fire
2756	3-21-2008	Quinlan Fire

2.2.3.4 Prioritization of Project Funding

Prior to the implementation of the State Hazard Mitigation Plan in 2008, the State Hazard Mitigation Team (SHMT) focused its actions efforts on flooding and flood prevention. Since the implementation of the State Hazard Mitigation Plan, the SHMT has broadened its selection of hazard mitigation projects to include all natural hazards that affect the State of Oklahoma. The SHMT reviews and evaluates the projects submitted for consideration and makes recommendations as to which would best serve the citizens and local jurisdictions and provide the most cost-effective use of funding. To ensure equitable consideration of proposed hazard mitigation projects, the following guidelines were developed:

1. Does the jurisdiction have an approved Hazard Mitigation Plan?
2. Is the project in their Hazard Mitigation Plan?
3. Is the project fundable as a mitigation project?
4. Is funding available for assignment to the project?

Due to the limited amount of project funding available, OEM employs a prioritization system for funding allocation. OEM reviews, ranks, and scores proposed projects using a scoring sheet (following page).The categories for ranking project submissions include the natural hazard event, history of damages, type of mitigation, impact on community, impact on environment, community commitment to mitigation, and benefits of mitigation. Generally, non-structural projects such as acquisitions, demolitions, relocation, and flood-proofing of repetitive loss and severe repetitive loss properties receive the highest ranking and greatest consideration for funding. Projects involving elimination of Repetitive Loss and Severe Repetitive Loss carry a high priority.

OEM Hazard Mitigation Project Score Sheet

Total Score_______

Applicant____

Project Title____

Date of NOI_________________ Date Approved for Funding_______________

Natural Hazards Addressed	Hazard — Value 2 points each Dam Failure Drought Earthquake Expansive Soils Extreme Heat Flooding Hail High Winds Landslides Lightning tornado Wildfires Winter Storms	Max Score 25 points
History of Damage in Project Area Repetitive Loss properties Severe repetitive loss properties	Average of all Properties 5 points per events documented by NCDC Or BC Module predicts an Average of <5 year Hazard Return Interval 25 >5 and <10 Hazard Return Interval 20 >10 and <25 Hazard Return Interval 15 >25 and <50 Hazard Return Interval 10 >50 and <100 Hazard Return Interval 5 >100 Hazard Return Interval 0	Max 25 points
Type of Mitigation	Non Structural (e.g., flood proofing, retrofitting, elevation, acquisition, development/implementation of codes and standards, etc.) 5 Structural (e.g., levee, flood wall, storm water drainage improvements, or dam construction/retrofitting) 0	Max 5 points
Potential Impact on Community	Severe (failure to implement project results in loss of life or essential services) 15 High (Communities with the most intense development pressures) 7.5 Moderate (failure to implement project results in economic hardship) 5 None (project has minimal or no impact) 0	Max 15 points
Estimated Environmental impact	Insignificant (CATEX) 5 Moderate (EA required) 2.5 Major (EIS required) 0	Max 5 points
Intangible Factors	Storm Ready 1 CSR rating (6-10) 1 point for each class 5 Cost Share arrangements (.25%) 2 History of mitigation projects -10 + 5 Intangible factors can also result in negative scores	Max 10 points
Cost Benefit Review	1 point per $5,000.00 benefits	Max 15 points
Total Points	100	
Bonus Point Section (Tie Breaker)	Quality of data in the application 2.5 Hazard Data (Zone) 2.5 Damage History 2.5 Benefit Cost Analysis 5.0 Environmental (Completeness) 2.5	Max 10 points

2.2.4 Step Four: Hazard Identification

The State Hazard Mitigation Team (SHMT) began identifying natural and man-made hazards that affect the State of Oklahoma in June 2003, based on the best information from climatology experts and disaster professionals throughout the state. These are discussed in Chapter Three.

To ensure the accuracy and completeness of information on hazards, the Oklahoma Climatological Survey profiled each hazard to include a history and probability analysis. This information was then summarized to include county-level information where possible.

The analysis of these hazards included the impacts upon the state's critical facilities, society, environment, economy, and future development. The resources of the state were found to exceed the local jurisdictional resources. The state gathered data and disseminated that information to all pertinent local jurisdictions to analyze and apply as needed to their local plans. In this case, hazard identification information flowed from the state to the local level.

After the State Hazard Mitigation Team reviewed the natural and man-made hazards that could potentially impact the State of Oklahoma, an initial prioritization of the hazards was determined. The Team collected the data on the hazards from available sources, including historical incidents and disaster declarations, records from the National Climatic Data Center (NCDC), input from federal and state emergency management agencies, the National Weather Service (NWS), the National Severe Storms Laboratory (NSSL), local governmental entities, and community service organizations such as the American Red Cross and Municipal League. The specific hazard identification and assessment justification, and methodology used, are included in Chapter Three, "Profiling Hazards."

In the February 17, 2014 update of this Plan, data gleaned from the review of the 134 FEMA-approved local and tribal plans covering 484 jurisdictions has been compared to the top-down data, and the top-down data was found to be lacking.

2.2.5 Step Five: Hazard Assessment

The hazard data was analyzed relative to its impact on public health and safety, buildings, transportation, infrastructure, critical facilities, and the local and state economy. Some of the work for Steps Four and Five had already been done in the preparation of the previous Plan. The planning team used historical data to estimate potential losses from the various hazards. Discussion of the situation and vulnerability assessment for each hazard is found in Chapter Three.

2.2.6 Step Six: Goal Setting

Project and community hazard mitigation goals and objectives for the State were developed by the State Hazard Mitigation Team and HM planning review staff to guide the development of this Plan. The goals, in the national and state context, are discussed in this chapter, and individual hazard goals and the goals-setting process are described in Chapter Four. The SHMT determined that these goals continue to be valid.

2.2.7 Step Seven: Possible Mitigation Actions

A wide variety of mitigation ideas and activities were examined. Mitigation activities are organized under the following six categories from the FEMA guides (Publications 386-1 and 386-3; also "Mitigation Ideas" dated January 2013). For a more detailed description of each category, see Chapter Four, "Mitigation Strategies and Priorities."

1. Public Education and Awareness – Outreach projects and technical assistance
2. Preventive Measures – Zoning, building codes, storm water management
3. Natural Resource Protection – Wetlands protection, forest/vegetation management
4. Property Protection –Acquisition, retrofitting, relocation, elevation
5. Emergency Services – Warning, sandbagging, evacuation
6. Structural Projects – Dams, reservoirs, retaining walls, safe rooms

2.2.8 Step Eight: Action Plan Draft

The draft copy of the updated State Plan was widely circulated for comment and reviewed at meetings with state and federal agencies. Prior to submission to FEMA, the draft was presented to the SHMT for final comment and approval.

2.2.9 Step Nine: Plan Adoption

In compliance with 44 CFR § 201.4(c)(6), following a final review by FEMA which Approves the plan Pending Adoption, the State Hazard Mitigation Plan must be formally adopted by the Governor's Authorized Representative prior to submittal to FEMA for final review and approval. The revised State Plan will then be submitted to FEMA for approval every three years.

2.2.10 Step Ten: Plan Maintenance and Continued Compliance

The State's adoption of the Hazard Mitigation Plan is only the beginning of the plan maintenance effort. State offices, other agencies and private partners will implement the plan's activities; Oklahoma Emergency Management, Hazard Mitigation Division, will monitor implementation progress, evaluate the effectiveness of the actions, and periodically recommend revisions to the action items. Progress in the implementation of the plan and the recommended action/mitigation strategies will be assessed annually. The Plan is a living document and will be reviewed, updated and adopted by state officials and submitted to the Federal Emergency Management Agency for approval every three years. The plan will be revised more frequently if conditions under which the plan was developed change; through new or revised state policy, a major disaster, or availability of funding, for example, to reflect the new reality of hazard mitigation in the State of Oklahoma. The State will continue to comply with all applicable federal statutes and regulations during the periods for which it receives grant funding, in compliance with 44 CFR 13.11 (c) and will amend this plan whenever necessary to reflect changes in state or federal laws and statutes as required in 44 CFR 13.11 (d) . The 44 CFR will be reviewed immediately after the annual 44 CFR updates.

Review and updates of the state plan will take place in several ways:

- Annually, for progress made on mitigation actions and projects identified in the Mitigation Strategy of the State Plan.

- After each major disaster in the State of Oklahoma declared by the President, to look for areas where the State Plan should be refocused due to the impact of the disaster.

- Every three years before the State Plan is resubmitted for approval to the Federal Emergency Management Agency.

2.3 Coordination Among Agencies

2.3.1 Oklahoma Emergency Management (OEM)

Oklahoma Emergency Management (OEM) coordinates statewide emergency preparedness, response, recovery, and hazard mitigation activities with federal, tribal, state, and local agencies to develop and implement the strategies outlined in this document, and to obtain interagency feedback on the mitigation steps taken and use that information in updating this plan. Created by Oklahoma statute in 1999, the State Hazard Mitigation Team (SHMT), comprised of state, federal, tribal and non-profit agencies, provides a methodology for coordinating hazard mitigation information among the represented agencies.

OEM reviewed, evaluated and discussed the existing Plan and concluded that while the primary goals have remained the same, the agency should expand horizons by identifying new and improved methods to achieve those goals. The analysis presented evidence that goals identified in the original Plan had been successfully accomplished and should be continued and expanded in scope. In reviewing the disasters which occurred during the years 2004 - 2013, OEM realized that new vulnerabilities existed as well as new technologies to mitigate these and formerly-identified hazards. Identification and further discussion of these changes are found in Chapter Four of this document.

Evaluation of management and coordination methods used to achieve the State's mitigation goals revealed that while the State's capabilities have increased, the current methods of operation and administration are proper, cost effective and well-administered.

In addition to the involvement of state agencies on the SHMT, other state and federal agencies were contacted to request the most current data, and their input to Plan updates. These agencies are listed below, along with a description of their interaction and coordination with OEM. These contributors provided input regarding their own mitigation initiatives and other possible sources of funding for mitigation projects. In-depth information about existing and proposed mitigation efforts is summarized in the table below.

In Oklahoma, each state agency is required to prepare an annual status report to the Governor and Legislature. This report must describe the activities of the agency as well as define its objectives and how it has completed those objectives during the past year in order to justify continued funding. In preparing its annual report, OEM, with assistance from the SHMT, reviewed the goals and mitigation action items profiled in the State Plan to determine if they have been successful, or the action is complete and funds can then be transferred to other projects.

2.3.2 Coordinating Agencies and Funding Sources

Agency	Coordination /Services	Available Funding	Supports Mitigation Efforts
National Weather	1) Hydro-Meteorological Studies		1) Yes

Agency	Coordination /Services	Available Funding	Supports Mitigation Efforts
Service	2) Weather Surveillance 3) NOAA Weather Radio 4) National Warning System 5) River Forecast Center		2) Yes 3) Yes 4) Yes 5) Yes
US Dept of Agriculture	1) Extension Services 2) Farmers Home Administration 3) Rural Electrification Admin 4) Natural Resource Cons Service 5) Watershed Protection/Flood Prevention (PL 83-566) 6) Flood Control Act 1944, (PL 78-534) 7) Floodplain Mgmt Studies 8) RC&D Program (PL 88-703) 9) Emergency Watershed Protection 10) Conservation Tech Assistance	1) Farm Service Agency loans 2) Emergency Loans 3) REA loans/tech asst 4) NRCS Financial/Tech assistance 5) Financial/Tech assistance 8) Financial/Tech assistance 9) Agricultural Credit Act of 1978	1) Yes 2) Yes 3) Yes 4) Yes 5) Yes 6) Yes 7) Yes 8) Yes 9) Yes 10) Yes
US Army Corps of Engineers, Tulsa District	1) Feasibility Studies/Projects 2) Emergency Stream Bank Protection 3) Small Flood Control Projects 4) Flood Control/Snagging & Clearing 5) Emergency Operations (PL 84-99) 6) Floodplain Management Services 7) Permit Authority 8) Disaster Response 9) Flood Control 10) Dam Safety	8) Memorandum of Understanding	1) Yes 2) Yes 3) Yes 4) Yes 5) Yes 6) Yes 7) Yes 9) Yes 10) Yes
US Department of Education	1) Floodplain Management Guidelines		1) Yes
Bureau of Reclamation (US Department of the Interior)	1) Water Supply 2) Hydroelectric Power 3) Flood Control		3) Yes
Fish & Wildlife Service (US Department of the Interior)	1) Flood Hazard Mitigation		1) Yes
US Geological Survey (US Department of the Interior)	1) Data Collection 2) Monitoring 3) Analysis 4) Predictive Modeling		1) Yes 2) Yes 3) Yes 4) Yes
National Park Service (US Department of the Interior	1) Flood Hazard Mitigation (Chickasaw National Recreation Area) 2) Construction 3) Shoreline Processes		1) Yes 2) Yes 3) Yes
US Department of Housing and Urban Development	1) Community Planning and Development 2) Home Investment Partnership Act 3) FHA Single Family Programs 4) Multi-family Housing Programs 5) Public Housing 6) Native American Programs	1) Grant program (match HMGP/PDM) 2) Home program 3) Mortgage/loan insurance 4) Mortgage Insurance program 5) Funding & assistance 6) Indian home loan guarantee program 7) Indian Develop Block Grant Program	1) Yes 2) Yes 3) Yes 4) Yes 6) Yes 7) Yes
US Department of Transportation	1) Post Flood Disaster replacement and/or reconstruction of highway		1) Yes

Agency	Coordination /Services	Available Funding	Supports Mitigation Efforts
	facilities		
US Small Business Administration	1) Financial Assistance-Disaster Loan Program	1) Home disaster loans 2) Business physical disaster loans 3) Economic injury disaster loans	
American Red Cross	1) Emergency & Health Services 2) Disaster Relief Programs		
Oklahoma Department of Agriculture-Forestry Division	1) Rural Fire Defense Program 2) Red Flag Fire Alerts 3) Technical Advice 4) Forest Stewardship Program 5) Forest Heritage Center 6) Project Learning Tree Program 7) Urban & Community Forestry Program 8) Water Quality Management Program 9) Regeneration/ Improvement Center		1) Yes 2) Yes 4) Yes 6) Yes 7) Yes 9) Yes
Oklahoma Climatological Survey	1) Oklahoma Mesonet 2) Flash Flood Guidance 3) Drought Monitoring Website 4) Historical Information		1) Yes 2) Yes 3) Yes 4) Yes
Oklahoma Department of Commerce	1) Community Development Programs	1) Grant & Loan Programs	1) Yes
Oklahoma Conservation Commission	1) District Operation Division 2) Water Quality Division 3) Mine Land Reclamation Division	1) Small Watershed Flood Control Fund 2) Cost Share Program/Watersheds 3) Federally Funded	1) Yes 2) Yes 3) Yes
Oklahoma Emergency Management Association	1) Storm Spotters Network 2) Emergency Operations Center 3) Disaster Preparedness Network		1) Yes 2) Yes 3) Yes
Oklahoma Department of Management and Enterprise Services	1) State Self Insurance Program		1) Yes
Oklahoma Department of Emergency Management	1) Preparedness, Response, Recovery, Mitigation Programs; Mitigation of repetitive loss property; Mitigation of Severe repetitive loss properties.	1) Federal Financial Assistance Programs 2) HMGP 3) FMA 4) SRL 5) PDM	1) Yes 2) Yes 3) Yes 4) Yes 5) Yes
Oklahoma Department of Environmental Quality	1) Customer Services Division 2) State Environmental Laboratory 3) Air Quality Division 4) Land Protection Division 5) Water Quality Division	1) Customer Assistance Program	 4) Yes 5) Yes
Oklahoma Floodplain Managers Association	1) Floodplain Management 2) Member Services 3) Internal Development/OFMA Strategic Plan	 2) Training/Education	1) Yes 2) Yes 3) Yes
Oklahoma Geological Survey	1) Earth Science Education 2) Geological Mapping 3) Geophysical Observatory		 2) Yes 3) Yes
Oklahoma Historical Society	1) Administer Federal Historic Preservation Programs 2) Identification of Archeological/Historic Properties		

Agency	Coordination /Services	Available Funding	Supports Mitigation Efforts
Oklahoma Department of Human Services	1) Temporary Emergency Assistance 2) Human Resource Management Division	1) Individual/Family Grants	1) Yes
Oklahoma Water Resources Board	1) National Flood Insurance Program 2) Dam Safety Program 3) Administration of State Water Laws 4) Water Resource Planning 5) Floodplain Management Program 6) Drought/Weather Mitigation	1) Community Assistance Program 2) Training 4) Loan/Grant Programs 5) Flood Insurance	1) Yes 2) Yes 4) Yes 5) Yes 6) Yes
Oklahoma Department of Wildlife Conservation	1) Communications/Relay Towers 2) Fisheries Division/Construction 3) Wildlife Division	 3) Tech. Assistance/Research/Education	1) Yes 2) Yes 3) Yes

2.3.3 The National Weather Service (NWS)

The mission of the NWS is to provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy. By increasing the nation's weather-readiness, the country will be better prepared to protect, mitigate, respond to, and recover from weather-related disasters. The NWS supports its mission through the following programs:

The **Advanced Hydrologic Prediction Service (ADHP)** is a new suite of forecasting products being offered by the NWS. These Internet-based products enable both government agencies and the general public to make better informed decisions regarding flood and drought mitigation. Weather forecasting was initially developed in response to the need of societies to protect themselves from storms, severe heat and cold, floods, etc., and minimize consequent economic losses. ADHP began as a post-disaster pilot program in the 1990's to monitor river levels in the Midwest and quickly grew into a nationwide program.

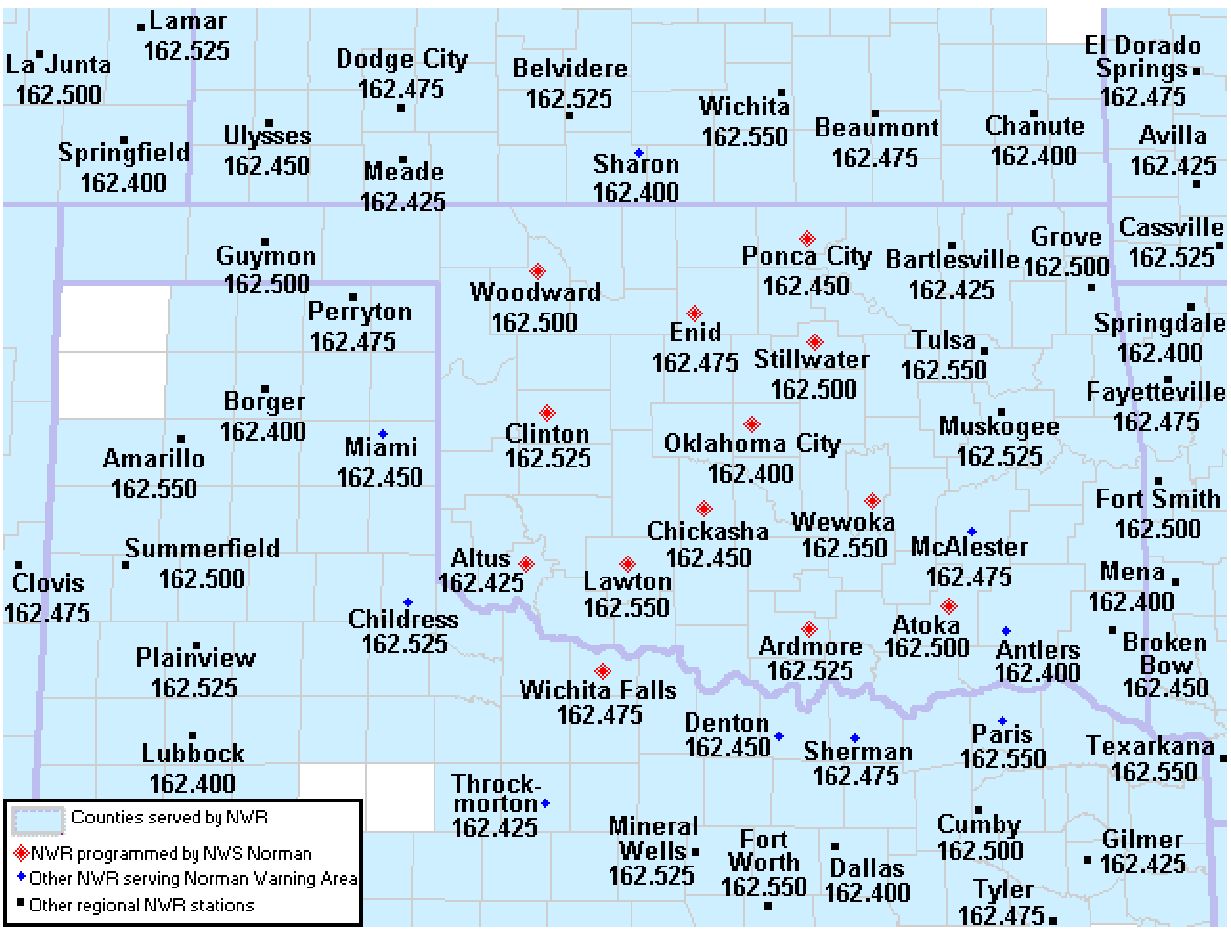
ADHP utilizes data from a network of water level gauges around the country, plus computer models, satellite data, and Doppler radars, to develop customized products that more accurately predict floods and droughts. These advanced forecasting products are the basis for the operation and management of flood-control structures. Emergency management officials can then use this data to develop evacuations plans and develop measures to mitigate the impact of flooding. The same data can also provide information about potential droughts. The information provided by the ADHP is invaluable to power companies, developers, businesses, as well as recreational users.

The **River Forecast Center (RFC)** located in Tulsa, OK, was founded as the Tulsa River Forecast Center in December 1947 in response to the record floods of 1945 in the Arkansas and Red River basins. Its mission has remained essentially unchanged through the years, while its geographical reach has extended all the way downstream to the Mississippi River, incorporating over 208,000 square miles and portions of seven states. The Tulsa RFC was selected as the first prototype site for modernized RFC technologies and operations. In 1991, the center was renamed **the Arkansas-Red Basin RFC** to better convey the area of responsibility. The data used by the RFC is provided by the US Army Corps of Engineers and USGS from water gauges on the rivers and streams from 200 river forecast points, 100 of which are located in Oklahoma, and combined with NWS satellite and radar data, then input to the hydrologic computer program model to develop the River Stage forecast.

Weather Surveillance RADAR-NEXRAD (WSR-88D) - The National Weather Service operate WSR-88D RADAR systems to detect and warn for severe thunderstorms, flash floods and tornadoes across Oklahoma. This system can predict rainfall patterns with more lead time when severe weather is occurring or anticipated. This state-of-the-art, computer-based, S-band (10 cm), Doppler weather radar system covers all areas of the United States including Alaska and Hawaii, as well as parts of the Caribbean. Currently there are 14 Radars that monitor Oklahoma.

NWS NOAA Weather Radio Coverage of Oklahoma

Source: National Weather Service website



NOAA Weather Radio Network (NWR) – Oklahoma is served by 13 transmitters programmed by the National Weather Service's Norman offices, as well as 10 additional transmitters programmed by other NWS locations, ensuring 100% coverage for the state of Oklahoma.

National Warning System (NAWAS) – Although not an agency in and of itself, the NAWAS program has been useful in maintaining contact with various jurisdictions on the local, state, and federal levels. Used extensively at one time, due to availability limitations, it is now primarily used when situations occur that require quick response by agencies. NAWAS is a comprehensive party line network of telephone circuits connecting state and federal warning points throughout the United States and is funded by FEMA. Although NAWAS is a national system, the day-to-day operation is under the control of individual states. Each state has its own plan for the use of NAWAS during weather emergencies. NWS offices should use this circuit only in accordance with individual state plans.

Watches and warnings are disseminated on the appropriate NAWAS by the issuing office. For Oklahoma weather situations, coverage by NAWAS drops are located in weather offices for direct communication with all the other NAWAS drops in this state, including Highway Patrol Headquarters (also the "primary warning point" under the state plan); most Troop Headquarters; and 17 city and county Emergency Operation Centers including the state EOC. Some weather offices outside Oklahoma provide this state with additional advance information and more radar coverage. Each office with a NAWAS drop can hear current information and can anticipate weather action in their respective areas. National Weather Service drops are located at the Norman and Tulsa Weather Offices and in Amarillo, Fort Worth, Texas; Shreveport, Louisiana; and Springfield, Missouri.

2.3.4 U.S. Department of Agriculture (USDA)

Post-disaster assistance may be provided to Oklahomans including farmers, ranchers, and agricultural producers by the USDA in the form of grants, technical assistance, and educational programs through the following programs:

Oklahoma Cooperative Extension Service (OCES)
Educational materials are provided through state universities to farmers, ranchers and others on what they can do to protect themselves and their property against hazards associated with disasters. This may also include technical advice on cleanup of damaged property; sanitation precautions; insect control; food preparation in an emergency; recovery actions on damaged farms; and renovation of damaged equipment and property.

Emergency Farm Loans
If the county is declared by the President or Secretary of Agriculture to be a disaster area, low-interest loans may be available through the *Farm Service Agency* and *Farmers Home Administration* to repair or replace buildings or other structures; purchase livestock and equipment; pay essential living expenses.

The Rural Utility Service (RUS)
This agency may provide electric and telephone cooperatives with low-interest loans and technical assistance to repair infrastructure and implement mitigation measures following a natural disaster.

The Natural Resource Conservation Service (NRCS)
This agency provides technical and financial assistance for soil erosion prevention on any watershed impaired by any natural disaster. The NRCS administers the Resource Conservation and Development Program (RC&D) authorized under Public Law 88-703. Under this program, technical and financial assistance is available for installation of flood prevention measures; however, funding for this program is limited.

2.3.5 U.S. Army Corps of Engineers - Tulsa District

Member Oklahoma Hazard Mitigation Team

The United States Army Corps of Engineers (USACE) has authority under Public Law 84-99 to assist public agencies in responding to flood emergencies. Assistance can be in the form of technical assistance, direct assistance, or rehabilitation of federal and certain non-federal flood control works, damaged or destroyed by floods. The USACE develops and implements flood control plans, and also has authority for emergency operations, stream bank protection, permit administration, and technical assistance. In Oklahoma, activities of the USACE include:

Feasibility Studies and Projects - Congress can authorize the USACE to perform feasibility studies that may result in projects for flood control, navigation, hydropower, water supply, and recreation.

Continuing Authorities – The USACE has discretionary authority to implement certain types of water resource projects without specific Congressional authority. These projects are typically limited in scope and cost. Currently, federal cost limitations are:

(1) Emergency Stream Bank Protection of Public Facilities: $500,000
(2) Small Flood Control Projects: $7.5 million
(3) Snagging and Clearing for Flood Control: $500,000

Emergency Operations - Under the provisions of Public Law 84-99, the USACE has the authority to respond to flood emergencies. This authority includes flood control operations, constructing advance measures (temporary) in anticipation of imminent flooding, and the repair of damaged flood control works after the flood event.

Floodplain Management Services - The USACE can provide assistance in evaluating flood hazards to a site, floodplain delineation, technical assistance, guidance, and comprehensive floodplain management to local and state governments, and authorized tribal organizations.

Permit Authority - By law, the USACE has the authority to issue Section 10 permits to cover construction, excavation, and other related work in or over navigable waterways; and Section 404 permits covering the discharge of dredged or fill material in all waters of the United States, to include adjacent wetlands.

Disaster Response - The USACE has a *Memorandum of Understanding* to coordinate with and support all FEMA response activities. Following the 1995 bombing of the Murrah Building, the USACE established a Disaster Field Office in Oklahoma City to coordinate public works and engineering in accordance with the Federal Response Plan. This effort included providing search and rescue personnel and structural engineering support. After the May 3, 1999, tornadoes that hit parts of Oklahoma, the USACE was involved in many aspects of the response and recovery, most notably the contracting and monitoring of debris removal from the tornado areas.

<u>Flood Control</u> - The USACE is responsible for controlling floodwater releases from all USACE lakes. The USACE also has agreements to monitor and control flow releases from dams owned or controlled by Grand River Dam Authority (GRDA), Bureau of Reclamation, and other federal agencies.

<u>Dam Safety</u> - The USACE has mandatory annual training for personnel on dam safety and all dams are inspected every four years for safety standards and the integrity of the dams.

2.3.6 Oklahoma Department of Education (DOE)

Member of Oklahoma Hazard Mitigation Team

Any proposed construction or modifications to structures involving federal financing must take into account the provisions of Executive Order 11988 and its accompanying Floodplain Management Guidelines. Prior to the construction or modification of public school structures in Oklahoma, the Department of Education (DOE) shall determine whether the proposed action will occur in a floodplain. This determination shall be made using current floodplain maps if available. If such maps are not available, a DOE representative shall make a determination of the location of the floodplain based on the best available information. If the school facilities are not located in a floodplain, the DOE representative will so certify. If they are, federal support can be rendered only if there is no practicable alternative. A determination of "no practicable alternative" will be made in accordance with the provisions outlined in *Executive Order 11988*. If school facilities are located in a floodplain and there is no practicable alternative, the DOE representative is responsible for certifying that the local facility has flood insurance up to the maximum amount available or up to the amount of damage assistance provided by the Education Department, whichever is the lesser.

2.3.7 U.S. Department of the Interior

The U. S. Department of the Interior is a Cabinet-level agency that manages America's vast natural and cultural resources through nine technical bureaus, six of which are active in Oklahoma's hazard mitigation initiative:

U.S. Bureau of Indian Affairs (BIA)

The BIA is responsible for managing and protecting natural resources on Indian trust lands. It provides community services, operates or provides financial support to operate schools, maintains law enforcement systems, provides social services, and assists in farming, ranching, forestry and mining on tribal reservations.

U.S. Bureau of Land Management (BLM)

The BLM is responsible for the appropriate multiple use management of natural resources. BLM also has the responsibility for mineral leasing and supervision of mineral operations on federal mineral estates that underlie other surface ownership and on Indian mineral estate lands held in trust.

U.S. Bureau of Reclamation (BOR)

BOR reconstructs, operates, and maintains multiple-purpose federal water projects in the 17 western states. BOR has constructed over 600 dams and reservoirs, including Hoover Dam, since the agency was established by the Reclamation Act of Congress in 1902. Authorized purposes at each project may include: water supply for agricultural irrigation and municipal uses, hydroelectric power, flood control, recreation, and fish and wildlife benefits. BOR constructed seven dams in Oklahoma including Altus, Arbuckle, Fort Cobb, Foss, McGee Creek, Mountain Park, and Norman.

U.S. Fish and Wildlife Service
The Fish and Wildlife Service has a principal federal responsibility to conserve, protect, and enhance fish and wildlife and their habitats. The Service manages the national wildlife refuge system. In addition, the Service manages fish hatcheries and is responsible for flood hazard mitigation in nine wildlife refuge areas in Oklahoma.

U.S. Geological Survey (USGS)
Created by an act of Congress in 1879, the USGS is the sole science agency for the Department of the Interior. The USGS serves the Nation as an independent fact-finding agency that collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems. The USGS provides impartial science because it has no regulatory or management mandate. The diversity of scientific issues that demand attention has prompted the USGS to focus its efforts into four major areas: natural hazards, resources, the environment, and information and data management. USGS scientific efforts include long-term data collection, monitoring, analysis, and predictive modeling.

National Park Service (NPS)
The NPS has the dual responsibility of protecting the natural and cultural resources of the park areas and providing for their use and enjoyment by the public. The NPS also conducts programs that promote and assist outdoor recreation planning, preservation of cultural and natural resources, and environmental compliance and review along with other federal agencies, state and local governments, and private organizations. The NPS is also responsible for flood hazard mitigation in Oklahoma for the Chickasaw National Recreation Area.

2.3.8 U.S. Department of Housing and Urban Development (HUD)

Member of Oklahoma Hazard Mitigation Team
As the name implies, the U.S. Department of Housing and Urban Development (HUD) is the agency of the federal government whose primary mission is to assist in providing good quality housing and suitable living environments for all segments of the population.

HUD has the capacity to wave or modify some policies and procedures in the event of Presidential disasters. Any discussion of replacement of disaster-damaged homes and hazard mitigation is of interest to HUD. For purposes of this Plan, special emphasis has been placed on how these programs relate to hazard mitigation, both before and after a disaster.

Under **CDBG**, the *Section 108 Loan Guarantee Program* provides opportunities for cities and towns to use HUD programs to reduce the risk of adverse impacts on communities prior to the occurrence of disaster. It allows them to transform a portion of their CDBG funds to pursue physical and economic revitalization projects that can renew entire neighborhoods. For example, houses that are located in flood-prone areas have a heightened exposure to sustaining damage from floods. Cities and towns might use CDBG, HOME funds, and local public and/or private resources to avoid this risk by creating more suitable, good quality housing opportunities elsewhere in the city.

The federal government, primarily through FEMA and SBA, provides disaster relief to meet some emergency, short term recovery needs. However, communities may elect to use their CDBG funds for emergency, short-term assistance if such activities are not funded by FEMA or SBA. CDBG may be used to fund clearance of debris and emergency reconstruction of essential infrastructure.

The Federal Housing Administration (FHA), a division of HUD, provides mortgage insurance for single-family homes. A "safe room" is an eligible amenity that can be included in an FHA mortgage. Also, during the loan approval process, FHA is required to ensure that new construction projects comply with FEMA requirements as they relate to development in Special Flood Hazard Areas.

2.3.9 U.S. Department of Transportation

The Federal Highway Administration (FHWA) is an agency within the U.S. Department of Transportation which oversees and approves the design and construction of federal aid highways. Regulations developed by FHWA to implement *Executive Order 11988* (Floodplain Management, May 24, 1977) are contained in 23 CFR § 650A prescribes the policies and procedures for the location and hydraulic design of high encroachments on floodplains. Any post flood disaster replacement or reconstruction of severely damaged highway facilities, using federal aid funding, would support hazard mitigation initiatives.

2.3.10 Small Business Administration (SBA)

The SBA was created by Congress in 1953 to provide financial assistance to victims of disasters. The SBA's *Disaster Loan Program* offers financial assistance to enable individuals and certain non-profit agencies to rebuild homes and businesses in the aftermath of a disaster. The SBA provides low interest loans, usually 4% or less, and/or long-term loans of up to 30 years for disaster victims. These loan proceeds may be used to repair or replace disaster-damaged property that is not fully covered by insurance.

2.3.11 American Red Cross (ARC)

It is not a government agency, but its authority to provide disaster relief was formalized when, in 1905, the Red Cross was chartered by Congress to "carry on a system of national and international relief in time of peace and apply the same in mitigating the sufferings caused by pestilence, famine, fire, floods, and other great national calamities, and to devise and carry on measures for preventing the same."

The American Red Cross provides a variety of essential emergency and health services through its many programs to people around the world. All services are consistent with the American Red Cross mission of helping people prevent, prepare for, and respond to emergencies and are provided by trained paid and volunteer staff members.

2.3.12 Association of County Commissioners of Oklahoma (ACCO)

Member of Oklahoma Hazard Mitigation Team

In Oklahoma, each county has three districts and each district has one commissioner. These county commissioners exercise the administrative powers given to them by the Oklahoma Statutes and the Oklahoma Constitution. Made up of the commissioners from the 77 counties in Oklahoma, ACCO is a non-profit association that provides orientation training and assistance to assist the commissioners in conducting their duties. ACCO's staff provides workshops, written study materials, technical support, and legal advice. Additionally, ACCO:

- Provides information to state lawmakers and officials relating to ACCO's position on a broad array of public policy issues.
- Advocates for legislation useful to counties and oppose bills detrimental to county government operations.
- Opposes unfunded mandates—state or federal initiatives requiring local governments to provide new programs or services with no revenue to support them.
- Provides high quality education and training programs for county commissioners through a variety of meetings throughout the year.
- Creates opportunities for county leaders to exchange ideas, share experiences and take advantage of expert advice.
- Provides a statewide forum for building consensus among commissioners after fully debating issues that affect county government.
- Communicates effectively on the issues and challenges facing counties and how they impact the lives of local citizens and their communities.

2.3.13 Oklahoma Dept of Agriculture, Forestry Division

Member of Oklahoma Hazard Mitigation Team

The Forestry Division of the Oklahoma Department of Agriculture serves the public, private landowners, forest industry, cities and towns, and other agencies and organizations through a wide variety of programs. These services include protection, management, improvement and use of Oklahoma's forests and their associated benefits. Oklahoma has an estimated 7.5 to 10 million acres of forestland. Professional foresters provide assistance in all 77 counties, contribute to the economy and improve the quality of life of all Oklahomans.

Created by the Oklahoma Legislature in 1925, the Forestry Division began as an agency charged with public education, reforestation and wildfire control to help the forests recover from overcutting and uncontrolled burning. As the public's interest in conservation grew, and federal and state programs were enacted, Forestry Services began to address natural resource issues with a comprehensive program of service in forest management, forest protection, law enforcement, education, urban forestry, water quality, forest regeneration and tree improvement and fire department assistance.

Forestry helps maintain forest health by minimizing damage from destructive fires, insects and diseases and by helping improve the productivity of the state's forests.

These services are provided through the Forestry Division:

- Rural Fire Defense Program
- Forest Fire Control and Management
- Red Flag Fire Alerts, information and technical advice to landowner
- Forest Stewardship Program

- Utilization and Marketing advice to the forest industry
- Forestry education through the Forest Heritage Center
- Project Learning Tree programs
- Urban and Community Forestry Program
- Forest Water Quality Management Program
- Forest Regeneration and Forest Tree Improvement Centers

2.3.14 Oklahoma Climatological Survey (OCS)

Member of Oklahoma Hazard Mitigation Team

The Oklahoma Climatological Survey (http://www.climate.ok.gov) was established in 1980 to provide climatological services to the citizens of Oklahoma, conduct research on the impacts of climate on human activities, and serve as a support facility for the State Climatologist. OCS has a legislative mandate to acquire, process, and disseminate climate and weather data and information for use by the state's citizens. The Survey maintains an extensive array of climatological information; operates the Oklahoma Mesonet, the nation's premier environmental monitoring network, and hosts a wide variety of educational outreach and scientific research projects. The OCS is a research unit of the College of Atmospheric and Geographic Sciences at the University of Oklahoma.

OCS historical information includes documenting tornado occurrences in the state, assessing the likelihood of severe weather, and documenting recent events that resulted in Federal disaster declarations in the state. Products on the OCS website include historical averages and extremes, available at a county or sub-county level, a weather timeline, and synthesized information for monitoring drought, heavy rainfall, and other weather hazards.

OCS also operates several outreach programs that provide training, products, and decision-support systems tailored to the needs of different groups. Groups served by OCS outreach programs include K-16 education, emergency management, wildfire manages, and agricultural producers. Additional information about these programs is on the OCS website under the Outreach tab.

A staff of climatologists at OCS is available to assist local decision-makers. OCS climatologists are adept at tailoring Oklahoma's climate records to provide information that can improve decision-making, whether in real-time or longer term risk analysis. Data archives allow staff to provide from the 'big picture' overview of Oklahoma climate, to local historical probabilities and occurrences of significant weather events. OCS programs include the following:

The Oklahoma Mesonet

This is a statewide network of 120 automated weather stations, with at least one station located in each county in Oklahoma. The network was developed through the cooperation of Oklahoma State University and The University of Oklahoma and established in 1994. The Mesonet reports observations of temperature, rainfall, winds, humidity, pressure, solar radiation, and soil temperature and moisture at 5-minute increments, around-the-clock. Mesonet data serve as the backbone of a number of public-safety oriented products provided by OCS.

Among the products provided by OCS and the Mesonet are real-time weather information, historical event and climate summaries, and several products tailored to public safety applications. Most real-time weather data, including radar images from sites around the state, are available online at http://www.mesonet.org. The Mesonet offers several products for real-time assessment of hazardous conditions.

OK-First Program
OK-First serves Oklahoma's emergency management and public safety communities, including meeting many of the requirements for the National Weather Service's ***Storm Ready*** community certification. Participants attend workshops where they learn how to access and interpret radar and other weather data sources, improve coordination of storm spotter activities with state and federal officials, and interact with colleagues and mentors from the state's meteorology community. Refresher workshops are offered every 18 months to provide the latest technology and weather information. OK-FIRST was recognized with Harvard *University's Innovations in American Government* award in 2001.

Southern Climate Impacts Planning Program (SCIPP)
The Southern Climate Impacts Planning Program (http://www.southernclimate.org) is a climate hazards preparedness program focused on the South Central United States, which aims to bridge the gap between climate science and local and state hazard planning processes. Focusing on the six-state region of Oklahoma, Texas, Louisiana, Arkansas, Tennessee, and Mississippi, SCIPP investigates major climate hazards of the region and actively engages community-level decision makers to determine hazard planning and climate data gaps; collaboratively develop assessment and decision support tools; and provide education and outreach.

Major climate hazards of interest of SCIPP include droughts, floods, hurricanes, and severe storms. As one of the National Oceanic and Atmospheric Administration's Regional Integrated Science and Assessment (RISA) Teams, SCIPP strives to continue the success of the RISA program in conducting critical, interdisciplinary research through stakeholder partnerships. SCIPP is a collaborative research effort between the Oklahoma Climatological Survey at the University of Oklahoma and the Department of Anthropology and Geography/Southern Regional Climate Center at Louisiana State University.

2.3.15 Oklahoma Department of Commerce (ODC),

Member of Oklahoma Hazard Mitigation Team
The Oklahoma Department of Commerce is the primary economic development arm of the State of Oklahoma government. The department's mission is to stimulate the creation, expansion and retention of jobs and growth of investment in Oklahoma. The agency cannot support the mission without critical communication, business process and customer interfaces.
The agency includes the operations of an Information Technology Division which serves the general needs of the agency. These include:

- Application and database administration and development
- Server technologies and network infrastructure implementation and support
- Personal computer implementation and support
- Training
- Contract system development and business process support

2.3.16 Oklahoma Conservation Commission (OCC)

Member of Oklahoma Hazard Mitigation Team

The OCC is an agency of the State of Oklahoma whose mission is to provide conservation districts the tools necessary for the responsible care and best management of Oklahoma's renewable natural resources. Technical assistance is provided in erosion prevention, control and care of soil resources; prevention of flood and sediment damage; development of water resources; pollution complaint tracking; environmental education coordination; water quality; and maintenance of small upstream flood control structures. The OCC has authority over Non-Point source water quality programs, the reclamation of abandoned mine lands and the development of the state's wetland management strategy. OCC's divisions and areas of responsibilities include:

Administration Services Division provides accounting services for the agency as well as claims processing for state funds allocated to the 88 conservation district offices. Policy decisions are made by this division, in cooperation with other divisions as well as numerous local, state, and federal entities.

District Operations Division administers the Small Watershed Flood Control fund. The OCC has authority to allocate any conservation district in the state, from the Small Watershed Flood Control fund, such sums as the Commission may deem necessary to enable that district to acquire real property needed to install upstream flood control structures on rivers and streams. OCC carries out a program of repair on upstream flood control dams that are affected as a result of a Presidential declared disaster. A design package, including plans, specifications, cost estimates and bid schedules, is presented for bid considerations.

Water Quality Division is responsible for the prioritization and management of non-point source pollution of the state's waters. Non-Point source pollution refers to the washing of materials from land areas into lakes and streams. The Water Quality Division has developed a monitoring strategy to monitor small feeder streams on a rotational basis to determine the impacts of Non-Point source pollution on the water resources of the state. The division coordinates the development of the state's water quality assessment and management program required under section 319 of the Federal Clean Water Act.

Abandoned Mine Land Reclamation Division conducts inventories, sets priorities, develops plans, and supervises the reclamation of abandoned coalmines. The program is 100% federally funded through a $35 a ton tax on coal production. Oklahoma has approximately 30,000 acres of abandoned coal mined land that was mined prior to the passage of the 1977 Federal Surface Mining Control and Reclamation Act. These projects include the elimination of dangerous high walls, the closure of mine openings, subsidence protection and reclamation of hazardous water filled strip pits.

2.3.17 Oklahoma Corporation Commission

Member of Oklahoma Hazard Mitigation Team

The Corporation Commission was established in 1907 by the Oklahoma Constitution to regulate public service corporations whose services were considered essential to the public, such as railroads, telephone, and telegraph. As the state grew, the Corporation Commission took on the responsibility of collecting and maintaining records of all corporations chartered or licensed to do business in Oklahoma.

As Oklahoma's oil and gas industry grew, the Corporation Commission was granted authority to regulate drilling activities; production and environmental protection; safety aspects of motor, rail, and pipeline transportation; and the environmental integrity of petroleum product storage tanks. The Corporation Commission supports the State's hazard mitigation by enforcing all state and federal regulations regarding transportation, storage, and disposal of petroleum products and certain oil and gas waste products, to prevent hydrocarbons from entering the state's reservoirs. The Commission has judicial, legislative and administrative authority to carry out its mission.

2.3.18 Oklahoma Emergency Management Association (OEMA)

Member of Oklahoma Hazard Mitigation Team

OEMA is a non-profit association whose goal is to assist local, state, tribal and federal agencies in the establishment and maintenance of effective emergency management organizations. Through research, legislative review, information exchange and education programs, OEMA strives to advance the professional standards of persons engaged in these activities.

Local emergency managers coordinate and direct the planning, organization, control, and implementation of local emergency management activities. Such activities may include the development of a severe storm spotter network designed to provide advanced/early warning of impending severe weather threats to the community. Oklahoma local emergency managers manage, operate and maintain Emergency Operations Centers, and coordinate, develop and implement the Emergency Operations Plan (EOP) for their jurisdiction and update it annually. They coordinate with community officials and with Oklahoma Emergency Management (OEM) as necessary to ensure the effective administration of the emergency management program. They prepare and distribute disaster preparedness material to the citizens of their jurisdiction, with the intent of offering an appropriate means of educating the community as to how they may prepare for and protect themselves from the consequences of potentially dangerous disasters.

2.3.19 Oklahoma Office of Management and Enterprise Services

Formerly known as the **Oklahoma Department of Central Services**, this agency provides leadership and services for innovative, responsive, and accountable public procurement by working in partnership with state agencies, local governments and suppliers to provide quality goods and services, striving to optimize taxpayer dollars while carefully monitoring and improving the use of the time, talent and resources.

2.3.20 Oklahoma Emergency Management (OEM)

Member/Chairperson of Oklahoma Hazard Mitigation Team

The Oklahoma Department of Emergency Management (OEM) prepares for, responds to, recovers from and mitigates against disasters and emergencies. OEM was created as the Department of Civil Defense by legislative action in 1951. Soon after its creation, the Civil Defense agency and the Department of Emergency Resources Management were combined into one unified disaster aid organization. Today, the department serves as the state's liaison with federal and local agencies on emergencies of all kinds. OEM maintains the State Emergency Operations Center which serves as a command center for reporting emergencies and coordinating state response activities. OEM delivers service to Oklahoma cities, towns and counties through a network of more than 400 local emergency managers. OEM also maintains, regularly updates and exercises the State Emergency Operations Plan.

The Department also procures and administers other funds for emergency management research and construction projects. OEM provides professional assistance, and maintains liaison with all state agencies, various federal agencies, local governments, industry, and the general public in the event of a natural, technological or man-made disaster.

As the Grantee for FEMA, OEM partners with FEMA to receive guidance and assistance in managing federal disasters, adhering to all regulations contained in the Stafford Act, as well as FEMA policies and guidelines. The OEM director is the *Governor's Authorized Representative* empowered by the Governor of Oklahoma to execute all necessary documents for disaster assistance.

2.3.21 Oklahoma Department of Environmental Quality (DEQ)

Member of Oklahoma Hazard Mitigation Team

The Oklahoma Environmental Quality Act (OEQA), passed in 1992, provides for the administration of environmental functions to provide that environmental regulatory concerns of industry and the public are addressed in an expedient manner; improve the manner in which citizen complaints are tracked and resolved; better utilize state financial resources for environmental regulatory services; and, coordinate environmental activities of state environmental agencies. In addition to its administration component and the Support Services Division, DEQ has a strong compliance/enforcement program.

The OEQA provides that each state environmental agency shall be responsible for:

- fully implementing and enforcing the laws and rules within its jurisdictional areas of environmental responsibility
- utilizing and enforcing the Oklahoma Water Quality standards
- seeking to enforce and strengthen relationships between federal, state, regional, and local environmental planning, development and management programs
- cooperate with all state environmental agencies and other entities to protect, foster and promote the general welfare and the environment and natural resources of the state

The Oklahoma Department of Environmental Quality (DEQ) was created to meet those legislative requirements within its jurisdictional area of environmental responsibility. As outlined, DEQ has jurisdictional responsibility for the following:

- Point Source and non-Point-Source discharges of pollutants
- storm water from all facilities, except those where specific authority has been designated to either the Department of Agriculture or the Oklahoma Corporation Commission;
- surface and groundwater;
- sole environmental jurisdiction to regulate air emissions from all facilities and sources subject to requirements of Title V of the Federal Clean Air Act;
- superfund responsibilities of the state under CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) and amendments thereto;
- radioactive waste and all regulatory activities for the use of atomic energy, except for diagnostic x ray facilities; public and private water, and wastewater supply or treatment systems;
- solid waste and hazardous substances; environmental regulation of any entity or activity;

- the prevention, control and abatement of any pollution, not subject to the specific statutory authority of another state environmental agency.

2.3.22 Oklahoma Floodplain Managers Association (OFMA)

The Oklahoma Floodplain Management Association was officially organized in November 1990 with the intent of bringing together those individuals who have a common interest in floodplain management. In the first year of its existence, membership more than tripled. In September 1999 the name was changed to Oklahoma Floodplain Managers Association. The OFMA objectives are to:

- Promote interest in flood damage abatement
- Improve cooperation among various related local, state and federal agencies
- Encourage innovative approaches to managing the nation's floodplain

OFMA issues a quarterly newsletter to broaden public awareness of Oklahoma's flood hazards. They also provide training to elected officials, floodplain managers, surveyors, engineers, lenders, and real estate agents and promote a Certified Floodplain Manager (CFM) program. OFMA holds an annual conference with guest speakers who discuss pertinent floodplain management issues. Interacting with other members provides opportunities for exchanging ideas and networking among agencies and companies to build cooperation. The association brings together those individuals who are experiencing similar problems with those who may have solutions. OFMA is a non-profit organization and has the ability to communicate a uniform position on current concerns, rule changes, local programs and other issues impacting floodplain management.

2.3.23 Oklahoma Geological Survey (OGS)

The Oklahoma Geological Survey is chartered in the State's constitution with the mission of investigating the land, water, mineral, and energy resources of the State, and disseminating the results of those investigations to promote the wise use of Oklahoma's natural resources consistent with sound environmental practices. The programs of OGS involve Fossil Fuels, Earth Science Education, Geologic Mapping, Industrial Minerals and Earthquakes.

OGS provides geologic mapping of the State. OGS provides data for the mineral mining industry in Oklahoma, which is 28th in the nation in total non-fuel mineral production value, accounting for more than 1% of the U.S. total. (See more information under the State description in this plan.)

The Oklahoma Geological Survey Observatory is a comprehensive geophysical observatory which records, identifies, and locates 30 to 167 earthquakes in Oklahoma each year, and also records about seven worldwide earthquakes per day. The data is depicted on maps provided with the centers of the seismic events starting in 1977.

2.3.24 Oklahoma Department of Health

Member of Oklahoma Hazard Mitigation Team

The State Department of Health has statutory responsibility for the public health of the people of Oklahoma (63 OS §1- 101). Special Health Services is responsible for food protection service and occupational licensing. Its nine-member State Board of Health is appointed by the Governor and confirmed by the Senate. The Commissioner of Health is appointed by the Board and is responsible for the administration of public health programs in the State.

Public health and medical systems were identified as critical infrastructure and vital support functions in the event of disasters and emergencies. In 2002, the Oklahoma State Department of Health formed the Bioterrorism Preparedness Division, which later evolved to the Emergency Preparedness and Response Service, to address the public health and medical implications of a large-scale disaster affecting the state's population.

Since that time, the Emergency Preparedness and Response Service has worked diligently with Oklahoma Emergency Management and other federal, state, tribal, local, non-governmental and private partners to ensure the safety of all Oklahomans. In addition, the Emergency Preparedness and Response Service routinely assists neighboring states in times of crisis.

2.3.25 Oklahoma Historical Society

Member of Oklahoma Hazard Mitigation Team

The State Historic Preservation Office (SHPO) is a division of the Oklahoma Historical Society, a State agency. The SHPO is responsible for administering the Federal historic preservation programs in Oklahoma. The National Historic Preservation Act (NHPA) established these programs and provides the framework for the preservation of the nation's heritage.

Section 106 of the NHPA requires that Federal agencies or their designees must consider the effect of their undertakings on archeological and historic resources listed in or eligible for listing in the National Register of Historic Places. The Advisory Council on Historic Preservation (Council), a Federal agency, has established the regulations (36 CFR Part 800) that govern the Section 106 process and provides guidance to Federal agencies and the SHPO. During disaster recovery efforts, SHPO is an invaluable advisor to FEMA in ensuring that repairs and reconstruction meet all NHPA regulations. Archeological sites, buildings, districts, objects, structures, landscapes, and Traditional Cultural Properties must be identified and evaluated prior to any federally-funded undertakings. The purpose of the Section 106 consultation is to find ways to avoid, minimize, or mitigate any adverse effects on these important properties. When adverse effects cannot be avoided, the SHPO works with the Federal agency to find ways to reduce the impacts. If the adverse effects cannot be avoided or minimized, the Memorandum of Agreement (MOA) will set forth the mitigation plan (such as documentation of a building or structure that must be demolished, excavation of an archeological site that will be destroyed, etc.).

The SHPO works in cooperation with the Oklahoma Archeological Survey (OAS) to carry out the Section 106 review.

2.3.26 Oklahoma Department of Human Services (DHS)

Member of Oklahoma Hazard Mitigation Team

In order to promote the general welfare of the people of the State of Oklahoma, DHS may provide temporary assistance to victims of disasters and emergencies. When a major or lesser disaster is declared in Oklahoma, DHS notifies its Family Support Services Division (FSSD) staff in the declared counties. At that time the FSSD readies its SNAP (Supplemental Nutrition Assistance Program) staff to expedite issuance of food vouchers. Other assistance may be in the form of providing bulk food and diapers to public shelters. DHS is also involved in disaster planning with area aging services to make sure elderly populations are adequately provided for in emergency situations.

2.3.27 Oklahoma Insurance Department

Member of Oklahoma Hazard Mitigation Team

The elective office of State Insurance Commissioner was created by the Oklahoma Constitution. Duties of the State Insurance Commission include: approval of the organization of domestic insurance companies of every authorized type; approval of all applications by foreign and alien insurers seeking admission into the State of Oklahoma for the purpose of transacting any insurance business; and approval of certain life, accident, and health insurance policy forms before such contract can be lawfully offered for sale within the State.

The State insurance Commissioner provides counsel to the State Hazard Mitigation Team regarding insurance issues as such pertains to acquisition of repetitive loss properties.

2.3.28 Oklahoma Municipal League ("The League")

Member of Oklahoma Hazard Mitigation Team

The Oklahoma Municipal League is a non-profit organization made up officials of Oklahoma cities and towns to promote the importance of supporting local government. Representatives of The League work during the legislative sessions to support bills useful to cities and towns, and oppose legislation detrimental to municipalities. The League provides guidance and training to existing and newly elected mayors and city managers and their staff, through workshops and a monthly newsletter.

2.3.29 Oklahoma Department of Transportation (ODOT)

Member of Oklahoma Hazard Mitigation Team

The Oklahoma State Department of Transportation, operating under rules, regulations and policies prescribed by the State Transportation Commission, is charged with the planning, construction, operation, maintenance, and coordination of designated multi-modal transportation systems designed to meet present and future transportation needs of the State.

Major areas of activity include the budgeting and accounting for all state and federal funds accruing to the Department; the development and implementation of a Statewide transportation plan; the engineering and acquisition of rights-of way; the award and administration of construction contracts for the improvement of the designated State Highway System and other such transportation facilities as may be applicable under the Statutes; the development and implementation of fiscal and administrative costs; and, the development of administrative rules and guidelines as needed to ensure compliance and compatibility with the objectives of various state and federal transportation programs. ODOT also provides professional assistance to OEM and FEMA regarding repair and replacement of disaster-damaged infrastructure.

2.3.30 Oklahoma Water Resources Board (OWRB):

Member of Oklahoma Hazard Mitigation Team

The OWRB is assigned the statutory responsibility of coordinating the National Flood Insurance Program Statewide, regulating dam safety, administering the water laws of the State, and planning and developing water resources to ensure water supplies are adequate to fulfill the present and future needs of Oklahoma. The OWRB currently coordinates with various local, State, and Federal agencies regarding NFIP activities. Agency manpower is assigned to the following divisions and programs:

Administrative Division - Provides administrative support for the three action divisions to achieve each Division's mission.

Planning and Management Division – Comprised of three sections: Planning, Technical and Permitting. The Planning Section oversees the Floodplain Management Program, the National Flood Insurance Program and the Dam Safety Program, as well as drought and weather mitigation activities and statewide water resources planning and management.

Floodplain Management Program - Responds to Oklahoma's frequent flooding incidents by coordinating with other State and Federal agencies and local governments to mitigate the catastrophic effects of these natural disasters. Members of the Division, as well as OWRB Field Office personnel, routinely serve on the State Hazard Mitigation Team. This Team inspects damages, identifies projects potentially eligible for hazard mitigation funding, and prepares recommendations to reduce future losses. The Team coordinates with Oklahoma Department of Emergency Management and FEMA to help provide Federal funds for the mitigation of flood damages to public or private facilities.

National Flood Insurance Program - Mitigates flood disasters through flood damage prevention and the control of development in designated hazard areas.

- Eligible communities must establish a floodplain board, recognize floodplain boundaries and regulate development in those areas. Affordable flood insurance is then available to property owners and renters anywhere in the community.
- Division staff provides guidance to communities in adopting these measures and visits with community officials to assess local floodplain management programs and assist program participants in understanding and implementing effective flood loss reduction techniques. These community assistance visits (CACs) and visits (CAVs) also allow the OWRB an opportunity to point out program deficiencies that need to be addressed to retain eligibility in the NFIP.
- The OWRB's efforts in floodplain management and hazard mitigation include community and public information assistance, and educational services. Primary funding for this program is through the Community Assistance Program administered by FEMA.

Dam Safety Program - An integral part of the Board's role in hazard mitigation relative to ensuring the safety of nonfederal dams 25 feet or more in height and/or impounding 50 acre-feet or more of water. Program staff maintains a current inventory of these dams.

- Many dams, mostly earth fill impoundments, are in need of maintenance or repair. Of particular concern are the structures that could cause loss of life and significant damage to property downstream in the event of failure.

- To check on the safety of these dams, the agency requires and/or conducts regular inspections to verify dam maintenance and integrity. If problems are discovered, the OWRB requires the dam owner or operator to make timely repairs. Agency staff coordinates dam inspection training seminars to ensure that interested private engineers are qualified to conduct professional examinations of nonfederal dams in the State.
- To confirm that construction is accomplished in a safe and responsible manner, those wishing to construct, enlarge, alter or repair nonfederal dams must first submit an application to the Board, including plans for the proposed modification.

The Permitting Section - Oversees the appropriation of stream and groundwater.

Technical Section - conducts hydrologic studies to determine water available for appropriation as well as various other water resources, studies and programs. This section also houses the water well drillers' program that includes the licensing of water well drillers and enforcement of minimum standards for well construction.

***Water Quality Programs Division* -** develops the State's Water Quality Standards for surface and ground waters. Other programs include the Clean Lakes Program, Oklahoma Water Watch, the Statewide Lakes Water Quality Assessment and the Beneficial Use Monitoring Program.

The Financial Assistance Division - Administers loan and grant programs especially for the financing and implementation of sewer and water facilities. The Division makes long-term, low interest loans backed by the Statewide Water Development Revolving Fund. It also makes emergency grants to smaller communities facing infrastructure crises that could threaten life, health or property.

2.3.31 Oklahoma Department of Wildlife Conservation (ODWC)

Member of Oklahoma Hazard Mitigation Team

The ODWC's mission is to manage Oklahoma's wildlife resources and habitat to provide scientific, educational, aesthetic, economic and recreational benefits for present and future generations of hunters, anglers and others who appreciate wildlife. ODWC oversees land and equipment purchases, public hunting and fishing areas and developments, refuges and game management areas. ODWC supervises the state's wildlife management operation.

The Administration's Division of ODWC consists of Accounting, Licensing, Data Processing, Human Resources, Communications and Property. The Communications Section operates and maintains the Department's radio network which is composed of 25 relay towers located throughout the State. This system allows rapid communication between field and office personnel and enhances communication between field personnel and local agencies such as sheriff's offices and police departments.

The Wildlife Division manages Oklahoma's wildlife resources and conducts wildlife research on both public and private land. This involves managing the land, wildlife and sportsmen, as well as monitoring and evaluating a wide variety of commercial activities to ensure that wildlife interests are considered, for 70 Wildlife Management Areas (WMAs) across Oklahoma. ODWC also has authority to enforce laws and regulations that protect Oklahoma's wildlife resources.

2.4 Integration With Other Planning Efforts

Oklahoma Emergency Management (OEM) is designated by the Governor to coordinate and assist Oklahoma's state agencies and political subdivisions in the preparation, maintenance and implementation of emergency preparedness plans and programs.

OEM also plans, prepares and implements hazard mitigation programs designed to minimize the effects of natural, technological, and man-made disasters upon the people and resources of the State. OEM works with other state; federal; and local agencies to develop and implement the strategies outlined in this document, and obtains interagency feedback. Oklahoma is also a member of EMAC (Emergency Management Assistance Compact).

The mitigation planning process is integrated into the plans described below by providing information to the representatives of the State Hazard Mitigation Team which administrates these programs. This information regarding strategy, risk assessment and progress made with actions in the State Plan is taken back to appropriate agency heads to be integrated into the plans which they administer. Input to FEMA proposing updates to their programs is provided through regular contacts with the FEMA Region VI Officials.

Several state agencies have used the OEM's Hazard Mitigation Division as a benchmark to implement their own mitigation plans and programs. For example, the Department of Transportation now considers mitigation in its transportation plans, and the Oklahoma Conservation Commission has partnered with FEMA in developing stream bank stabilization planning to help mitigate specific flooding problems in communities such as Piedmont, Oklahoma. Positive results and case studies will be included in updates of the State Mitigation Plan. This process is described in more detail in Appendix E, "Integration with Other Planning Initiatives."

OEM's Mitigation Division has the following general responsibilities:

- Administer the Mitigation Program
- Coordinate program activities with state, federal, and local governments
- Serve as Chair of the State Hazard Mitigation Team
- Identify and review cost-effective mitigation projects
- Review local and tribal hazard mitigation plans for content and accuracy
- Submit local and tribal hazard mitigation plans to FEMA Region VI
- Inspect completed mitigation projects
- Prepare mitigation project close-out reports
- Prepare and conduct mitigation presentations for local jurisdictions and contractors
- Develop, review, and update the State Mitigation Plan

The State of Oklahoma is fully committed to an effective and comprehensive mitigation program. Oklahoma is somewhat unique in that the HMGP, FMA, PDM, RFC, SRL, and mitigation planning are all the direct responsibility of OEM Hazard Mitigation Division. In order for these programs to achieve full potential, state activities should complement appropriate mitigation goals and strategies.

The State Hazard Mitigation Plan is only a part of the state's mitigation program. The Local Mitigation Plans comprise another part of the program. As such, the development process for the State plan takes into consideration the mitigation goals and objectives identified in the local plans. OEM intends to share the State Hazard Mitigation Plan with federal and state agencies and local governments to cross-reference mitigation information with as many as possible.

Other Programs
The State hazard mitigation planning process is closely integrated with other mitigation programs and initiatives. The following is a partial list of plans and studies that reflect current conditions and approaches to addressing Oklahoma's hazards. The strategies and proposed actions within this plan conform to those presented in these other documents and in many cases are the same actions. Several employees of the Oklahoma Department Emergency Management participated in the groups that developed the following plans.

Planning Process and Funding Initiatives
The State hazard mitigation planning process is dependent upon FEMA's mitigation programs and initiatives. The authority for this initiative is the *Disaster Mitigation Act of 2000* (DMA2K) which stipulates the necessity for and content of both state and local mitigation plans. DMA2K established a timeline for plan completion, and OEM is cognizant of the penalties FEMA can impose for non-compliance. Other FEMA programs that greatly influence mitigation efforts include:

- **The National Flood Insurance Program (NFIP).** Participation in NFIP by municipalities, counties, and tribal organizations is voluntary. OEM and FEMA have strongly encouraged non-participating jurisdictions to join the NFIP since this plan was approved in 2008. Prior to 2008, there were 52 counties participating; currently there are 54. In 2008 there were 303 municipalities in Oklahoma participating in NFIP; today there are 392. The March 5th, 2010 Region VI report showed only two tribal participants; currently there are four. Several communities have pending applications.

- **The Flood Mitigation Assistance (FMA) Program** is another FEMA program through which local jurisdictions may obtain grant funds to complete flood mitigation plans and projects. OEM has worked diligently with local jurisdictions to assist them in integrating their FMA plan and HM plan to satisfy FEMA's criteria.

- **The Emergency Management Performance Grant (EMPG)**, a grant from FEMA to the state, funds a broad spectrum of emergency management activities including the partial funding of a full- time Mitigation Specialist. OEM also uses some EMPG funds for earthquake mitigation projects and educational efforts, and some EMPG funds have been used to assist with preparation of the local Hazard Mitigation Plans.

Chapter Three: Risk Assessment

Requirement 44 CFR §201.4(c)(2) [The State Plan must include risk assessments] ***that provide the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview.***

Each section of this Plan Update from the period of prior approval through September 30, 2013 was analyzed and reviewed by the planning team and revisions were recommended. As a result of this review, OEM's planning team partnered with Oklahoma Climatological Survey and Oklahoma Geological Survey to provide expert opinion which resulted in the following changes:

-Updated Hazard Chart – *How and Why* identified
-Updated maps, charts and tables
-Deletion of maps, charts and tables that were no longer valid
-Updated history and other segments of *Hazard Profiles*
-Inclusion of additional photos
-Updated *Significant Previous Occurrences*
-Verified and updated *Cost Analysis* information
-Updated and reformatted CPRI data
-Reclassification of *Sinkhole* hazard to *Subsidence* hazard

3.1 Identified Hazards:

The hazards are summarized in the following Hazard Identification Table, along with how and why they were identified. They are listed in alphabetical order and are not assigned any priority at this point.

Hazard	How Identified	Why Identified
Dam Failure **Hazard # 1**	1) Information from OWRB 2) Historical Records	Of 4600 dams in Oklahoma 361 are high hazard dams & 136 significant hazard dams. These could put people and structures at risk. Though not a natural hazard, flooding potential exists if dam failure occurs. **Identified in 146 Local and Tribal Plans**
Drought **Hazard # 2**	1) Information from Oklahoma Climatological Survey, 2) Oklahoma Water Resources Bulletin, 3) US Geological Survey 4) Declarations 5) Historical Data	Highly variable annual precipitation has resulted in a long history of drought in Oklahoma, i.e. 'Dust Bowl', and recent episodes of drought. **Identified in 177 Local and Tribal Plans**
Earthquake **Hazard # 3**	1) Information from Oklahoma Geological Survey 2) Past Historical Records 3) Newspaper Accounts	Past history, existing fault lines within State. Oklahoma has 2-3 per year that are large enough to be felt **Identified in 164 Local and Tribal Plans**
Expansive Soils **Hazard # 4**	1) Visual Inspections 2) Limited Historical Data	Oklahoma has soils that tend to shrink or swell due to changes in moisture content but damage estimates are incomplete and inconclusive. The State recognizes this hazard in some regions but available data is lacking. **Identified in 113 Local and Tribal Plans**
Extreme Heat **Hazard # 5**	1) Information from Oklahoma Climatological Survey 2) Historical Data 3) National Weather Service	Oklahoma can have prolonged periods of high temperatures and is prone to wide swings of temperature. Record High 120 degrees Record Low -31 degrees **Identified in 165 Local and Tribal Plans**

Hazard	How Identified	Why Identified
Flooding **Hazard # 6**	1) Oklahoma Climatological Survey 2) Historical Data 3) Declared Disasters 4) Oklahoma Water Resource Board	From 1960-2012, there have been over 100 deaths due to flooding in Oklahoma. Flooding is most common in spring or Fall. This is costly to the State. **Identified in 177 Local and Tribal Plans**
Hail **Hazard # 7**	1) Oklahoma Climatological Survey 2) Daily Oklahoman Archives 3) Oklahoma Mesonet Records 4) National Weather Service 5) Storm Prediction Center	Oklahoma experiences a high number of storms each year along with damaging hail. **Identified in 177 Local and Tribal Plans**
High Winds **Hazard # 8**	1) Oklahoma Climatological Survey 2) Historical Data	High winds usually accompany severe storms, but Oklahoma also frequently observes non thunderstorm high wind events. **Identified in 166 Local and Tribal Plans**
Landslides **Hazard # 9**	1) Oklahoma Department of Transportation 2) Limited Historical Data	In Oklahoma, landslides are infrequent and limited to in selected areas of the State. **Identified in 6 Local and Tribal Plans**
Lightning **Hazard # 10**	1) Oklahoma Climatological Survey 2) Daily Oklahoman Archives 3) Oklahoma Mesonet Records 4) National Weather Service 5) Storm Prediction Center	Oklahoma experiences a high number of storms each year along with damaging lightning. **Identified in 152 Local Plans**
Subsidence **Hazard # 11**	1) Oklahoma Conservation Commission 2) Abandoned Mine Land Program 3) McAlester News-Capital & Democrat	Sixteen Counties in Oklahoma are vulnerable to subsidence from abandoned mining operations. **Identified in 1 Local Plan**
Tornadoes **Hazard # 12**	1) Oklahoma Climatological Survey 2) Historical Records 3) Declared Disasters 4) Daily Oklahoman Archives	Oklahoma is among the most tornado prone regions in the U.S. State has had over 3269 past incidents. **Identified in 179 Local and**

Hazard	How Identified	Why Identified
		Tribal Plans
Wildfires **Hazard # 13**	1) Oklahoma Climatological Survey 2) Department of Agriculture Forest Service 3) FEMA Website 4) National Interagency Fire Center 5) Oklahoma Fire Danger Model	Wildfire is a natural part of Oklahoma's ecosystem. The 2005-2006 fire season was especially destructive to lives and property. The continued development of urban-wildland is part of a growing problem. **Identified in 178 Local and Tribal Plans**
Winter Storms/Ice/Freezing Rain **Hazard # 14**	1) Oklahoma Climatological Survey 2) Historical Data 3) Oklahoma Mesonet Archives 4) Daily Oklahoman Archives 5) The Tulsa World Archives 6) National Climate Data Center Storm Events Database 7) National Weather Service	From 2000-2012 the NCDC lists 182 snow and ice event days within Oklahoma, causing nearly $1.3 billion in damage. **Identified in 180 Local and Tribal Plans**
Special Events (Tar Creek Project) **Hazard # 15**	1) Information from local plans 2) State Records	Approximately 30,000 acres of Lead and Zinc mines, now abandoned, create hazardous conditions during rain runoff and flood events in this area. **Identified in 1 Local Plan**

Hazard Prioritization

The following overview of the natural hazards that could affect the State of Oklahoma includes an explanation of the Critical Priority Risk Index (CPRI) weighting factors and explains how each identified hazard was weighted according to the following criteria of probability, magnitude/severity, warning time and duration. The planning team initially went through all the hazards in a roundtable discussion, based on their personal knowledge and experience in Oklahoma. With a white board, the team talked through the rankings and the members re-adjusted the CPRI categories as needed based upon data provided by Oklahoma Climatological Survey, Oklahoma Geological, and Oklahoma Emergency Management. Based on history in the State of Oklahoma, and the team's experience and expertise, a final logical CPRI ranking was assigned.

The CPRI factors the elements of risk: Probability (P), Magnitude/Severity (M), Warning Time (WT) and ≤≤Duration (D), to create an index that allows for the prioritization of mitigation activities based on the level of risk. Each hazard is evaluated based on potential or probability using the elements of the index, and a weighting factor to determine the impact, in the following manner:

WEIGHTING FACTORS			
.45 Probability of Occurrence	.30 Magnitude/Severity Expected of Hazard	.15 Warning Time Possible to Event	.10 Duration Of Event
4 Highly Likely 3 Likely 2 Possible 1 Unlikely	4 Catastrophic 3 Critical 2 Limited 1 Negligible	4 < than 6 hrs 3 6 – 12 hours 2 12 – 24 hours 1 24 + hours	4 > 1 week 3 ≤ 1 week 2 ≤ 24 hours 1 ≤ 6 hours

PROBABILITY OF OCCURRENCE	DEFINITION
4-HIGHLY LIKELY	Event is probable within the calendar year. Event has a 1 in 1 year chance of occurring.
3-LIKELY	Event is probable within the next three years. Event has up to 1 in 3 year's chance of occurring.
2-POSSIBLE	Event is probable within the next 5 years. Event has up to 1 in 5 year's chance of occurring.
1-UNLIKELY	Event is possible within the next 10 years. Event has up to 1 to 10 years chance of occurring.
MAGNITUDE / SEVERITY LEVEL	**CHARACTERISTICS**

CATASTROPHIC	≤ Multiple deaths. ≤ Complete shutdown of facilities for 30 or more days. ≤ More than 50% of property is severely damaged.
CRITICAL	≤ Injuries and/or illnesses result in permanent disability. ≤ Complete shutdown of critical facilities for at least two weeks. ≤ More than 25% of property is severely damaged.
LIMITED	≤ Injuries and/or illnesses do not result in permanent disability. ≤ Complete shutdown of critical facilities for more than one week. ≤ More than 10% of property is severely damaged.
NEGLIGIBLE	Injuries and/or illnesses are treatable with first aid. Minor quality of life lost. Shutdown of critical facilities and services for 24 hours or less. Less than 10% of property is severely damaged.

The following table lists the Critical Priority Risk Index for each hazard that could affect the State of Oklahoma. The hazards are listed in the order of their Priority Risk. Because there is no way to estimate the probability, severity, warning time or duration of a man-made or special event (because by definition the event is usually unknown) that hazard ranking is a best guess estimate using the CPRI and is less than exact.

Hazard	Probability	Magnitude/ Severity	Warning Time	Duration	Priority Risk Index
Flooding **Hazard Priority # 1**	Highly Likely	Catastrophic	6-12 Hours	Less than one week	3.75
Tornado **Hazard Priority # 2**	Highly Likely	Catastrophic	Less 6 Hours	Less than 6 hours	3.7
Winter Storms/Ice/Freezing Rain **Hazard Priority #3**	Likely	Catastrophic	12-24 Hours	Less than one week	3.15
Drought **Hazard Priority #4**	Likely	Catastrophic	24+ Hours	More than one week	3.1
Hail **Hazard Priority # 5**	Highly Likely	Limited	Less 6 Hours	Less than 6 hours	3.1
High Winds **Hazard Priority # 6**	Highly Likely	Limited	Less 6 Hours	Less than 6 hours	3.1
Lightning **Hazard Priority # 7**	Highly Likely	Negligible	Less 6 Hours	Less than 6 hours	2.8
Wildfires **Hazard Priority # 8**	Likely	Limited	Less 6 Hours	Less than one week	2.75
Dam Failure **Hazard Priority # 9**	Unlikely	Catastrophic	Less 6 Hours	Greater than 1 week	2.65
Extreme Heat **Hazard Priority # 10**	Likely	Limited	24+ Hours	Less than one week	2.4
Expansive Soils	Likely	Negligible	24+ Hours	More than	2.2

Hazard	Probability	Magnitude/ Severity	Warning Time	Duration	Priority Risk Index
Hazard Priority # 11				one week	
Special Events (Tar Creek Project) Hazard Priority # 12	Possible	Limited	24+ Hours	More than one week	2.05
Earthquake Hazard Priority # 13	Possible	Negligible	Less 6 Hours	Less than 6 hours	1.9
Subsidence Hazard Priority # 14	Unlikely	Limited	Less 6 Hours	Less than 6 hours	1.75
Landslide Hazard Priority # 15	Unlikely	Negligible	Less 6 Hours	Less than 6 hours	1.45

The following lists the CPRI weighting factor for each hazard and shows how each was obtained.

Calculated Priority Risk Index (CPRI)

Flooding = 3.75

Probability		4 Highly Likely		
Magnitude/Severity		4 Catastrophic		
Warning Time		3 6-12 Hours		
Duration		3 Less than one week		
The CPRI for the Flooding hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (4 x .30)	+ (3 x .15)	+ (3 x .10)	= 3.75

Calculated Priority Risk Index (CPRI)

Tornado = 3.7

Probability		4 Highly Likely		
Magnitude/Severity		4 Catastrophic		
Warning Time		4 Less than 6 Hours		
Duration		1 Less than 6 hours		
The CPRI for the Tornado hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (4 x .30)	+ (4 x .15)	+ (1 x .10)	= 3.7

Winter Storms/Ice/Freezing Rain = 3.15

Probability		3 Likely		
Magnitude/Severity		4 Catastrophic		
Warning Time		2 12-24 Hours		
Duration		3 Less than one week		
The CPRI for the Winter Storms hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (4 x .30)	+ (2 x .15)	+ (3 x .10)	= 3.15

Drought = 3.1

Probability	3 Likely
Magnitude/Severity	4 Catastrophic
Warning Time	1 24+ Hours
Duration	4 More than one week
The CPRI for the Drought hazard for the State of Oklahoma is:	

Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (4 x .30)	+ (1 x .15)	+ (4 x .10)	= 3.1

Hail = 3.1

Probability			4 Highly Likely	
Magnitude/Severity			2 Limited	
Warning Time			4 Less than 6 Hours	
Duration			1 Less than 6 hours	
The CPRI for the Hail hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (2 x .30)	+ (4 x .15)	+ (1 x .10)	= 3.1

High Winds = 3.1

Probability			4 Highly Likely	
Magnitude/Severity			2 Limited	
Warning Time			4 Less than 6 Hours	
Duration			1 Less than 6 hours	
The CPRI for the High Winds hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (2 x .30)	+ (4 x .15)	+ (1 x .10)	= 3.1

Lightning = 2.8

Probability			4 Highly Likely	
Magnitude/Severity			1 Negligible	
Warning Time			4 Less than 6 Hours	
Duration			1 Less than 6 hours	
The CPRI for the Lightning hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (1 x .30)	+ (4 x .15)	+ (1 x .10)	= 2.8

Wildfires = 2.75

Probability			3 Likely	
Magnitude/Severity			2 Limited	
Warning Time			4 Less than 6 Hours	
Duration			2 Less than one day	
The CPRI for the Wildfires hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (2 x .30)	+ (4 x .15)	+ (2 x .10)	= 2.75

Dam Failure = 2.65

Probability			1 Unlikely	
Magnitude/Severity			4 Catastrophic	
Warning Time			4 Less than 6 Hours	
Duration			4 More than one week	
The CPRI for the Dam Failure hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(1 x .45)	+ (4 x .30)	+ (4 x .15)	+ (4 x .10)	= 2.65

Extreme Heat = 2.4

Probability			3 Likely	
Magnitude/Severity			2 Limited	
Warning Time			1 24+ Hours	
Duration			3 Less than one week	
The CPRI for the Extreme Heat hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (2 x .30)	+ (1 x .15)	+ (3 x .10)	= 2.4

Expansive Soils = 2.2

Probability			3 Likely	
Magnitude/Severity			1 Negligible	
Warning Time			1 24+ Hours	
Duration			4 More than one week	
The CPRI for the Expansive Soils hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (1 x .30)	+ (1 x .15)	+ (4 x .10)	= 2.2

Special Events (Tar Creek Project) = 2.05

Probability			2 Possible	
Magnitude/Severity			2 Limited	
Warning Time			1 24+ Hours	
Duration			4 More than one week	
The CPRI for the Special Events hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(2 x .45)	+ (2 x .30)	+ (1 x .15)	+ (4 x .10)	= 2.05

Earthquake = 1.9

Probability			2 Possible	
Magnitude/Severity			1 Negligible	
Warning Time			4 Less than 6 Hours	
Duration			1 Less than 6 hours	
The CPRI for the Earthquake hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(2 x .45)	+ (1 x .30)	+ (4 x .15)	+ (1 x .10)	= 1.9

Subsidence = 1.75

Probability			1 Unlikely	
Magnitude/Severity			2 Limited	
Warning Time			4 Less than 6 Hours	
Duration			1 Less than 6 hours	
The CPRI for the Subsidence hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(1 x .45)	+ (2 x .30)	+ (4 x .15)	+ (1 x .10)	= 1.75

Landslide = 1.45

Probability			1 Unlikely	
Magnitude/Severity			1 Negligible	
Warning Time			4 Less than 6 Hours	
Duration			1 Less than 6 hours	
The CPRI for the Landslide hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(1 x .45)	+ (1 x .30)	+ (4 x .15)	+ (1 x .10)	= 1.45

3.2 Profiled Hazard Events:

The following is an explanation of each hazard or threat confronting the State of Oklahoma. The hazards are listed according to their priority risk index as identified in the preceding tables above.

3.3.1 Flooding

Flooding in Kingfisher after tropical storm, Erin - August 19, 2007 (*Credit: The Oklahoman*)

Hazard Priority # 1

3.2.1.1 Description:

Floods are one of the most common hazards in the United States including Oklahoma. Flooding is the deadliest thunderstorm hazard in the U.S. annually (followed by lightning). Flood effects can be local, impacting a neighborhood or community; or very large, affecting entire river basins and multiple states. The two general types of flooding are flash flooding and river flooding.

A flood is a natural event for rivers and streams. River flooding is when a river rises to its flood stage and spills over the banks. The amount of flooding is usually a function of the amount of precipitation in an area, the amount of time it takes for rainfall to accumulate, previous saturation of local soils, and the terrain around the river system. For instance, a river located in a broad, flat floodplain will often overflow to create shallow and persistent flood waters in an area that do not recede for extended periods of time. The excess water can be from snowmelt or rainfall far upstream. Over 75% of Presidential disaster declarations result from flooding. Average annual flood losses total several billion dollars and continue to increase.

Flash flooding occurs when the precipitation rate becomes so large that local waterway drainage cannot evacuate the runoff. It can develop very quickly during or immediately after a nearby heavy rainfall. Driving through water covered roadways during a flash flood is especially dangerous since as little as 6 inches of fast moving water can compromise control of a vehicle. The "Turn Around Don't Drown™" campaign by the National Weather Service educates the public about flood safety and the dangers of entering a flooded area. The primary threat from flash flooding is often to human life and safety, while the slower onset and more widespread nature of river flooding causes the primary threat to be economic and property damage.

Several factors determine the severity of floods, including rainfall intensity and duration. The size of a stream's watershed is the dominant factor in the time scale of its response to heavy precipitation. For example, very small creeks and branches of creeks can respond in minutes to heavy precipitation. Larger rivers, such as the Arkansas, may take days to crest after prolonged periods of rainfall. Below is a table identifying the contributing factors to flash-flooding hazard and vulnerability in Oklahoma.

Factor	Effect
Precipitation Rate	As the rate of precipitation increases, so does its ability to outpace watershed drainage. *This is the dominant factor in flash flooding events, and can overwhelm any or all of the following factors.*
Training Echoes	Storm cells that follow each other (much like box cars on a train) can repeatedly deposit large amounts of water on the same watershed, overwhelming its ability to handle runoff.
Slope of Watershed	Steeper topography (hills, canyons, etc.) will move runoff into waterways more quickly, resulting in a quicker response to precipitation.
Shape of Watershed	Longer watersheds tend to spread runoff so that water arrives at the main stream at different times. In watersheds that are more square or circular shaped, runoff tends to arrive in the main stream at the same time, intensifying the response. This factor becomes more significant with larger watersheds.
Saturation of Soils	Saturated or near-saturated soils can greatly reduce the rate at which water can soak into the ground. This can increase runoff dramatically.
Hardened Soils	Extremely dry soils can develop a pavement or "crust" that can be resistant to infiltration. This is especially true in areas of recent wildfire, where plant oils or resins may cause the soil to be even more water-resistant.
Urbanization	The urban environment usually intensifies the response to heavy precipitation. The two dominant urban factors are: 1) increased pavement coverage, which prevents infiltration and dramatically increases runoff; and 2) Urban systems are designed to remove water from streets and byways as quickly as possible. This accelerates the natural response to precipitation by placing runoff in waterways much more quickly.
Low-water crossings	The vast majority of flash-flood related deaths occur in vehicles. Many of these deaths occur at low-water crossings where the driver is unaware of the depth of the water or the consequences of driving into it.

3.2.1.2 Location:

The conditions that lead to flash flooding can happen anywhere in Oklahoma, during any season, and at any time of day. Riverine flooding may occur anywhere in Oklahoma near a river, creek or stream. Residents and communities in Oklahoma downstream from US Corp of Engineers flood control dams are particularly at risk for riverine flooding. Deliberate flooding may occur when water is released from flood control dams to prevent the facilities from being overtaxed.

3.2.1.3 Extent

The State of Oklahoma considers a rainfall of 1 inch per hour, or a river rise that stays within the river's banks, to be a minor severity. A major severity to Oklahoma is identified as a rainfall of 3 inches per hour and greater, or more than 1 inch in three hours on saturated ground, or a river rise that overflows the banks of the river.

3.2.1.4 Previous Occurrences:

Since 1950, the National Climatic Data Center (NCDC) has registered 2,150 flood records in Oklahoma. Of that number 41 flood events since 1955 have been severe enough to be determined by the federal government as Major Disaster Declarations with four occurring during the 2008 calendar year. There have been 36 flood and flash-flood related deaths in Oklahoma from 1950 through 2012.

Significant flooding events for Oklahoma can occur from tropical storm related rainfall in the late summer and autumn. Remnant moisture from land falling tropical storms can interact with a slow-moving front to provide heavy rainfall for days at a time. The tropical moisture can come from remnants of Gulf of Mexico storms or even originating in the eastern Pacific. Below is a table of remnant tropical storm events that caused flooding in Oklahoma.

Year	Month	Remnant Storm Name	Source Region	Comments
2007	September	Erin	Gulf of Mexico	Central Oklahoma
1996	September	Fausto	Pacific	6+ inches rain; minor flooding along North Canadian.
1995	August	Dean	Gulf of Mexico	12-16 inches in parts of OK; interacted with weak, stalled cold front; major flooding along much of Salt Fork of the Arkansas River in Grant and Kay Counties; flooding also occurred on Cimarron, Washita and Arkansas Rivers.
1988	September	Gilbert	Gulf of Mexico	Interaction with slow-moving front; 4+ inch rains fell onto saturated soils; flooding on creeks and rivers.
1986	September-October	Paine	Pacific	Up to 20 inches in north-central OK; massive flooding on Cimarron. Flooding on the Arkansas River; ground was already saturated by rainfall associated with remnants of Pacific Hurricane Newton; estimated damages of $350 million; 52 counties declared disaster areas.
1983	October	Tico	Pacific	Up to 17 inches rain in southwest and central OK; Red River at Burkburnett and Terral rose to highest stage in 60 years; widespread flooding of smaller rivers and creeks.
1981	October	Norma	Pacific	Up to 24 inches of rain in south-central OK (Monthly total of 25.8" at Madill is greatest for any station during any month in OK history).

Significant Oklahoma Flood Events

(*Information provided by the National Weather Service, Oklahoma Climatological Survey, and NOAA's National Climatic Data Center*.)

May 31 – June 1, 2013

While the tornadoes, large hail and damaging winds that occurred during the afternoon and evening of May 31, 2013 garnered most of the attention, the flash flooding and river flooding also proved to be deadly and damaging during this severe weather event. The flash flooding that occurred in Oklahoma County during the evening of May 31st and early morning of June 1st killed a total of 13 people, including 12 people in Oklahoma City, making this event the deadliest ever for the city, and most deadly event in the state since the May 26-27, 1984 flash flood in Tulsa, when 14 people perished. This was also the deadliest flash flood event in the NWS Norman forecast area since April 3-4, 1934 when 17 people were killed by a flash flood along the Washita River near Hammon, OK.

June 14, 2010

Heavy rain from a persistent thunderstorm complex occurred over parts of the Oklahoma City metro area during the early morning. Due to already saturated ground, flash flooding quickly occurred covering roadways with high water and stranding cars. The heavy rain accumulated quickly during the busy morning drive time. Navigating in and around the metro area became almost impossible, and many motorists had to be rescued by boat. Widespread totals of five to nine inches were reported over much of Oklahoma City. Some areas had received over a foot of rainfall for the day, much of it in only a few hours. Will Rogers World Airport reported its largest daily precipitation since records began in 1891, with 7.62 inches. One hundred twenty-two homes were affected, 52 of those home receiving minor damage, 11 receiving major damage, and one home was completely destroyed. One person died after his vehicle stalled in flood waters, and at least 136 people were injured. Damage was estimated at $5.5 million in Oklahoma County alone. Significant rain also developed over southwest Oklahoma by early afternoon. Lawton was hard hit, receiving between four and five inches of rain, resulting in several roadways becoming flooded. The event was part of a disaster declaration.

September 2008

A very moist air mass was over Oklahoma Sept 10-12, allowing for several rounds of showers and thunderstorms to develop and move over the same areas. Additional moisture associated with the remnants of Tropical Storm Lowell from the eastern Pacific led to widespread flooding across northern Oklahoma. Rainfall rates of one to one-and-a-half inches were common, with some areas receiving near three inch per hour rates. At least half of the roadways from Woodward to Kay County were closed at some point during the event. Many roads were damaged, with at least 125 miles of roadway damaged in Alfalfa County alone. Half of the roadways in Pond Creek and Lamont were damaged, and 40 percent of the bridges were damaged. The Chikaskia River reached its highest level ever recorded. In all, 20 homes were completely destroyed, 14 homes sustained major damage, 52 homes sustained minor damage, and 96 homes sustained at least some damage. Damage totals for the event reached over $8 million. The event was part of a disaster declaration.

August 2007

Remnants of Tropical Storm Erin moved across Oklahoma August 18 and 19, leading to historic flooding in and around Kingfisher. Four feet of water flowed over HWY 33 in Kingfisher and four to five feet of water also flowed over HWY 81 between Kingfisher and Dover. Several cars were stalled due to water over HWY 81 north of Okarche. An elderly couple had to be rescued by an OHP helicopter after their car was washed off US HWY 81. Both sustained minor injuries. A 52-year old man died as he tried to flee his vehicle after it had been washed off of HWY 33 14 miles west of Kingfisher. Several homes and businesses sustained major flood damage, with others faring slightly better. The First Baptist Church had 20,000 gallons of water in the basement, which included the kitchen. Over nine inches of rain fell in west central Oklahoma and strong winds accompanied the remnant storm. Over $4 million of damages and 6 deaths resulted from the flooding. The summer of 2007 ended up becoming Oklahoma's wettest on record. The event was part of a disaster declaration.

July 2007

A wet spring and heavy rains in late June, which resulted in Oklahoma's wettest June on record, led to flooding on Oklahoma rivers in early July. The statewide average Emergency management in Bartlesville, Washington, Durant, and Bryan Counties reported flooding along the Caney River and Red River. Lake Texoma overtopped the spillway causing landowners to evacuate, move livestock and other belongings away from river bottom and low lying areas. Miami County emergency management reported evacuation of about 2,500 residents from near the Neosho River as it rose to 30 feet. An estimated 250 to 300 homes sustained flood damage and Steve Owens Boulevard flooded cutting off east-west traffic in the center of Miami. Payne County also had significant road and bridge damage from flooding. The event was part of a disaster declaration.

October 1986

Remnants of two Pacific tropical cyclones (Newton and Paine) combined to produce widespread one-week rainfall totals of 10-20 inches across northern Oklahoma, leading to major flooding on the Arkansas River and its tributaries. Flooding was reported in 52 counties with damages estimated at $350 million. The event was part of a disaster declaration.

May 26-27, 1984

During the 1984 Memorial Day weekend up to 15 inches of rain created one of the worst urban flash floods in Oklahoma history. The flooding left 14 people dead, damaged or destroyed 5,500 homes and over 7,000 vehicles. In response to the tragedy, Tulsa launched a large and effective flood prevention and warning public safety program. The event resulted in a disaster declaration.

October 17-23, 1983

Moisture from the remains of Pacific hurricane Tico combined with a weather front to produce widespread rainfall of 6-15 inches across southwest, central, and northeast Oklahoma. Extensive flooding resulted from Rush Springs to Shawnee with damages estimated at $84 million. The 24-hour rainfall record at Oklahoma City of 8.95 inches occurred during the storms. The event resulted in a disaster declaration.

October 10, 1973

Heavy rain produced the state daily record of 15.68 inches Enid. The rain accumulated in only 13 hours, with 12 inches falling in just three hours. The flash flooding that followed led to nine deaths. The event resulted in a disaster declaration.

May 1957

Heavy rains produced major flooding on the Cimarron, Arkansas, and Canadian River systems. Damages losses to agriculture alone were $20 million and water overtopped the Lake Texoma emergency spillway for the first time. The floods marked the end of persistent drought that began in 1952.

October 1923

Before modern flood control measures, the North Canadian River would regularly flood through Oklahoma City. In June of 1923 a quick river rise after heavy rains killed nearly all the animals of the Oklahoma City Zoo, located near NE 10th and Eastern with the state fairgrounds at the time. In the fall, heavy rains continued, building a flood on the North Canadian in early October. A high water crest reached the Lake Overholser dam October 16, causing it to be quickly overtopped and breached as 15,000 residents in the lowlands of Oklahoma City sought higher ground. The flood damage was extensive and citizens were displaced for weeks. The Oklahoma City Zoo and the state fairgrounds were moved to the present day locations.

Some of the more significant floods in Oklahoma history, as identified by the National Weather Service and Oklahoma Climatological Survey, are listed in the table below.

3.2.1.5 Probability of Future Events:

The probability remains **Highly Likely** for future flood events occurring anywhere in Oklahoma.

Calculated Priority Risk Index (CPRI)

Flooding = 3.75

Probability			4 Highly Likely	
Magnitude/Severity			4 Catastrophic	
Warning Time			3 6-12 hours	
Duration			3 Less than one week	
The CPRI for the Flooding hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (4 x .30)	+ (3 x .15)	+ (3 x .10)	= 3.75

3.2.1.6 Vulnerability and Impact:

River flooding flash flooding can be a destructive force in Oklahoma. Neither property nor lives are exempt from its ravages. Oklahoma floods have caused deaths of people, wildlife and livestock and caused disruption of traffic flow not only for citizen and critical services such as emergency police, fire, and ambulance. School bus and mail routes can also be disrupted when flood waters damage or destroy roads and bridges. Power and water outages have occurred which cause food spoilage and sanitation problems for communities. Cleanup efforts can be a threat to public health due to water and debris contamination. Employment is often affected due to resultant businesses closures. The local economy invariably suffers until pre-disaster operations can be restored.



3.2.1.7 Vulnerable Populations:

During a flash flood drivers may be swept off by the heavy currents or drive off into a hole caused by a washed out roadway that was “hidden” by the flood water. Flooding rivers and streams invade homes and businesses destroying walls and contents. Farmers and ranchers lose millions of dollars worth of crops and livestock when flood waters overrun their fields. The impact of their losses not only affects the State of Oklahoma but also the national and world economies.

The counties most vulnerable to the hazard of flooding include Logan, Seminole, Pottawatomie, McClain, Grady, and Comanche. The major population centers of Oklahoma and Tulsa Counties have worked diligently to correct flooding issues.

Several initiatives work to minimize the loss of life due to river flooding:

(1) Physical Floodwater Control – Widespread damming of rivers and upstream tributaries has dramatically reduced the frequency and magnitude of river flooding in Oklahoma.

(2) More Accurate Forecasting – Hydrological forecasting has improved, as has the timeliness and availability of rainfall observations. As a result, the forecast level of larger streams is much more predictable. River stage forecasting has matured to levels of accuracy that were impossible early in the century.

(3) Longer Warning Lead-Times – Because river flooding typically occurs hours to days after rainfall ceases, warnings for river flooding often provide much more lead time than those for flash flooding.

(4) Removal of repetitive loss and severe repetitive loss properties – These properties flood over and over placing residents at risk from loss of life and property. Consistent with OEM goals, the State encourages each jurisdiction with repetitive loss properties to secure approved hazard mitigation plans and process grant applications to acquire funding for their removal.

The National Weather Service issues several products relating to flooding. A flash flood watch is issued for areas of Oklahoma expected to experience the threat of flash flooding within the next 48 hours and a flash flood warning is issued when there is an immediate threat for flash flooding, especially in low-lying or poor drainage areas. For river flooding a flood watch is issued when there is high confidence that a given location on the river will rise above flood stage in the next one to two days. A flood warning is issued when a river is expected to reach flood stage and remains in effect until the river falls back below flood stage.

3.2.1.8 Conclusion:

Oklahoma comprises a major part of the Arkansas-Red River Basin. River and flood data from the basin depicted below is monitored by the Arkansas-Red Basin River Forecast Center (ABRFC) in Tulsa, Oklahoma**.** The Arkansas-Red Basin River Forecast Center is one of thirteen River Forecast Centers in the National Weather Service that provide basic hydrologic forecast information and technical support for local NWS forecast offices.

Research continues though the National Weather Service Hydrologists and the ABRFC to improve the river forecasting and improve warning capability.

When a community chooses to join the National Flood Insurance Program (NFIP) they are required to adopt and enforce a minimum amount of floodplain management criteria. These criteria include:

- requiring permits for construction within designated floodplains;
- reviewing development plans and subdivision proposals to determine if proposed building sites will be reasonably safe from flooding;
- requiring protection of water supply and sanitary sewage systems to minimize infiltration of flood water and discharges from the system into flood waters;
- obtaining, reviewing, and utilizing all available base flood elevation data;
- assuring the maintenance of flood-carrying capacities within all water courses.

Oklahoma is a member of the NFIP. 52 of 77 counties, three Tribes, and 411 communities are also members. A current list is provided in Appendix B. The State, through the Oklahoma Water Resources Board, has aggressively pursued a policy of mitigation through incremental reclamation of flood-prone areas. This has gradually reduced the number of residences in harm's way.

3.3.2 Tornado:

Tornado near Snyder, OK, November 7, 2011 (*Credit: Peter Veals*)

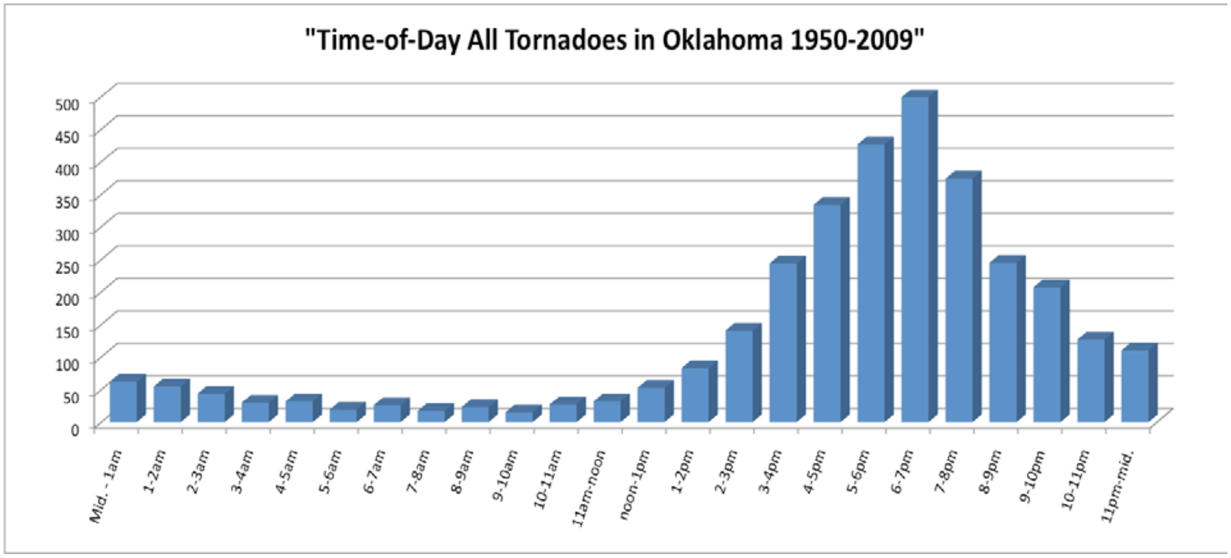
Moore, OK May 31, 2013 RSOE-EDIS

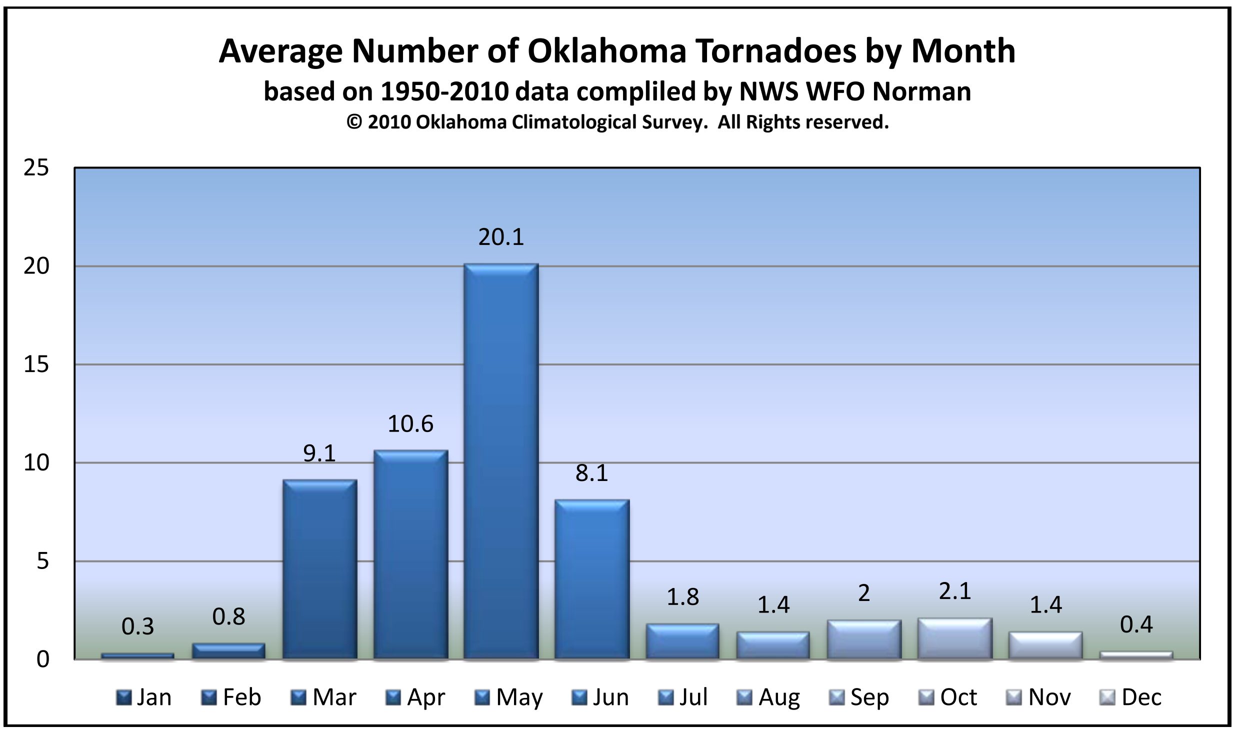
Hazard Priority # 2

3.2.2.1 Description

A tornado is traditionally defined as a violently rotating column of air that reaches from the bottom of a cumulonimbus cloud to the ground. Tornadoes are found in severe thunderstorms, but not all severe thunderstorms will contain tornadoes. While all tornadoes touch both the ground and the bottom of a cloud, it is possible for only part of the tornado to be visible. A tornado may be on the ground for only a few seconds, or last for over an hour.

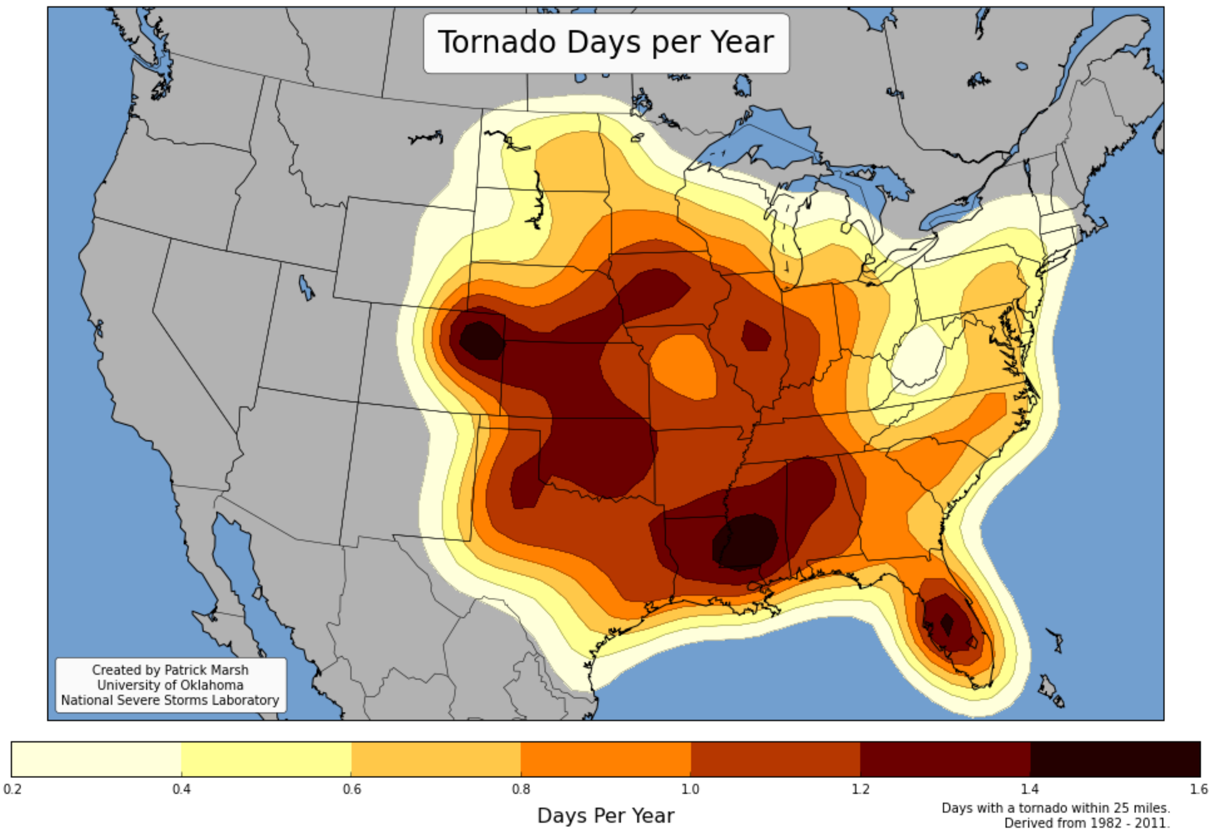
Tornadoes can appear in a variety of shapes and sizes ranging from thin ropelike circulations to large wedge shapes greater than one mile in width. However, a tornado's size is not necessarily related to its wind speed. The strongest tornadoes can have wind speeds in excess of 200mph. Over 80% of Oklahoma tornadoes have struck between 3PM and 9PM, but can still occur anytime. Spring is the peak season for Oklahoma tornadoes, but they can form during any season when the necessary atmospheric conditions of wind shear, lift, instability, and moisture are present.





A type of thunderstorm called a supercell produces most tornadoes. A supercell is a rotating thunderstorm with a strong, sustained updraft. When well developed, a supercell can have a lowering of the cloud base called a wall cloud and indicates possible tornado development. A funnel cloud can also appear from the cloud base and may reach the ground as a tornado at any time. Even though funnel and wall cloud features can indicate a tornado forming, they are not always present or visible and it is common for dark skies or rain to obscure these features and even the actual tornado. Tornadoes generally move from the southwest to the northeast, but could still travel in any direction with very slow or quick forward speeds.

The United States has the highest incidence of tornadoes worldwide, with more than 1,000 occurring every year. This is due to the unique geography of the middle U.S. that involves moist air at low levels from the Gulf of Mexico, dry air aloft from the Southwest and wind shear from an active jet stream that can produce conditions favorable for severe thunderstorms tornadoes. In the Southern Plains specifically, the dry line, which is a sharp moisture gradient between air masses, is often the focal point for the formation of thunderstorms. Tornadoes can come one at a time, or as part of a larger outbreak. Oklahoma experiences the most tornadoes per square mile of any state in the plains.



3.2.2.2 Location:

The entire State of Oklahoma is at risk from tornadoes.

3.2.2.3 Extent:

Tornado wind speeds are estimated after the fact based on the damage they produce. Tornadoes are categorized on a scale of 0 (weakest) to 5 (strongest) according to the Fujita (F) or Enhanced Fujita (EF) Scale. The EF scale with more accurate wind speed estimates replaced the original F scale in 2007, however tornadoes prior to 2007 are still referred to using their original F scale designation. Oklahoma may experience any of the EF Scale intensity tornadoes at any time during the year and anywhere in the state.

The Fujita Scale was first proposed by Dr. Fujita in 1971. It is used by meteorologists to estimate the speed of winds after a tornado by studying the damage caused by the tornado to structures.

Fujita Scale

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.

Enhanced Fujita (EF) Scale		
Enhanced Fujita Category	**Wind Speed (mph)**	**Potential Damage**
EF0	65-85	**Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86-110	**Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	**Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136-165	**Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	**Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.

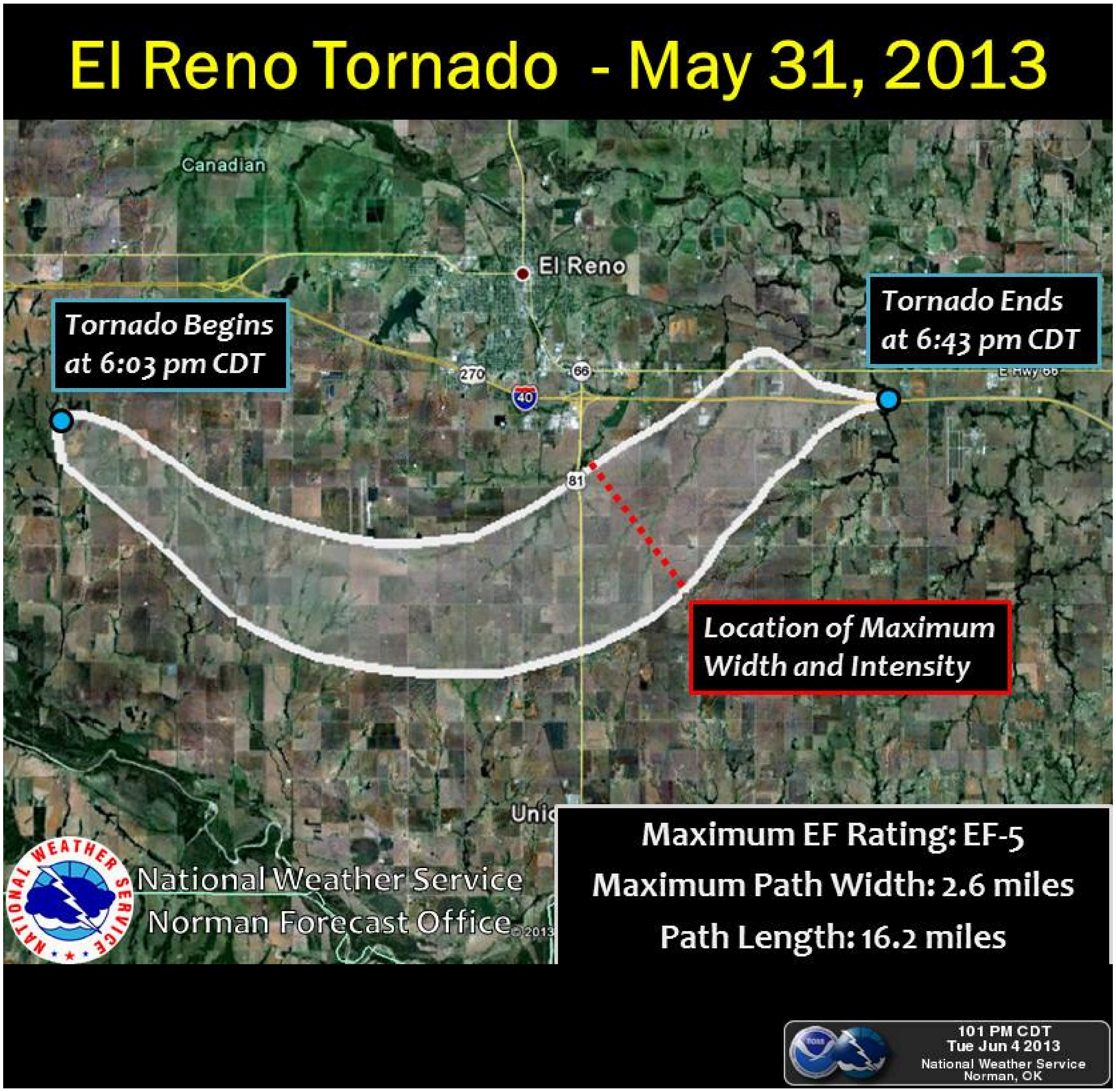
EF5	>200	**Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

The State of Oklahoma considers any event of EF2 and below to be a minor severity and EF3 and above to be a major severity.

3.2.2.4 Previous Occurrences:

Oklahoma is often referred to as part of Tornado Alley, a result of the sheer number of tornadoes the state has experienced. Unfortunately, the frequency of tornadoes in Oklahoma comes with a long history of lost lives and damaged property.

Total tornadoes	Total Deaths	Total Injured
3800 (Average of 57.25/yr) Ten Year Average	304	4915
Property damage figures based upon NCDC property damage costs since 1950 through 2013; tornado property damage has exceeded $3.25 billion in Oklahoma. Since the last plan update in 2011 there have been 334 tornadoes, 23 Deaths, 562 Injuries and $12 million dollars in damages.		



The largest tornado recorded in US history, to date, led to FEMA Disaster Declaration #4117.

Significant Oklahoma Tornadoes
(*Information provided by the National Weather Service, Oklahoma Climatological Survey, and NOAA's National Climatic Data Center*.)

Snyder, OK May 10, 1905
Even before Oklahoma was a state, a tornado rated F-5 hit Snyder leaving 97 dead. The tornado struck Snyder at about 8:45pm and despite being a half-mile wide, traversed the town in under 3 minutes. All but a few buildings in the town were destroyed.

Woodward, OK April 9, 1947
A tornado rated F-5 began in the Texas Panhandle before striking Woodward after dark at 8:42pm.

This tornado is the deadliest on record in Oklahoma, killing 116. The tornado was on the ground for 100 miles, up to 1.8 miles wide and traveled with forward speed of about 50mph. Over 100 city blocks were destroyed and fires broke out in damaged areas following the tornado.

Blackwell, OK May 25, 1955
A tornado rated F-5 struck the east side of Blackwell after dark at 9:27pm, killing 20 people and injuring 280. About 80 blocks in town were damaged or destroyed, with 190 homes completely destroyed. The tornado was on the ground for 28 miles and up to 500 yards wide. The tornado was part of a larger outbreak May 25-26 that included another F5 in Kansas.

Bridge Creek – Moore, OK May 3, 1999 Oklahoma City, OK
A tornado rated F-5 struck part of urban Bridge Creek, Oklahoma City, and Moore from 6:23pm-7:48pm, killing 36 people and injuring 295. The tornado path was 38 miles long and up to a mile wide. The F-5 tornado's parent supercell thunderstorm produced 14 tornadoes over three and a half hours, with combined damage path length over 70 miles. The storm was part of an even larger outbreak of tornadoes and other severe weather across the Great Plains. There were 66 tornadoes identified in Oklahoma and southern Kansas, 11 of which were F3 or greater. Despite the causalities heavy coverage of the tornado by media, long lead times on National Weather Service warnings, and the tornado preparedness of Oklahomans were credited with saving lives. Two deaths from the tornado outbreak overall were attributed to seeking shelter under a highway overpass, which is not a safe location during a tornado. The necessity of safe rooms or below ground shelters for surviving violent tornadoes was highlighted by the event and state programs in Oklahoma, such as the Safe Room Rebate Program, have since subsidized the cost of building residential storm shelters. The tornado outbreak earned a presidential Major Disaster Declaration, with the overall damages and costs from the event at $2.2 billion (2012 cost adjusted value).

OK May 4-10, 2003 Outbreak
The May 4-10 tornado outbreak produced 393 tornadoes in 19 states across the central and eastern U.S., killing 39 people but none in Oklahoma. The unique aspect of this event was the ongoing severe weather in the U.S. for nearly seven days. The most active tornado days in Oklahoma were May 8 and 9. The strongest tornado was a F4 that tracked across the southern Oklahoma City metropolitan area May 8, very near the May 3, 1999 tornado track. Advanced warnings and weather preparedness by Oklahomans were credited with saving lives, but the storm still injured 134 and resulted in $370 million in damages. The tornado outbreak earned a presidential Major Disaster Declaration.

Joplin, MO May 22, 2011
While not in Oklahoma, the EF-5 rated tornado just across the border in nearby Joplin, MO serves as a recent example of the existing urban threat to a catastrophic tornado event. The tornado struck part of urban Joplin from 5:34pm-6:12pm local time, killing 158 people and injuring over 1,000. The tornado path was 22.1 miles long, up to a mile wide, and with winds estimated at over 200 mph. The high death toll made the Joplin tornado the deadliest individual tornado since modern record keeping began in 1950 and the only tornado that caused over 100 deaths since 1953. Most fatalities occurred in residences and some people were killed despite seeking appropriate shelter. Joplin is an example of what can happen when the strongest of tornadoes impact a populated area, even despite modern weather warnings, communication, and buildings. The infrastructure loss to the city was severe with a heavy damage to a hospital, schools, and utilities. The NWS service assessment for the Joplin tornado

suggested that initial siren activation and severe weather warnings in general have lost a degree of credibility for most people. Not until a non-routine, extraordinary risk trigger, such as a second siren alert, visual confirmation, or urgency on television, did residents take protective action. By learning from the Joplin tornado, the NWS hopes to improve the warning dissemination system and provide a more coordinated message. The tornado was part of a larger multiday outbreak across the Midwest and Southeast. The tornado outbreak earned a presidential Major Disaster Declaration, with the overall damages and costs from the event at $9.3 billion (2012 cost adjusted value).

El Reno, OK May 24, 2011

A tornado outbreak occurred over parts of northern and central Oklahoma, with one EF-5, two EF-4, and two EF-3 rated tornadoes resulting in 11 deaths. The EF-5 tornado tracked across the northwest Oklahoma City metro area near El Reno and Piedmont killing 7 people and injuring 112. The tornado crossed I-40, where cars were thrown thousands of feet off the roadways. A nearby weather station measured a 151 mph wind gust, but the maximum estimated wind speed inside the tornado was 200+mph. The tornado was up to a mile wide and left a track 39.6 miles long. The tornado outbreak earned a presidential Major Disaster Declaration.

Additional Oklahoma Tornado Statistics - 1950 – 2013

	ALL TORNADOES				**Significant tornadoes F2**		**Violent tornadoes F3 & above**	
Year	**Number**	**Days**	**Fat.**	**Inj.**	**Number**	**Days**	**Number**	**Days**
00s Avg.	**57.25**	**14.9**	**1.7**	**35.3**	**5.5**	**3**	**0.4**	**0.4**
2009	38	12	8	4	8	5	1	1
2008	85	26	6	159	12	6	2	2
2007	39	17	2	2	6	3	0	0
2006	27	13	0	13	2	1	0	0
2005	27	12	0	0	0	0	0	0
2004	62	16	0	0	3	1	0	0
2003	78	12	0	151	9	5	1	1
2002	18	11	0	1	2	2	0	0
2001	61	17	1	16	8	4	0	0
2000	44	13	0	7	5	3	0	0
90s Avg.	**68.1**	**16.3**	**5.5**	**111.4**	**10.6**	**3.9**	**0.8**	**0.4**
1999	145	21	42	786	25	6	3	1
1998	83	15	0	35	15	4	0	0
1997	55	13	0	5	3	2	0	0
1996	48	18	0	0	1	1	0	0
1995	79	19	3	8	8	5	0	0
1994	40	13	0	11	2	2	0	0
1993	64	23	7	133	6	3	1	1
1992	64	16	0	33	11	3	1	1
1991	73	17	2	71	20	8	3	1
1990	30	8	1	32	15	5	0	0
80s Avg.	**48.7**	**18.9**	**2.9**	**63.2**	**13.3**	**6.3**	**0.6**	**0.6**
1989	20	13	0	2	1	1	0	0
1988	17	12	1	2	0	0	0	0
1987	23	11	0	8	5	3	0	0
1986	47	16	0	18	8	6	0	0
1985	36	23	0	35	5	5	0	0
1984	50	16	13	214	13	6	2	2
1983	92	22	3	12	26	12	0	0
1982	101	30	6	224	38	15	2	2

	ALL TORNADOES				Significant tornadoes F2		Violent tornadoes F3 & above	
1981	76	30	6	100	27	8	2	2
1980	25	16	0	17	10	7	0	0
70s Avg.	**51.4**	**22.2**	**6.2**	**77.5**	**19.2**	**9.3**	**1.3**	**1**
1979	51	22	7	140	23	9	3	2
1978	21	9	0	3	9	4	1	1
1977	54	20	1	18	25	12	1	1
1976	28	14	5	81	10	7	3	2
1975	34	14	3	98	18	8	0	0
1974	45	17	21	302	23	5	1	1
1973	76	32	12	220	29	13	2	2
1972	30	20	5	8	9	6	1	1
1971	39	21	0	13	11	8	0	0
1970	50	23	6	158	18	8	1	1
1969	31	19	0	2	10	8	0	0
1968	55	25	0	15	19	15	0	0
1967	49	18	4	12	14	7	2	1
1966	36	15	0	21	10	5	1	1
1965	74	29	0	12	23	16	1	1
1964	53	25	0	4	18	11	0	0
1963	30	15	1	11	12	7	0	0
1962	67	28	0	16	16	11	2	2
1961	82	30	17	85	42	16	1	1
1960	98	29	35	314	49	14	5	2
1959	70	28	7	42	29	13	2	2
1958	42	26	0	21	14	6	0	0
1957	107	27	22	54	31	11	5	4
1956	49	25	5	161	21	10	2	2
1955	77	34	23	299	18	10	3	1
1954	53	23	2	107	27	10	2	1
1953	54	23	5	44	14	5	0	0
1952	22	15	0	2	5	4	0	0
1951	43	23	0	16	17	12	0	0

	ALL TORNADOES				Significant tornadoes F2		Violent tornadoes F3 & above	
1950	23	17	6	45	11	8	1	1
TOTALS	3435	1167	288	4423	869	411	58	44
AVG./YR	**57.6**	**19.5**	**4.8**	**73.7**	**14.5**	**6.9**	**1.0**	**0.7**

Oklahoma’s Costliest Tornadoes (1950 - 2013)			
Rank	**Location**	**Date**	**Damage ($)**
1.	Moore – El Reno tornadoes	5/18 – 6/2 2013	$1.084 billion
2.	Bridge Creek – Moore - Del City tornadoes	05/03/1999	$ 1 billion
3.	Moore - OKC - Choctaw tornadoes	05/08/2003	$370 million
4.	Altus - Altus AFB tornado	05/11/1982	$200 million
5.	Ardmore tornado	05/07/1995	$100+ million
6.	Cordell tornado	10/09/2001	$100 million
7.	Tulsa tornado	04/19/1981	$75-100 million
8.	Stroud tornado	05/03/1999	$60 million
9.	Catoosa tornado	04/24/1993	$50+ million
10.	Downtown Bartlesville tornado	03/15/1982	$30-40 million

Note: *Some of the damage costs listed here are estimates. In addition, the damage costs listed have not been adjusted for inflation to current dollar amounts.*

Violent Tornadoes (F4/F5) in Oklahoma (1950 - 2013)

Date	Time (CST)	Length of Path (miles)	Width of Path (yards)	F-Scale	Killed	Injured	County
04/28/1950	1905	5	200	**F4**	5	32	Hughes
05/01/1954	1415	34	267	**F4**	0	0	Tillman/ Kiowa
05/01/1954	1800	59	N/A	**F4**	0	65	Pottawatomie/ Lincoln/ Creek
05/25/1955	1700	46	1100	**F4**	2	18	Roger Mills Co.
05/25/1955	2126	28	500	**F5**	20	280	Kay Co.
04/02/1956	2130	108	880	**F4**	2	29	Kay Co.
04/03/1956	0010	42	400	**F4**	0	59	Ottawa Co.
01/22/1957	0645	NA	880	**F4**	10	20	Sequoyah
04/02/1957	1729	5	200	**F4**	2	6	Marshall

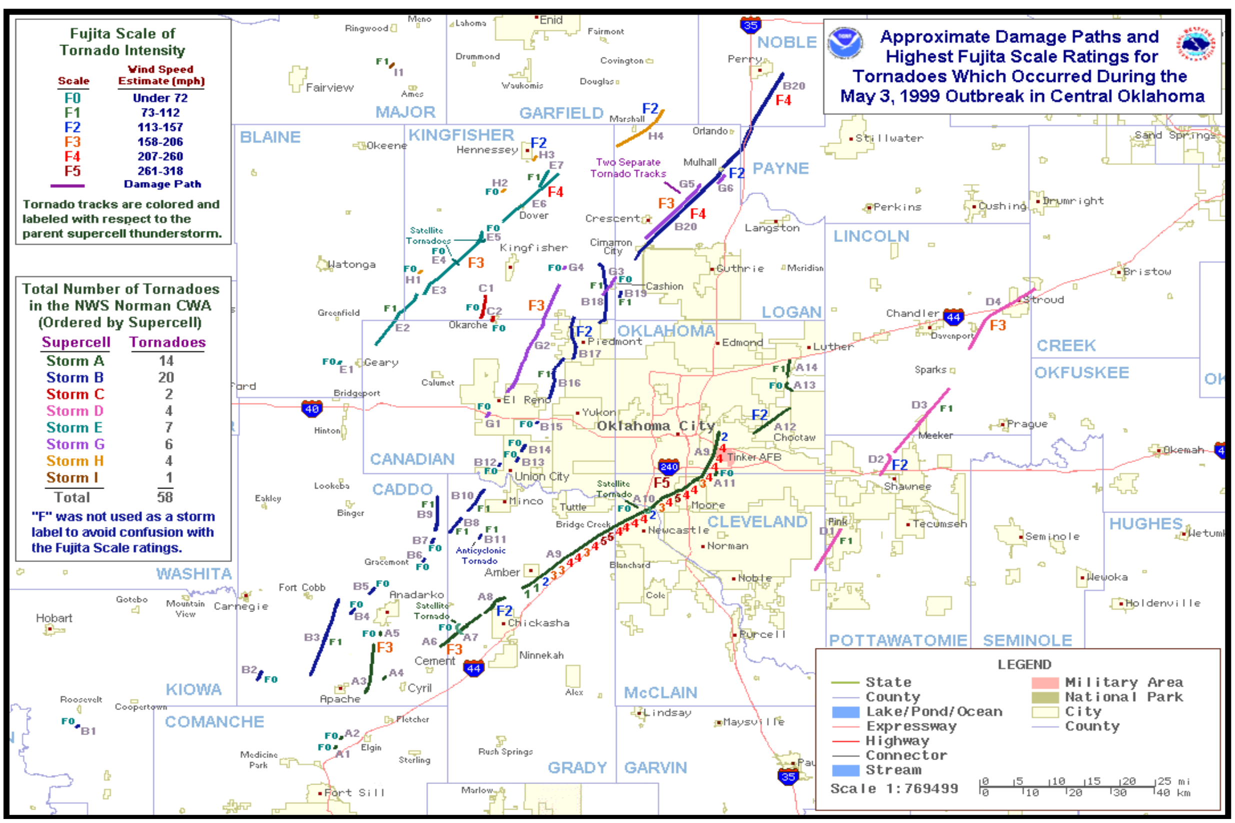
Date	Time (CST)	Length of Path (miles)	Width of Path (yards)	F-Scale	Killed	Injured	County
04/02/1957	1758	8	200	**F4**	3	3	Bryan
05/24/1957	1730	22	880	**F4**	4	5	Cotton/Comanche
09/14/1957	1730	68	440	**F4**	2	6	Cleveland/ Pottawatomie/ Seminole/Hughes
05/09/1959	1840	6	900	**F4**	7	12	Pontotoc
09/27/1959	1800	20	440	**F4**	1	1	Craig
05/04/1960	2005	8	N/A	**F4**	0	0	Pottawatomie/ Seminole
05/04/1960	2116	31 *	150	**F4**	0	3	Choctaw/Pushmataha
05/05/1960	1700	72	800	**F5**	5	81	Pottawatomie/Lincoln/ Okfuskee/Creek
05/05/1960	1910	62	200	**F4**	16	106	Latimer/Haskell/ Sequoyah
05/05/1960	1940	5	n/a	**F4**	5	13	Sequoyah
05/05/1961	1720	26	400	**F4**	16	58	Le Flore
05/25/1962	1828	7	250	**F4**	0	9	Washita
05/26/1962	2000	10	400	**F4**	0	1	Cotton
03/16/1965	1640	83	300	**F4**	0	7	Grant/Kay
04/27/1966	1900	10	300	**F4**	0	2	Johnston/Atoka
06/10/1967	1704	9	300	**F4**	4	1	Custer
06/10/1967	2045	N/A	N/A	**F4**	0	0	Blaine
10/05/1970	1542	25	150	**F4**	4	84	Pottawatomie/Lincoln/ Okfuskee
04/19/1972	1700	28	n/a	**F4**	5	6	Carter/Murray/Garvin
05/24/1973	1600	13	300	**F4**	2	4	Canadian
05/26/1973	1600	4	500	**F4**	5	25	Muskogee
06/08/1974	1555	29	400	**F4**	14	150	Payne/Creek/Tulsa/ Osage
03/26/1976	1450	11	440	**F4**	1	4	Latimer/Le Flore
03/26/1976	1528	12	440	**F5**	2	64	Le Flore
04/17/1976	0412	33	440	**F4**	0	6	Caddo

Date	Time (CST)	Length of Path (miles)	Width of Path (yards)	F-Scale	Killed	Injured	County
05/18/1977	12:50	38	440	**F4**	0	0	Cimarron
5/10/2010	16:21	23	1320	**EF-4**	2	100	Cleveland/Oklahoma
04/30/1978	18:20	9	1760	**F4**	0	0	Canadian/ Oklahoma
04/10/1979	15:20	11	880	**F4**	0	1	Tillman
04/10/1979	18:30	11	1760	**F4**	0	0	Jefferson
05/02/1979	16:15	21	880	**F4**	1	25	Major/Garfield
05/17/1981	19:00	34	600	**F4**	0	2	Seminole/Okfuskee/ Okmulgee
05/22/1981	18:49	17	1333	**F4**	0	0	Caddo/Canadian
03/18-19/1982	01:00	88	880	**F4**	0	12	Beaver
04/02/1982	15:50	53	500	**F5**	0	29	Choctaw/McCurtain
04/26/1984	22:05	22	880	**F4**	3	37	Creek/Pawnee
04/29/1984	09:20	27	200	**F4**	1	60	Creek/Pawnee/Osage
04/26/1991	17:30	66	1500	**F4**	0	6	Garfield/Noble/Osage
04/26/1991	19:10	32	1700	**F4**	1	24	Pawnee/Osage
04/26/1991	20:45	4	1300	**F4**	0	22	Rogers
05/11/1992	15:00	10	400	**F4**	0	3	Pittsburg
04/24/1993	17:50-18:03	6	250	**F4**	7	100	Tulsa/Rogers
05/03/1999	17:26-18:48	38	1760	**F5**	36	583	Grady/McClain/ Cleveland/Oklahoma
05/03/1999	20:10-20:38	15	880	**F4**	1	11	Kingfisher
05/03/1999	20:25-21:45	39	1760	**F4**	2	26	Logan/Payne/ Noble
05/08/2003	16:15-16:38	13.5	700	**EF4**	0	89	Cleveland/Oklahoma
05/10/2008	16:25-16:54	24	1760	**EF4**	6	150	Ottawa
02/10/2009	19:09-19:43	21	880	**EF4**	8	0	Carter
05/10/2010	16:21-16:45	23	1320	**EF4**	2	100	Cleveland/Oklahoma
05/10/2010	16:33-16:54	16	2000	**EF4**	3	117	Cleveland/Pottawatomie

Date	Time (CST)	Length of Path (miles)	Width of Path (yards)	F-Scale	Killed	Injured	County
05/20/2013	14:56-15:35	14	1936	**EF5**	24	*	McClain/Cleveland
05/31/2013	18:03-18:43	16.2	4576	**EF5**	8	*	Canadian

Above statistics provided through the National Weather Service, Norman, OK
**As of this Plan Update, final figures still pending*

Since the latter part of the 19th century, two mitigating factors have been working in opposition to determine the State's risk from tornadoes: the increases in both population and technology. An increase in population enhances the hazards posed by tornadoes. As the population grows, the threat of a tornado striking in a populated area increases. Population growth is naturally accompanied by the necessary infrastructure and by-products of civilization, all of which increase the potential loss in the event of a tornado. The exodus of rural populations to urban areas is problematic as well. A tornado striking a larger population density significantly increases the chances for fatalities, as evidenced by the central Oklahoma outbreak of May 3, 1999, which caused more than $1 billion in damages and killed 40.



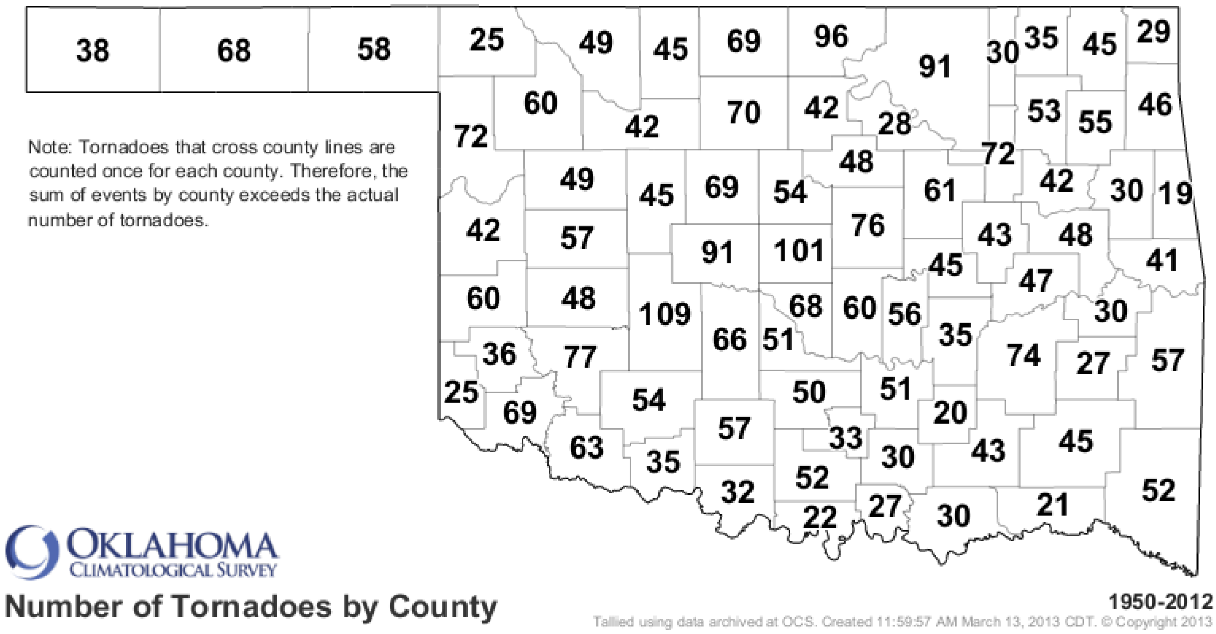
The hazard of population increase has been somewhat offset by the advancements in technology over the last half-century. Improvements in remote sensing, such as radar and satellites, coupled with improved communication systems, have increased the lead-time for warnings tremendously. Tornado warnings have improved significantly and the number of tornado casualties has decreased by nearly half since a network of Doppler weather radars, Doppler (WSR-88D), also known as NEXRAD, was installed nationwide by the National Oceanic and Atmospheric Administration's National Weather Service in the mid 1990's. A future significant upgrade to Weather Surveillance Radar will likely be the Phased Array Radar, which will reduce the scan rate of six minutes currently, to a minute or less, thereby making it more efficient in seeing smaller short lived or earlier stages of developing tornadoes.

The next step in NOAA's long-time research and advancement of weather radars is phased array radar. Using electronic controls of beams and frequencies, these new radars can scan more quickly, thereby increasing lead times for tornado warnings.

Better construction practices have also worked to limit the damage potential from all but the most violent tornadoes. Many residences and businesses of today are more likely to withstand the damaging winds of weaker tornadoes than those structures built 50 years ago. The inclusion of safe rooms, below ground storm shelters, (Oklahomans have installed more than 10,500 safe rooms and storm cellars over the past decade) hurricane straps, and foundation anchor bolts in current construction plans, have helped reduce the hazard to both life and property. Mobile and manufactured homes, however, are not safe places in a tornado.

Weather forecasters use highly advanced computer models to anticipate severe weather outbreaks and an elevated threat of tornadoes several days in advance. On the day of such an outbreak, there are two types of alerts that government organizations issue to warn of a possible tornado threat. One type of alert is a tornado watch, issued by the Storm Prediction Center (SPC) in Norman, Oklahoma. A tornado watch means that atmospheric conditions are favorable for tornadoes in the watch area. A tornado watch will usually last for several hours and cover several hundred square miles. Another type of alert, the tornado warning, represents a more immediate threat. A tornado warning means that a tornado is imminent or already occurring as indicated by either Doppler radar or a report of a spotted tornado. A tornado warning typically lasts for about an hour or less and covers an area about the size of a county. Oklahoma's tornado warnings are issued by the Tulsa, OK, Norman, OK, Amarillo, TX, or Shreveport, LA National Weather Service (NWS) Forecast Offices. Television and radio stations, as well as National Oceanic Atmospheric Administration (NOAA) weather radios relay watches and warnings. They can also be viewed by visiting the NWS web site, http://www.weather.gov.

Tornado counts for a specific area, such as a county, are affected by several factors, including: size of the area, population base, and location. Some counties in Oklahoma have counts that reflect those factors quite well. Oklahoma and Tulsa counties both have high populations and high tornado event count~~s~~ with 101 and 72 reported tornadoes, respectively. Caddo and Osage counties, both with large land areas, have high counts as well, at 109 (the State's highest) and 91, respectively. However, variations do occur. Kay County, neither overly populous nor large in area (957.74 sq. mi.), has a total of 96 tornadoes.



Top Ten Deadliest Oklahoma Tornadoes (1882 - 2013)					
Rank	**City/Town**	**Date**	**F-Scale**	**Fatal**	**Injuries**
1.	Woodward	04/09/1947	**F5**	116	782
2.	Snyder	05/10/1905	**F5**	97	58
3.	Beggs	05/02/1920	**F4**	71	100
4.	Antlers	04/12/1945	**F5**	69	353
5.	Pryor	04/27/1942	**F4**	52	350
6.	Bridge Creek - Moore – Oklahoma City	05/03/1999	**F5**	36	583
7.	Oklahoma City	06/12/1942	**F4**	35	29
8.	Cleveland County	04/25/1893	**F4**	33	100
9.	Bethany	11/19/1930	**F4**	23	150
10.	McAlester	05/08/1882	**F3**	21	42

While 69% of all tornadoes are considered weak; over 82% of all tornado deaths are due to violent tornadoes (F4-F5), despite only 2% of all tornadoes falling into that category. Between 1950 and 2013, of the 249 deaths attributed to tornadoes in Oklahoma, 210 (84.33%) were a result of F4 and F5 tornadoes. Additionally, the injury rate during F4 and F5 tornadoes was nearly as high with 2,453 (57.23 %) out of 4,286 injured during violent tornadoes in relation to the other. Nine of the top ten deadliest tornadoes in Oklahoma were in the violent category. Tornado deaths by county are dominated by singular events, and largely a result of significant (F2-F4) tornadoes.

The State's most deadly tornado occurred before 1950, when an F5 tornado devastated the city of Woodward on April 9, 1947. The tornado, which was over a mile wide leveled over 1000 homes and businesses and left 116 dead in its wake as it crossed into Kansas. While 9 of Oklahoma's 10 deadliest tornadoes occurred before 1950, the threat for a catastrophic event still exists as evidenced by the 2011 tornado disasters in Alabama, Joplin, MO and the May 20 and 31 tornadoes in Moore and El Reno Oklahoma.

Oklahoma Tornadoes by Fujita Scale and Month (1950 – 09/2013)								
Month	**F?**	**F0**	**F1**	**F2**	**F3**	**F4**	**F5**	**Total**
Jan	0	5	3	12	0	1	0	**21**
Feb	1	9	24	18	7	1	0	**60**
Mar	4	91	83	67	24	7	1	**277**
Apr	13	224	194	186	55	30	3	**705**
May	34	509	392	239	90	38	8	**1310**
Jun	7	218	150	85	29	5	0	**494**
Jul	4	36	43	25	3	0	0	**111**
Aug	4	35	34	13	2	0	0	**88**
Sep	3	74	23	17	3	4	0	**124**
Oct	1	65	45	21	8	3	0	**143**
Nov	1	21	38	17	11	0	0	**88**
Dec	0	0	10	12	2	0	0	**24**
Total	**72**	**1287**	**1039**	**712**	**234**	**89**	**12**	**3445**

3.2.2.5 Probability of Future Events:

Because tornadoes are random, every county in Oklahoma is at risk, there is a **HIGHLY LIKELY** probability of future events occurring.

Calculated Priority Risk Index (CPRI)

Tornado = 3.7

Probability		4 Highly Likely		
Magnitude/Severity		4 Catastrophic		
Warning Time		4 Less than 6 Hours		
Duration		1 Less than 6 hours		
The CPRI for the tornado hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI

(4 x .45)	+ (4 x .30)	+ (4 x .15)	+ (1 x .10)	= 3.7

3.2.2.6 Vulnerability and Impact:

Tornadoes cause hundreds of thousands of dollars of damage to property every year, and catastrophic events can cost much more. Houses, businesses and government infrastructure often suffer extensive damage in tornadoes as well as the death of people, wildlife and livestock. Some people leave and never return leaving empty or debris riddled lots for someone else to deal with. There can be disruption of traffic flow occurring not only for the citizens' day to day travel, but also for critical services such as emergency police, fire, and ambulance. School bus and mail routes can also be disrupted due to damaged or destroyed roads and bridges. Power and water outages can occur which cause food spoilage and sanitation problems for communities. Schools, hospitals, grocery stores and other critical need and economically important facilities can be damaged and closed for extended periods. Employment is often affected due to businesses that are forced to close due to the tornado damage and /or loss of business.

Even with the advances in meteorology, warning times may be short or sometimes not possible. Tornadoes and violent windstorms occur frequently in the State of Oklahoma and can be very deadly.

3.2.2.7 Vulnerable Populations:

Oklahoma is among the most tornado-prone areas of the nation. Virtually all of the State is at risk. Poorly constructed homes, older homes and mobile home parks are at highest risk to sustain the greatest damage.

The greatest vulnerability to be faced would be in the event an EF3 or higher tornado was to hit a major metropolitan area such as Oklahoma City or Tulsa and their surrounding communities. Substantial damage could be incurred by state, local, and federal facilities. The damage to infrastructure would be enormous with lost power, water, sewer, gas, and communications. Roads and bridges could be damaged or at the least blocked and cluttered with debris. Many people would lose their homes and be displaced from their primary residence with high numbers of injuries and fatalities possible. This situation was realized on May 3, 1999 when a tornado with winds believed to be the strongest ever observed made a path through south Oklahoma City and the surrounding community of Moore.

The map in section 3.2.2.4 shows the number of tornadoes observed in each county in Oklahoma since 1950. Even though some counties have more recorded tornadoes than others, tornadoes in rural areas can occur undetected. The entire state is vulnerable to tornadoes. State-owned property is vulnerable to severe weather the same as all other property. Special concerns may arise over critical facilities such as electric transmission lines, and communications towers being affected as well as highways that may be closed by debris on the highway.

Tornadoes are typically observed more often in urban rather than rural areas; since more populated areas generally have better weather radar coverage and more people and structures that could be affected. In unpopulated areas tornadoes may occur undetected.

3.2.2.8 Conclusion:

Climatological records for Oklahoma indicate that a real danger to both life and property is faced by residents in Oklahoma from tornadic activity. While the number of reported tornadoes has increased, advances in detection technology, better training of storm spotters, and increased construction of shelters has led to a reduction in injuries and fatalities.

3.3.3 Winter Storms, Ice, Freezing Rain

Hazard Priority # 3

3.2.3.1. Description:

Oklahoma's experience with severe winter weather includes disruption of travel and damage to infrastructure due to excessive snow or ice. Even slight amounts of snow or ice often snarl traffic due to slick roads and inexperienced drivers. Most of the fatalities associated with winter precipitation in Oklahoma are due to traffic accidents. Ice storms do the most damage, however, as they topple power lines and vegetation. From 2000 - Jan 2013, the NCDC lists 182 winter weather, winter storm, blizzard, heavy snow, or ice event days somewhere within Oklahoma, which caused over $1.3 billion in damage.

A severe winter storm can range from freezing rain or sleet to moderate snow over a few hours to blizzard conditions and extremely cold temperatures that lasts several days.

WINTER STORM can refer to a combination of winter precipitation, including snow, sleet and freezing rain.

SEVERE WINTER STORM is one that drops 4 or more inches of snow during a 12–hour period, or 6 or more inches during a 24- hour span.

BLOWING SNOW is wind-driven snow that reduces visibility and causes significant drifting. Blowing snow may be snow that is falling and/or loose snow on the ground and picked up by the wind.

BLIZZARDS occur when falling and blowing snow combine with high winds of 35 mph or greater reducing visibility to near zero.

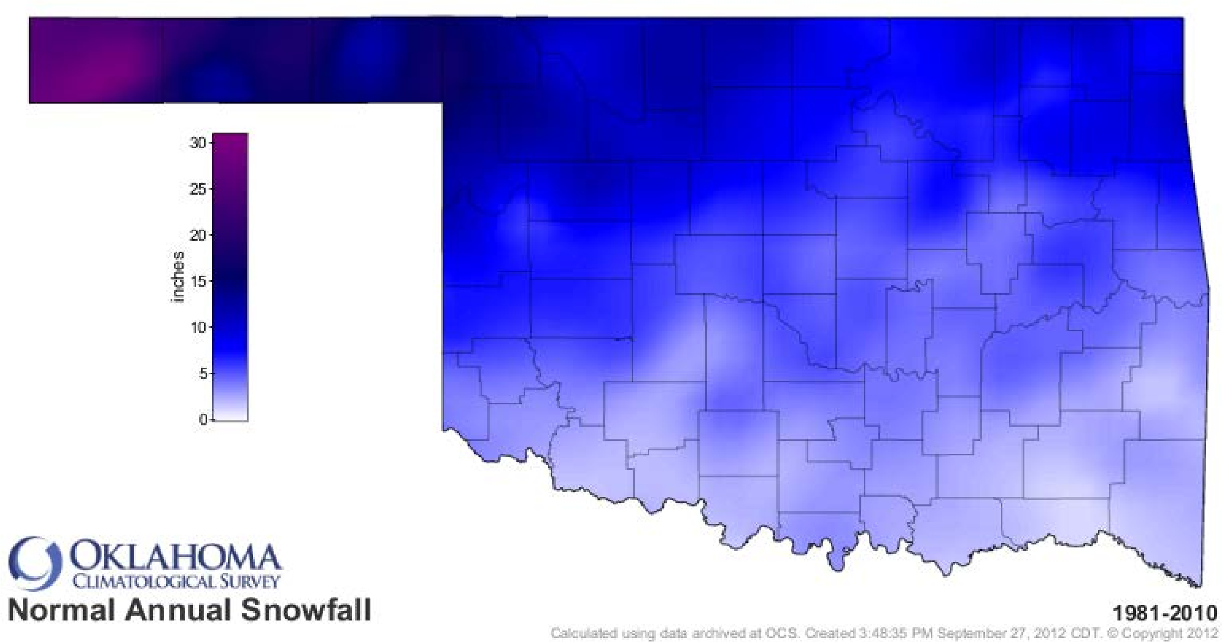
FREEZING RAIN is rain that falls as liquid onto a surface with a temperature below freezing. This causes the drops to freeze on contact onto surfaces like trees, utility lines, cars, and roads, forming a coating or glaze of ice. Even small accumulations of ice can cause a significant hazard.

SLEET is frozen precipitation that has melted by falling through a warm layer of the atmosphere and then refreezes into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not immediately stick to objects. However, it can accumulate like snow and cause a hazard to motorists.

ICE STORMS are extended freezing rain events, lasting several hours to sometimes days, when the freezing rain accumulates a thick enough glaze on surfaces to damage trees, utility lines, and cause major travel hazards. Ice storms can result in a heavy glaze an inch thick or more, but even a quarter inch ice accumulation can cause problems under windy conditions.

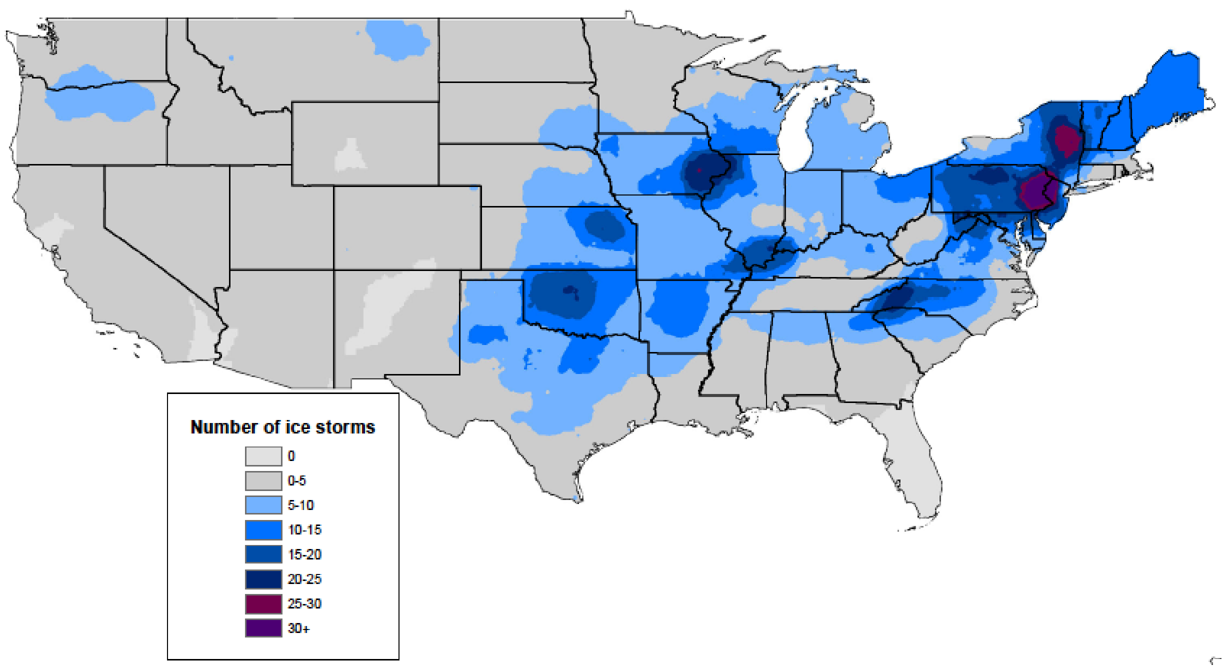
WIND CHILL is used to describe the relative discomfort and danger to people from the combination of cold temperatures and wind. The wind chill chart below from the National Weather Service shows the apparent temperature derived from both wind speed and temperature. (Wind Chill Chart)

The gradient of average annual snowfall across Oklahoma increases from less than two inches in the extreme southeast to 30 inches in the western panhandle. The frequency of snow events also increases sharply along the same gradient. Locations in southeast Oklahoma have gone several years between events, while northwestern Oklahoma typically records several snow events each winter. Blowing snow and blizzard conditions can pose significant problems for automobile travelers, but the effects of most snowstorms in the state are short-lived. Snowfall remaining on the ground more than a few days is an uncommon occurrence in northwestern Oklahoma, quite rare in central Oklahoma, and almost unheard of in the southeast. Recent blizzards December 24, 2009 and February 1, 2011 have included some of the heaviest snowfalls on record for parts of the state. The greatest seasonal snowfall ever recorded in the state was 87.3 inches at Beaver during the winter of 1911-12.



Since 2000 a series of major ice storms have plagued Oklahoma winters. The icy cover can down power lines and limbs, causing millions of dollars in damage and widespread power outages. These events, which can leave an ice coating lasting several days, are extremely paralyzing to the communities affected. While ice accumulation is often less than an inch, storms depositing several inches of ice have occurred. The consecutive winters of 2000-01 and 2001-02 each featured a major ice storm that deposited more than three inches of ice in 24 hours across much of SE and central Oklahoma. Similar events occurred in December 2007 for central and western Oklahoma and January 2007 in eastern Oklahoma. For the electric utility industry, and businesses, freezing rain and ice storms are economic disasters. An ice storm has two waves of impact for the electric utility industry: first from the initial ice accumulation and wind stress; then later from stresses caused by the rapid recoil of power lines when accumulated ice melts and falls. The December 2007 storm caused the largest power outage in state history. The image below depicts the number of ice storms as identified by National Climatic Data Center records from 1998-2011 during the months of December, January and February. Oklahoma is one of the parts of the country that has observed a relatively high number of ice storms, with 15-20 during the time period.

Total Winter Ice Storms 1998-2011



(*Credit: Carly Kovacik*)

3.2.3.2. Location:

The entire State of Oklahoma is at risk from Winter Storms.

3.2.3.3. Extent:

An index scale used by the utility industry to anticipate impact and damage of an icing event to transmission lines is the Sperry-Piltz Ice Accumulation Index. As a tool for risk management and winter weather preparedness, the index uses National Weather Service forecast parameters to predict the spatial coverage, total ice accumulation, and potential damage from ice storms.

The Sperry-Piltz Ice Accumulation Index, or "SPIA Index" – Copyright, February, 2009

ICE DAMAGE INDEX	* AVERAGE NWS ICE AMOUNT (in inches) *Revised-October, 2011	WIND (mph)	DAMAGE AND IMPACT DESCRIPTIONS
0	< 0.25	< 15	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	0.10 – 0.25	15 - 25	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
	0.25 – 0.50	> 15	
2	0.10 – 0.25	25 - 35	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
	0.25 – 0.50	15 - 25	
	0.50 – 0.75	< 15	
3	0.10 – 0.25	> = 35	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 – 5 days.
	0.25 – 0.50	25 - 35	
	0.50 – 0.75	15 - 25	
	0.75 – 1.00	< 15	
4	0.25 – 0.50	> = 35	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 – 10 days.
	0.50 – 0.75	25 - 35	
	0.75 – 1.00	15 - 25	
	1.00 – 1.50	< 15	
5	0.50 – 0.75	> = 35	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.
	0.75 – 1.00	> = 25	
	1.00 – 1.50	> = 15	
	> 1.50	Any	

(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

The State of Oklahoma considers a reading of 1 or below on the SPIA Index a minor severity and a reading of 1 or above to be a major severity.

Wind chill is also a dangerous component of winter weather events. Wind chill is the combination of wind and temperature that serves as an estimate of how cold it actually feels to exposed human skin. Wind chill values below -19 degrees Fahrenheit are considered extremely dangerous to the population of the State of Oklahoma, although hypothermia can still occur at higher temperatures and cause deaths. Parts of the Oklahoma Panhandle sometimes experience wind chills of -19 degrees several times per year.

The National Weather Service implemented the current Wind Chill Temperature (WCT) index during the 2001/2002 winter season. The WTC Index makes use of advances in meteorology, biometeorology and computer modeling to provide a more accurate, useful formula for calculating the dangers from winter winds and freezing temperatures.

Wind Chill Chart

Wind Chill Chart

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	29	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

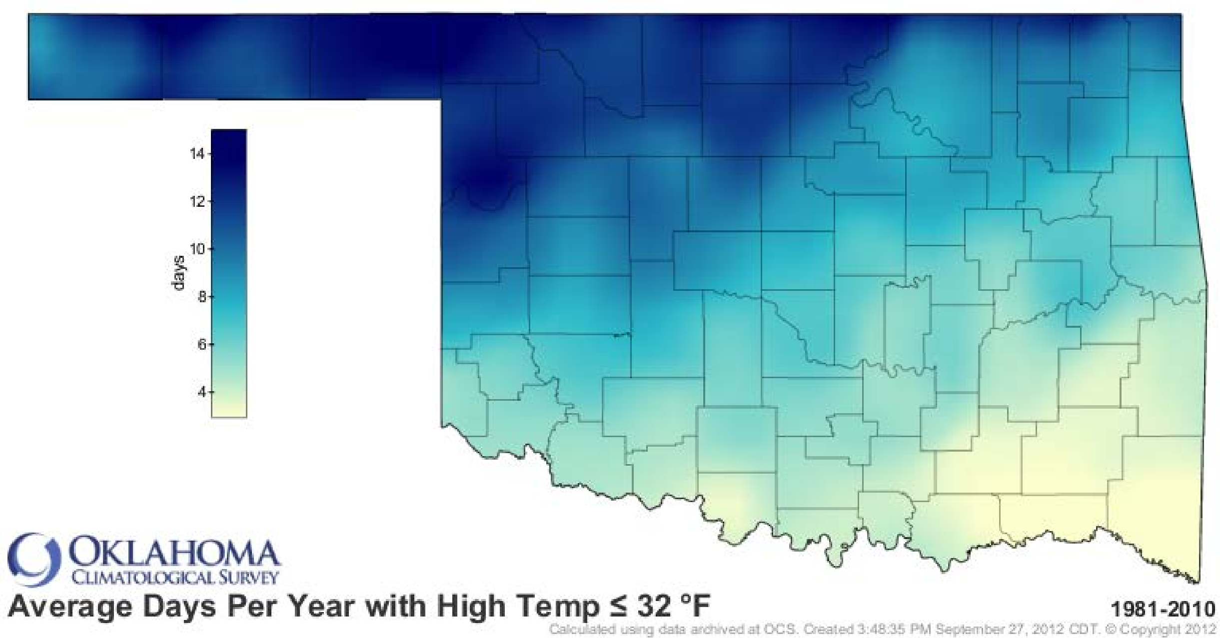
$$\text{Wind Chill } (^\circ F) = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

3.2.3.4. Previous Occurrences:

The following map shows the average number of days per year where the high temperature is at or below 32 degrees. The counties of Cimarron, Texas, Beaver, Harper, Ellis, Woodward, Woods, Alfalfa, Grant, Garfield, Kay, and Noble are most vulnerable to having more than 12 days per year where the daily high temperature is at or below 32 degrees.



Major damaging snow and ice storms have occurred over the state during the past several decades. NCDC indicates there have been 695 records of Snow and Ice Storms between 1950 and December

2013, though many winter weather events from the earlier years are likely not represented by this count.

Significant Oklahoma Winter Storms
(Information provided by National Weather Service, Oklahoma Climatological Survey and the National Climate Data Center)

January 31 - February 1, 2011
Precipitation began in eastern Oklahoma during the evening of January 31 as freezing rain and sleet before changing to snow. Heavy snow fell February 1 resulting in more than four inch accumulations north of a Sallisaw to McAlester line. A large portion of northeastern Oklahoma received more than ten inches of snow and a swath of 20 inch snows were measured across Osage, northern Tulsa, Rogers, and Ottawa Counties. Tulsa recorded its top two-day snowfall on record with 14 inches and Oklahoma City tied its second greatest snowfall at 12.1 inches. Strong winds frequently gusting to more than 35 mph resulted in near zero visibilities and snow drifts up to about five feet across northeastern Oklahoma. The storm had a crippling impact on the region with interstate highways impassable and closed, the Tulsa International Airport closed, and many businesses shut down during and the days immediately following the storm. In Ottawa County on February 3rd, the day when I-44 was reopened, a SUV slid on a bridge near Miami and tumbled over the guard rail, causing three indirect storm fatalities and five injuries. A couple schools experienced collapsed roofs from the weight of the snow as did a casino in the Tulsa area. Boat docks on Grand Lake were destroyed by the weight of the snow. Damage estimates for that area alone were at $30 million. This storm resulted in a disaster declaration.

January 28-29, 2010
Early morning January 28 freezing rain moved into southwest Oklahoma, spreading northeast into Oklahoma City and across the Tulsa area. Enhanced precipitation rates in southwest and south-central Oklahoma resulted in widespread 1 to 1.5 inch ice accumulations, while other parts of the state received ice followed by several inches of snow. Widespread power outages occurred with significant damage to power systems, including high voltage lines. At the height of this storm, approximately 180,000 meters were without service. Numerous shelters were setup across the state with a focus on south-central and southwest sections. Department of Emergency Management dispatched generators to the impacted regions and also used FEMA supplied generators. Many towns were without power for days. There were 1242 injuries, mostly slip and fall accidents, and seven fatalities. The storm resulted in a disaster declaration.

December 24, 2009
The winter storm that converged on the Southern Plains December 24, 2009 resulted in the most widespread blizzard conditions to affect Oklahoma in decades. A rapidly intensifying low pressure, cold air from the north, and Gulf moisture created blustery winds and heavy precipitation. The storm produced 4 to 8 inches of snow across Wichita Falls up through Oklahoma City and Stillwater. Local snow totals exceeded ten inches, including the most snow ever recorded in a single day at Oklahoma City, 13.5 inches. For several hours, winds sustained at 40 mph and gusting to 60 mph created whiteout conditions with visibility of less than 100 feet and deep snow drifts. The dangerous travel conditions led to abandoned cars littering the roads and highways, making travel impossible even for better-equipped vehicles. The National Guard was called in to rescue stranded motorists and hundreds of people spent Christmas Eve night in shelters. The blizzard conditions or near blizzard conditions continued in eastern Oklahoma through early Christmas morning. The storm resulted in

over $18 million of damage across Oklahoma and 1024 injuries. There were 9 fatalities from weather related traffic accidents or from being struck by cars while assisting stranded motorists. The storm resulted in a disaster declaration.

December 8-11, 2007
A prolonged ice storm across much of the state began December 8 and resulted in up to four inches of ice accumulation. Both of the state's large metropolitan areas lay squarely within the storm's path, making this ice storm one of the worst for Oklahoma's urban areas. Precipitation totals of up to four inches were recorded along the path of the storms. The storm left about 700,000 customers without power, with the actual number of people without power much larger. This storm resulted in the largest power outage recorded in Oklahoma history. Catastrophic tree damage from central through northeastern Oklahoma left cities and towns with an enormous amount of debris cleanup. There were 29 fatalities, and an estimated $826 million in damage. The storm resulted in a disaster declaration.

January 12-15, 2007
A strong winter storm crippled much of Okla., spreading snow, freezing rain and sleet across the state. The freezing rain and sleet occurred mainly over central and southwest Oklahoma with mainly freezing rain over the southeast. Many trees and power lines were downed with thousands of residents without power, mainly over southern and eastern Okla. The severe cold that accompanied this storm also caused water main breaks in Clinton and Lawton. Damage included the roof collapses of two school gymnasiums and four greenhouses. The prolonged wintry precipitation closed airports, schools, malls, and other places of business, in some cases for a week or longer. This storm caused severe damage to the power systems in the eastern 1/3 of Oklahoma, where ice accumulations were more than 3" in localized areas. Over 100,000 customers were without power at the height of the storm and some in rural areas were without power for nearly a month. The storm caused 32 fatalities and an estimated $40 million in damage. The storm resulted in a disaster declaration.

December 3, 2002
A winter storm left damage from freezing rain in a narrow band from W-central to N-central Okla., with several inches of snow to the north. The main impact of the ice storm was damage to electrical distribution systems. Because much of the area is rural, the primary victims of the storms were members of the rural electric coops (RECs) with about 50,000 customers without power. The storm resulted in $4.5 million in damages and a disaster declaration.

January 28-31, 2002
The ice storm began January 28 and ended up being especially damaging to parts of rural Oklahoma. Freezing rain left ice accumulations of 1-2 inches northwest of a line from Chandler, to Norman, to Lawton and Frederick. Several inches of snow also fell across far NW Okla. The Oklahoma Association of Electric Cooperatives reported over 31,000 electrical poles destroyed due to the ice resulting in over 1,550 miles of destroyed power supply capabilities. The storm left over 255,000 residences and businesses without power. Dozens of towns, like Enid, were entirely without electricity for days. Some areas of northwest Oklahoma were without power for weeks. There were 7 reported fatalities and damage costs of $300 million. The storm resulted in a disaster declaration.

December 25-27, 2000
A winter storm struck statewide, with the most significant ice in the southeast. Power was lost to about 170,000 homes and businesses, including 90 percent of the residents of McIntosh, Latimer, and

Pittsburg counties. Extended power outages also led to disruptions of local water supplies in some areas. The storm resulted in 27 fatalities and $76 million in damages. The storm resulted in a disaster declaration.

March 13, 1999
Heavy snow across portions of northern Oklahoma resulting in hundreds of closed roads, traffic accidents, stranded motorists and power outages. The heaviest snow fell in a band across N-central Okla. From near Cherokee, extending E and SE to Medford, Pond Creek, Enid, and Perry with up to 20 inches reported. Due to electricity loss in cold conditions Chandler National Guard in Lincoln County accommodated 500 people, while the Perry National Guard in Payne County accommodated 400 people. Four churches in Stroud in Lincoln County accommodated a total of 1000 people. There were five fatalities reported.

January 5-7, 1988
Snow storm totals exceeded 4" over virtually the entire state, and exceeded 6" over all but a few areas near the Red River and far western Panhandle. Records indicate that the maximum storm total was 17" in Hennessey. The 12.1 inches at Oklahoma City stood as an all-time record for storm total snowfall until Dec 25, 2009.

December 25-27, 1987
Ice accumulations up to 2" from Duncan to Norman to Tulsa left many areas without power for a week or more. About 114,000 customers were left without power. Ranked as one of the costliest storms on utility company records. Several large broadcast antennas collapsed. The storm resulted in $10 million of damages

February 20-22, 1971
Although this was confined to a relatively small part of NW Okla., the blizzard snow total of 3 feet at Buffalo nearly doubles the maximum storm total of any other snow storm in Okla. history. Winds whipped snow into enormous drifts, forcing some people to use second-story windows to get out of their homes. *(See photo below)*
Cattle and hogs were buried under the snow for many days. Remarkably, some of them were found alive by rescuers after the storm was over. Those who were not buried were still without a food source. After the storm, the National Guard searched for stranded herds from the air and dropped hay to them. In all, 11,000 cattle, 3,500 hogs, and 1,000 sheep were lost to the storm.

A deep snow drift from the 1971 blizzard in northwest Oklahoma

The top 10 Oklahoma snowstorms since 1951 (Table courtesy of the NWS).	
Date	**Highest Amount/Heavy Snowfall Event**
Feb. 21-22, 1971	Highest Snowfall Total: 36 inches in Buffalo.
Feb. 7, 2011Nov. 25, 1992	27 inches in Spavinaw. The snowpack helped contribute to the state record low temperature a few days later of -31°F in Nowata Feb. 1022 inches in Laverne. Heavy snow was confined to a small portion of extreme northwestern Oklahoma.
Mar. 2009	26 inches in Freedom and Woodward.
Nov. 25, 1992	22 inches in Laverne. Heavy snow was confined to a small portion of extreme northwestern Oklahoma.
Mar 16, 1970	20 inches in Bartlesville. Amounts of a foot or more were reported along the Kansas border
Mar. 13, 1999	19 inches in Medford.
Mar. 4-5, 1989	18 inches in Kansas, Oklahoma. Near-blizzard conditions occurred from south central through southeast Oklahoma.
Jan. 18-19, 1990	18 inches in Goodwell. Between 12 and 18 inches fell in the western two-thirds of the Oklahoma Panhandle.
Dec. 22-24, 1997	18 inches in Laverne.
Mar. 18-19, 1999	18 inches in Kenton.

3.2.3.5. Probability of Future Events:

There is a **Highly Likely** probability of future Winter Storm events in Oklahoma.

Calculated Priority Risk Index (CPRI)

Winter Storms/Ice/Freezing Rain = 3.15

Probability			3 Likely	
Magnitude/Severity			4 Catastrophic	
Warning Time			2 12-24 Hours	
Duration			3 Less than one week	
The CPRI for the Winter Storms hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (4 x .30)	+ (2 x .15)	+ (3 x .10)	= 3.15

Resources:
Archived data from the Oklahoma Mesonet
Archived information from the Oklahoma Climatological Survey
The National Climate Data Center's (NCDC) Storm Events Database
The Federal Emergency Management Agency (FEMA)
The National Weather Service (NWS)

3.2.3.6. Vulnerability and Impact:

Winter storms can be accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chill. Especially when coupled with ice accumulation, the strong winds with these intense storms can knock down trees, utility poles, and power lines.

Extreme cold often accompanies a winter storm or is left in its wake. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening. Infants and elderly people are most susceptible. Freezing temperatures can cause severe damage to crops and other critical vegetation. Pipes may freeze and burst in homes or businesses that are poorly insulated or without heat. Structure fires occur more frequently in the winter due to lack of proper safety precautions with heaters and present a greater danger because water supplies may freeze and impede firefighting efforts. People can die of hypothermia from prolonged exposure to the cold. Indigent and elderly people are most vulnerable to winter storms and account for the largest percentage of hypothermia victims largely due to improperly or unheated homes, but the leading cause of death during winter storms is from automobile or other transportation accidents.

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

Heavy snow can immobilize an area and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, repairing damages, and loss of business can have large economic impacts on cities and towns.

3.2.3.7. Vulnerable Populations:

Virtually all of Oklahoma is vulnerable to winter storms. Winter storms are considered deceptive killers as they indirectly cause transportation accidents, injury and death from exhaustion and overexertion, hypothermia and frostbite from wind chill, and asphyxiation from unvented heaters and improper use of generators.

The highest vulnerability associated with a winter storm would be a severe winter storm hitting a major city such as Oklahoma City or Tulsa and their surrounding communities. Roads, bridges, utilities, and communications systems could be greatly impeded or completely brought to a total stop. Transportation and emergency response would be hampered in the least and utilities such as electricity, water, gas, sewer, and communications could be totally shut down. Buildings could become snow and ice laden and collapse. The elderly and young children are vulnerable to the cold temperatures and without power or other forms of heat could become sick or fall victim to the cold temperatures. State, local, and federal facilities located in the winter storm area would also be shut down and operations greatly hindered. Broken and falling tree limbs would endanger people, power lines, vehicles, and buildings they happen to fall on or strike. Severe winter storms often paralyze whole communities. State and local governments, charities, and others are often hard pressed to furnish shelter, food and warmth to the citizens of the jurisdiction. Other critical facilities such as police, fire, and medical are over-taxed and burdened with an excess of calls and medical emergencies. Without backup power these institutions often become unable to operate due to lost communications and power. The elderly, young children and homeless people are most vulnerable to extreme cold temperatures.

3.2.3.8. Conclusion:

History has shown that Oklahoma's winter storms can be dangerous and devastating. Since year 2000, Oklahomans have suffered the effects of a series of disastrous ice storms that crippled the state with downed trees and power lines causing extended power outages. The storms together caused over a billion dollars in damage to structures and cost at least 102 individuals their lives. State-owned property is vulnerable to winter weather. Concerns may arise over critical facilities such as electric lines, and communications towers being affected as well as highways that may be closed due to drifting or ice conditions. As has been illustrated, every county in Oklahoma is at risk for winter storms, including snow, ice, and freezing rain.

3.3.4 Drought

Above picture is of a dry farm pond near Buffalo, OK, taken on January 10, 2012, during an extreme drought. The pond is spring fed and normally maintains water year round, even during previous dry periods. (*Credit: Gary McManus*)

Hazard Priority # 4

3.2.4.1. Description:

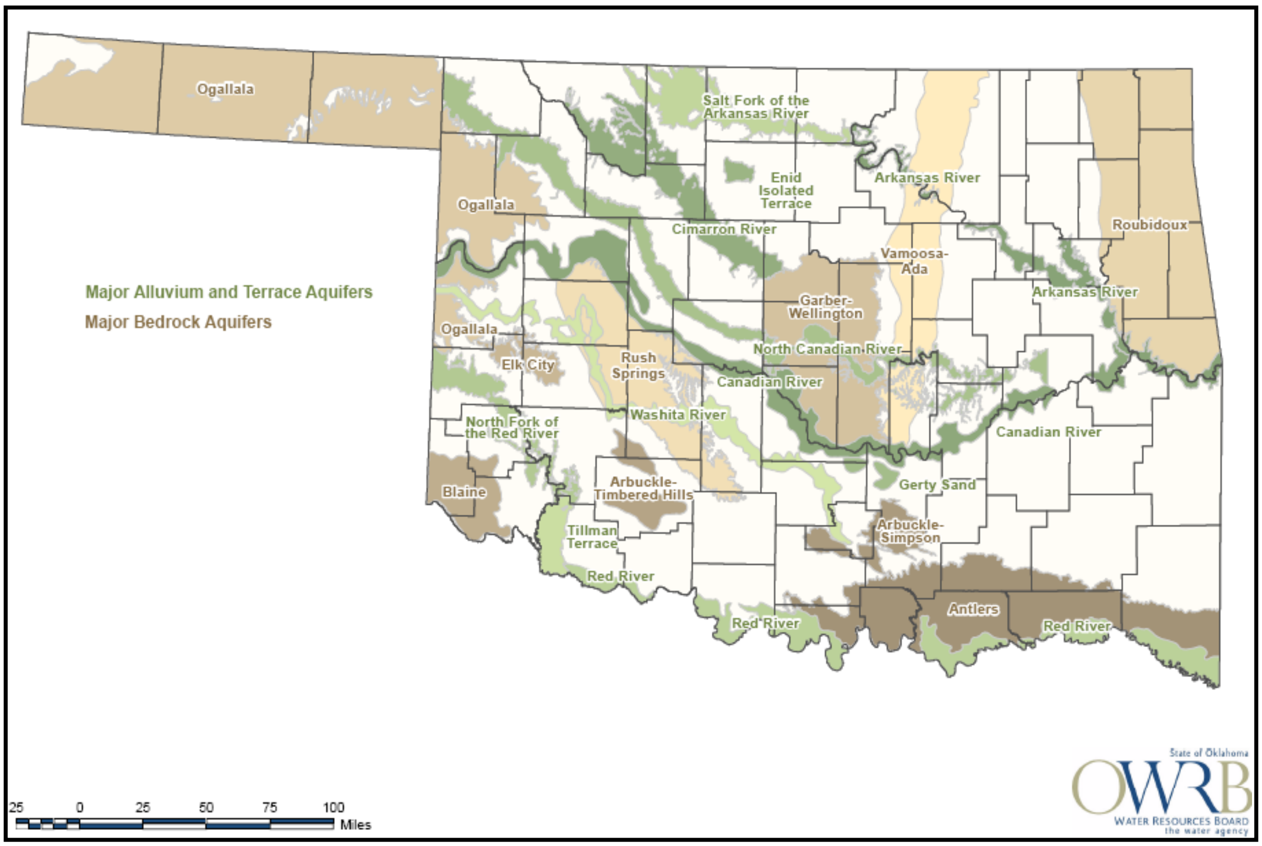
Drought is a very complex natural phenomenon because its very identity is intimately tied to society. There is no single universal definition of drought, but perhaps the most widely accepted definition is deceptively simple: drought occurs when the water resources (*supply*) are unable to meet established water needs (*demand*). This definition identifies two distinct factors in determining the existence or severity of a drought:

1. The available supply of usable water, which is heavily influenced by natural factors.
2. The demand for water, which is heavily influenced by social customs.

Oklahoma and several of its Plains States neighbors differ from much of the rest of the country, especially the West, in that it imports very little surface water through rivers. The vast majority of water used in Oklahoma falls in Oklahoma, unlike many western states that rely on precipitation from other parts of the country for their water needs. This simplifies the assessment of drought somewhat for Oklahoma, such that precipitation versus historical values is a strong indicator of drought severity.

Drought's ability to produce widespread economic damage is far greater than that of violent weather. In fact, the numbers associated with drought damage are staggering. On a national scale, 16 of the 133 billion-dollar disasters from 1980-2011 were related to drought or associated heat. However, those 16 disasters accounted for nearly a quarter (23.8%) of the group's economic damage.

Precipitation (rain or snow) falls in uneven patterns across the state. When no rain or only a small amount of rain falls, soils dry out and plants brown during the growing season. When rainfall is less than normal for several weeks, months, or years the flow of streams and rivers declines, water levels in lakes and reservoirs and aquifers fall, causing the depth of water in wells to decrease; however, a period of below-normal rainfall does not necessarily result in drought conditions. If dry weather persists and water supply problems develop, the dry period can become a drought. The first evidence of drought usually is seen in records of decreased rainfall. Within a short period of time, the amount of moisture in soils can begin to decrease. The effects of a drought on flow in streams and rivers or on water levels in lakes and reservoirs may not be noticed for several weeks or months. Water levels in wells may not reflect a shortage of rainfall for a year or more after the drought begins due to aquifer availability.



Oklahoma's Aquifers – provided by Oklahoma Water Resources Board

A variety of measures are used to predict the severity and impact of droughts, but each one measures different aspects or types of drought. Any single index cannot describe everything about the original data, and the indices are only approximations of real-world phenomena. According to the National Drought Mitigation Center, there are four types of drought:

1. Meteorological drought is based on precipitation departures from normal, and is often a strong indicator of short-term drought.
2. Hydrological drought refers to deficiencies in surface and subsurface water supplies and is often a strong indicator of long-term drought. It is measured as stream flow, and as lake, reservoir, and ground water levels.
3. Agricultural drought occurs when there isn't enough soil moisture to meet the needs of a particular crop at a particular time.
4. Socioeconomic drought is when a lack of water starts to affect people, communities, and the economy.

3.2.4.2. Location:

Drought may be experienced anywhere in the State of Oklahoma.

3.2.4.3. Extent:

One way drought conditions can be monitored is through the U.S. Drought Monitor. This is a tool used to monitor rainfall trends and determine how harsh current drought impacts might be. It gives a good idea not only of the lack of rainfall as compared to normal values, but an assessment of drought based on agriculture and reservoir conditions as well. There are five different categories on the drought monitor. D0 is abnormally dry, D1 is a moderate drought, D2 is a severe drought, D3 is an extreme drought, and D4 is an exceptional drought. It should be noted, however, that the Drought Monitor focuses on broad-scale conditions and that local conditions may vary.

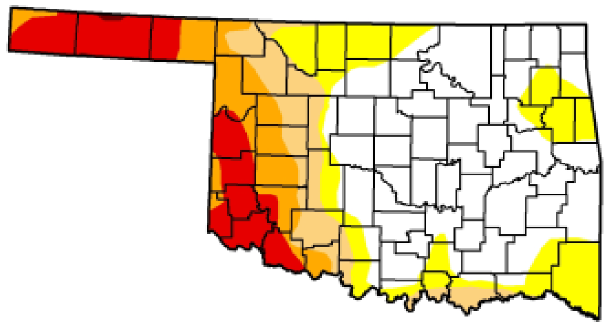
U.S. Drought Monitor

August 13, 2013
Valid 7 a.m. EST

Oklahoma

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	49.40	50.60	32.98	22.62	12.57	0.19
Last Week (08/06/2013 map)	45.72	54.28	37.94	32.04	21.91	4.47
3 Months Ago (05/14/2013 map)	17.40	82.60	67.93	52.78	32.60	9.53
Start of Calendar Year (01/01/2013 map)	0.00	100.00	100.00	100.00	94.89	37.06
Start of Water Year (09/25/2012 map)	0.00	100.00	100.00	99.98	95.33	42.09
One Year Ago (08/07/2012 map)	0.00	100.00	100.00	100.00	96.78	16.03



Intensity:

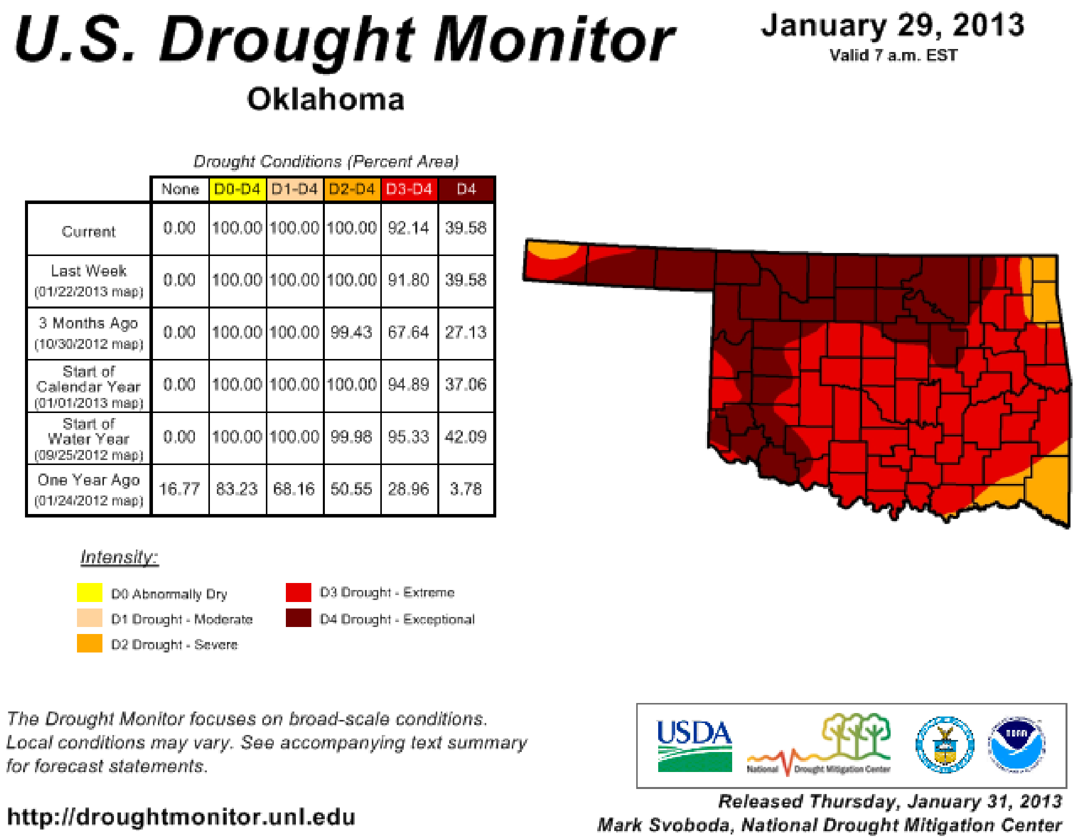
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu

USDA National Drought Mitigation Center

Released Thursday, August 15, 2013
Michael Brewer, National Climatic Data Center, NOAA



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	100.00	92.14	39.58
Last Week (01/22/2013 map)	0.00	100.00	100.00	100.00	91.80	39.58
3 Months Ago (10/30/2012 map)	0.00	100.00	100.00	99.43	67.64	27.13
Start of Calendar Year (01/01/2013 map)	0.00	100.00	100.00	100.00	94.89	37.06
Start of Water Year (09/25/2012 map)	0.00	100.00	100.00	99.98	95.33	42.09
One Year Ago (01/24/2012 map)	16.77	83.23	68.16	50.55	28.96	3.78

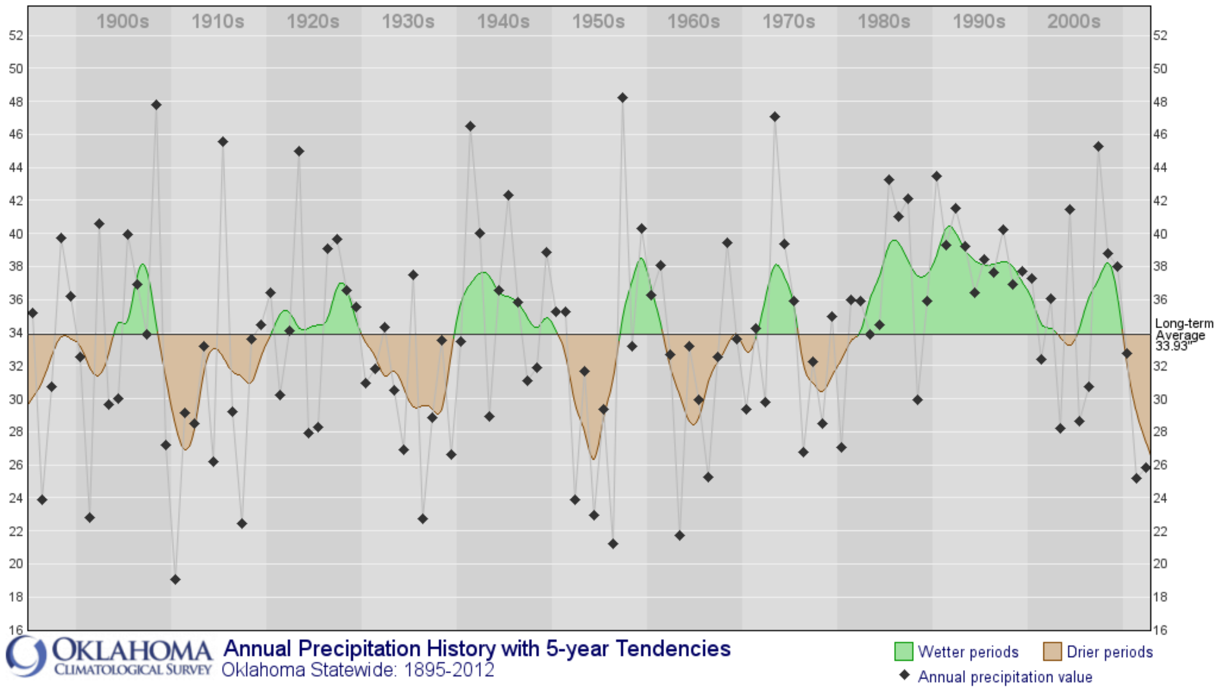
Please note the difference between the January 29, 2013 Drought Monitor, and the August 13, 2013 Drought Monitor, showing changes in statewide drought conditions after record breaking rains occurred.

Based on the intensity scale above, the State of Oklahoma considers a reading of D2 and below to be a minor severity and a reading of D3 and above to be a major severity.

3.2.4.4. Previous Occurrences:

Drought is a “creeping hazard” that is a recurring and a natural part of Oklahoma’s climate cycle. It does not produce images and descriptions as compelling as those of violent weather. Despite the relative inattention paid to drought, its larger coverage and longer timescales make it Oklahoma’s costliest natural hazard.

Drought returned to Oklahoma in October 2010 and was still ongoing at the start of 2013. This most recent drought has paralleled Oklahoma’s major drought periods in the 1950s and 1930s, but has not yet matched their nearly decade long duration. Low lake levels threatened water supplies causing jurisdictions all over the state to seek alternate ways of meeting the public demand for water. Some cities drilled additional wells while others are building pipelines to distant lakes to pump water in when necessary. State agricultural interests were hardest hit, especially in western Oklahoma where even native grass cover on grazing lands has been depleted. As seen on the state precipitation history graph, Oklahoma had generally been experiencing a 30-year wet period from about 1980-2010. This caused many communities and businesses to become accustomed to above normal precipitation. Since modern climate observation began in the mid-1890s, the three long-term drought episodes have occurred from 1909-1918, 1930-1940, and 1952-1958.

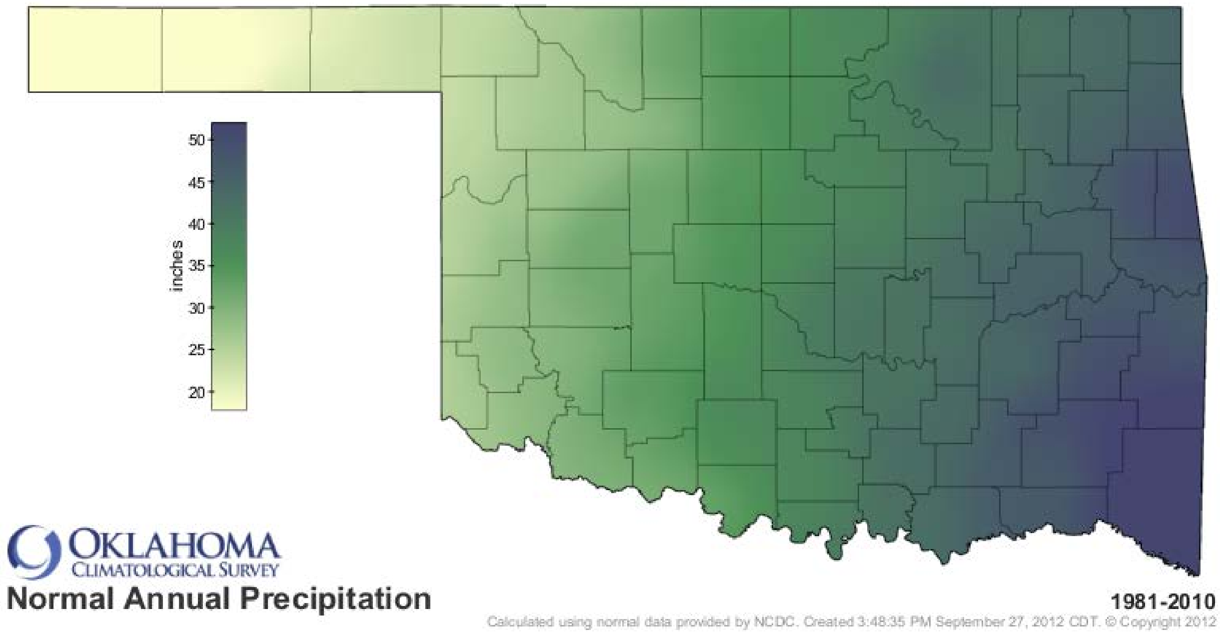


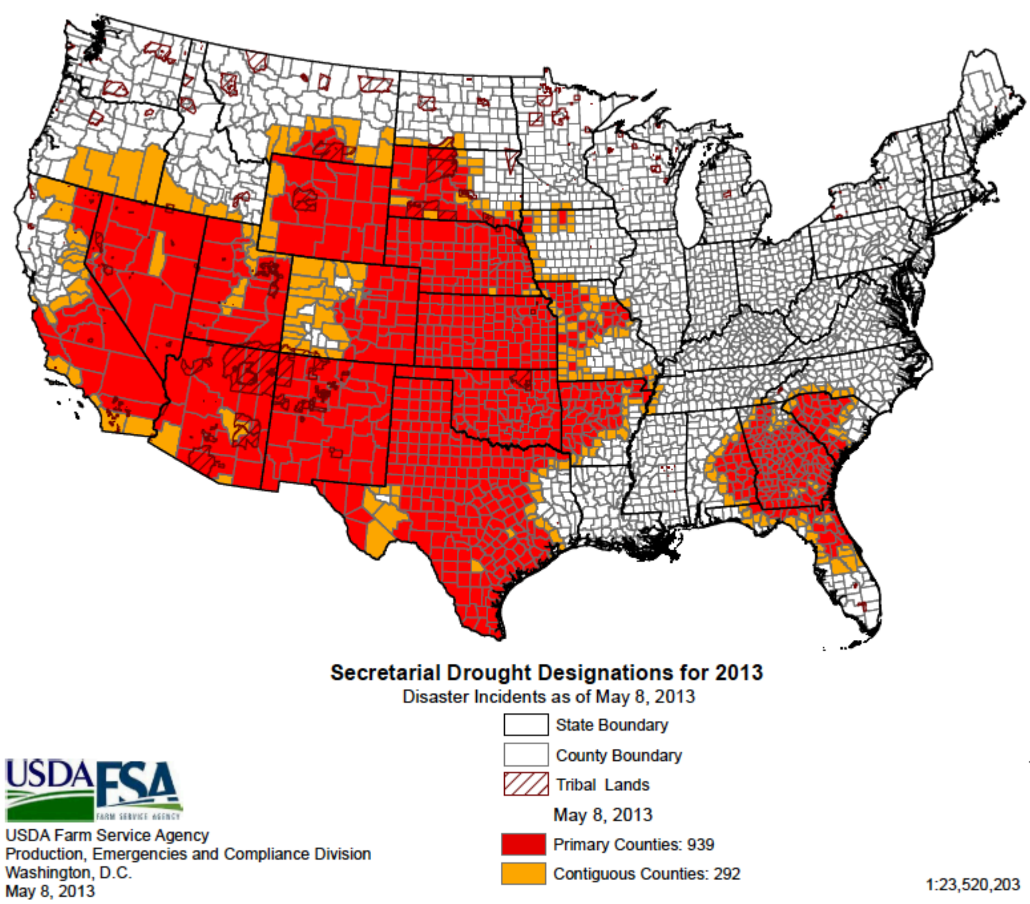
A severe drought impacted all regions of Oklahoma, beginning in February 2005 and finally terminating by April 2007. Oklahoma's wheat crop in 2006 was particularly hard-hit, posting the lowest yield since the major drought years of the 1950s. The cattle industry was similarly impacted, as the cost of hay exceeded twice the normal price. Many cattlemen were forced to sell off part or all of their herds because there was no hay available at any price. This drought also led to one of the most severe wildfire episodes in State history (FEMA DR-1623) which claimed many lives.

The drought of 2005-2006 was preceded by several smaller episodes, dating back to a severe wintertime drought of 1995-1996. Fire management assistance was frequently requested during these events, particularly during spring 1996, spring 1998, fall 2000, and winter 2005-2006. The 1995-1996 drought in the Southern Plains caused an estimated $5 billion damages, with at least $1 billion in Oklahoma alone. Thereafter, short summertime droughts occurred in 1998 and 2000. A longer drought, similar to the 1995-1996 events in timing, occurred from mid-2001 into mid-2002. Agricultural losses again approached $1 billion.

The map below depicts normal annual precipitation across Oklahoma. In a typical year precipitation is abundant in the east, with up to about 50 inches observed, and decreases to the west, with only about 20 inches annual precipitation in the panhandle. Much of this falls as rain in May and June as springtime thunderstorms form off the high plains and track eastward across the state. Therefore, deficient rainfall during spring in Oklahoma predisposes the state for a year of drought. The already marginal rainfall climate in western Oklahoma results in water becoming very scarce during drought.

Agricultural produces in the west must rely almost entirely on irrigated water from aquifers and deep groundwater wells when dry conditions persist.





The 2013 USDA drought designations, showing all Oklahoma counties in drought disaster

Significant Oklahoma Drought History

(Information provided by National Weather Service, Oklahoma Climatological Survey, and the National Climate Data Center.)

October 2010-January 2013

All 77 Oklahoma counties have been declared a disaster area by the U.S. Department of Agriculture because of the ongoing drought. The declaration means farmers in the affected counties can apply for low-interest loans of 2.15 percent. Extreme summer heat has accompanied this drought, resulting in very high evaporation rates off reservoirs and drying soils. Some of the records Oklahoma observed during this drought include the warmest summer on record in 2011, the driest May-December period on record in 2012, and the warmest year on record in 2012. Oklahoma State University researchers estimated the state suffered at least $2 billion in losses, mostly agricultural, from the 2011 and 2012 drought.

2005-2006

In 2006 the USDA declared all 77 Oklahoma counties a drought disaster. Drought levels ranged from severe to exceptional, with the driest conditions in SE Oklahoma. Wildfires became a serious problem also during this period, throughout most of the state. Dry conditions in the summer of 2006 maintained an increase in wildfire potential across the region with burn bans being issued by the state. Many communities continued to institute voluntary or mandatory water rationing programs. Low lake levels caused problems for recreation and wildlife. Two fish kills were reported. One occurred at Great Salt Plains Lake in Alfalfa Co. in northern Okla. Officials estimated 10,000 fish were killed due to the low water levels and hot temperatures. Another fish kill occurred on Lake Texoma in south central Okla. Several thousand fish were found dead in the Wilson Creek Cove area of the lake. For the recreation industry, some lakes were closed to boating, swimming, and fishing. Receding shorelines caused many boat ramps and docks to become dry. Boaters on area lakes also had several accidents due to the low water levels bringing objects on the floor of the lakes closer to the surface. The agriculture community continued to be hit hard by the drought conditions. Okla. was declared a disaster area allowing federal assistance. Ranchers and farmers continued to sell part or all of their livestock herds due to dried up farm ponds, lack of pasture land, and the lack of hay. Summer crops were also affected by the dry conditions. Officials say part of the cotton crop suffered from the dry and hot conditions. Those crops or areas that rely on irrigation were also adversely affected by the drought. The estimated loss in agricultural production alone in Oklahoma was $500 million.

2001-2002

Most of the northwestern two-thirds of Oklahoma suffered from protracted drought from late spring 2001 through early summer 2002. The drought of 2001-02 was the last (and longest, at places) of a series of dry episodes dating to the winter of 1995-96. The timing, location and duration of the event made it most damaging to Oklahoma's agricultural sector. Agricultural disaster was declared in 30 Oklahoma counties. The largest sectors to be adversely affected were winter wheat producers and those livestock operations that rely on what for winter forage. Row crops were injured by the lack of rainfall and associated heat wave during summer 2001. Hay operations also suffered greatly from the event. The wheat harvest of spring 2002 was severely damaged. At the time the Panhandle recorded the 2nd-driest Jun-Jul (14 mos.) period on record; west central and N central experienced 5th-driest and

6^{th}-driest Jun-May on record, respectively. The estimated agricultural loss from this drought was $1 billion.

August 2000
An extended period of unusually dry weather began in early August and lasted for 2 months. Many parts of the state did not receive rain in August, with portions of southwest and south central Oklahoma remaining dry for almost 90 days, starting in June. August 2000 was Oklahoma's driest on record with only .14 inches average statewide precipitation. Due largely to Oklahoma's major crops of wheat, cotton, and peanuts, which greatly suffered, total agricultural losses were estimated at over $600 million statewide. Seven Oklahoma counties near the Texas border, including Carter, Comanche, Cotton, Jefferson, Love, Marshall, and Tillman, were declared federal disaster areas. Reservoir levels were also low across SW and south central Okla., averaging 50 percent of normal.

July 1998
A devastating drought and heat wave affected SE Oklahoma farmers during the month of July. At McAlester, the only rainfall during July was 0.19" on the first two days of the month. The SE Oklahoma climate division (which includes Choctaw, Pushmataha, Latimer and Le Flore Counties) received 50 percent of normal rainfall from May 1 through July 31. By the end of July, the Palmer Drought Index classified SE Oklahoma as being in the midst of a "severe drought", while east-central Okla. was experiencing "moderate drought". From a historical perspective, the period from June 1-July 31 was the third driest on record in SE Okla., while the period from April 1-July 31 was the fourth driest on record in east-central Oklahoma. When combined with 100+ degree temperatures on 24 out of 31 days during the month (at McAlester) and relative humidity's under 25 percent on many afternoons, crops stood little chance of survival. The Oklahoma Agriculture Secretary estimated crop damage throughout Oklahoma at $2 billion, of which $500 million might have taken place in southeast and east central Oklahoma. The President declared the counties listed here as a drought disaster area, nine of sixty-six counties throughout southern and central Oklahoma receiving this designation.

August 1995- May 1996
There was extreme drought during this period, especially in the southeast part of the state. Drought effects were felt especially hard in the timber, livestock, and poultry industry. Many lakes and reservoirs suffered near record low water levels. The fire season was also disastrous.

1952-1956
Drought was accompanied by intense summer heat, insect invasions and crop failures. The State's "Wheat Belt", in central and north-central Oklahoma, was particularly injured by the event. The mid-50s years of 1952-1956 were easily the driest five consecutive years in State history. Ironically, 1957 was the wettest year on record, one year after 1956 became the second-driest year on record.

1930-1940
The drought in Oklahoma during this period was not as statistically severe as those of the 1910s or 1950s, but the events of the Dust Bowl left the deepest scar on the State's economy and psyche. The Dust Bowl was at its worst in Oklahoma during the mid 1930s, when severe drought, intense heat, poor agricultural practices and overall economic conditions combined to cause the greatest exodus of citizens in State history. Reaction to the event revolutionized farm and conservation practices in much of the U.S.

1909-1918

Drought consisted of two severe multi-year episodes, interrupted by 1915, one of the wettest years of the 20th Century. This event comprises the lowest ten-year statewide rainfall on record. 1910 was the smallest annual rainfall Statewide and for four of Oklahoma's nine climate divisions.

3.2.4.5. Probability of Future Events:

All counties in the State of Oklahoma have a Likely probability of future drought events.

Shifting air patterns in the equatorial Pacific due to La Nina can lead to the disruption of normal weather patterns across the globe. The La Nina climate phenomenon is marked by cooler than normal waters off the west coast of South America. The impacts most common in the United States are above normal temperatures and below normal precipitation across the southern one-third of the country, and cooler and wetter than normal weather in the Pacific Northwest and Ohio Valley. The impacts due to La Nina are normally strongest from late fall through early spring in the Southern Plains, although not every La Nina season is the same. La Nina years, as identified by the Climate Prediction Center, favor drought in Oklahoma.

Calculated Priority Risk Index (CPRI)

Drought = 3.1

Probability			3 Likely	
Magnitude/Severity			4 Catastrophic	
Warning Time			1 24+ Hours	
Duration			4 More than one week	
The CPRI for the Drought hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (4 x .30)	+ (1 x .15)	+ (4 x .10)	= 3.1

Resources: Oklahoma Climatological Survey; Oklahoma Mesonet; Oklahoma Water Resources Board; National Drought Mitigation Center; National Integrated Drought Information System; National Weather Service

3.2.4.6. Vulnerability and Impact:

Throughout history, Oklahoma has been susceptible to drought. Short-term events (1-2 months) are fairly common, and tend to occur somewhere within the State during most years. Increased fire danger and/or crop stress often accompanies these episodes. Medium-term (up to a year) drought episodes can encompass a crop cycle, causing significant economic damage, or water supply/distribution problems for municipalities. Longer-term droughts (several years) add the issue of reservoir and aquifer depletion. Because these long-term events are often composed of intermittent episodes, their onset and conclusion are often difficult to identify until long after the event is over.

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services.

Impacts are commonly referred to as direct or indirect. Reduced crop, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. The consequences of these impacts illustrate indirect impacts. For example, a reduction in crop, rangeland, and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime and foreclosures on bank loans to farmers and businesses, and disaster relief programs.

Not all impacts of drought are negative. Some agricultural producers outside the drought area or with surpluses benefit from higher prices, as do businesses that provide water-related services or alternatives to water-dependent services.

Economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the dependence of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and diseases to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher risk.

Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Reduced income for farmers has a ripple effect. Retailers and others who provide goods and services to farmers face reduced business. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue for local, state, and federal government. Less flexible income affects the recreation and tourism industries. Prices for food, energy, and other products increase as supplies are reduced. In some cases, local shortages of certain goods result in the need to import these goods from outside the stricken region such as hay for cattlemen. Hydropower production may also be curtailed significantly.

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; decay of landscape quality; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary abnormality. The decay of landscape quality, including increased soil erosion, may lead to a more permanent loss of natural production of the landscape. Although environmental losses are difficult to measure, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Social impacts mainly involve public safety, health, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts specified as economic and environmental have social components as well. During the warm season, municipalities are often faced with more demand for water than they are able to distribute. This leads to rationing and curtailment, and businesses that rely on heavy water usage (car washes, landscapers) may suffer financially.

Longer-term droughts threaten the water supply itself. During extended droughts, declining aquifers reduce stream flows. Coupled with high evaporation, lake levels may drop rapidly, negatively impacting municipal and rural water supplies. Grand Lake, in northeastern Oklahoma, generates hydropower, which may also be affected by low lake levels. In addition, navigation in the Kerr-

McClellan Waterway, along the Arkansas River, may be diminished by low stream flows and low storage from upstream reservoirs.

Municipalities may be adversely affected during an extended drought. Municipalities often rely on water sales for revenue especially in smaller communities, where the water utility makes up a majority of the operating budget. Because of this, communities often operate their water systems at maximum capacity until the extended drought forces them to curtail consumption. Citizens are then left with severe usage restrictions when supplies are depleted.

Timescale of Drought Vulnerability

Drought Issue or Vulnerable Community	Approx. Time Scale of Onset	Some Prominent Impacts	Approx. Avg. Time Between Significant Events on This Time Scale	Contributing Factors and Circumstances	Related Notes
Drought-Enhanced Wildfire Danger	1-2 months	Dried organic soil material can act as additional fuel to wildfire; more frequent wildfires; more intense wildfires	Fairly common. Tends to occur at least somewhere in the State during most years.	Time since last burn; density of undergrowth (often enhanced by preceding prolonged wetness); severity of drought.	Somewhat seasonal.
Horticulture / Urban, Suburban Lawns	1-2 months	Increased municipal water use; horticultural failure; lawn damage; increased pest damage	Somewhat common. Most growing seasons will undergo one or two fairly dry months. Consecutive dry months are slightly rarer.	Effectiveness of conservation and mitigation practices; severity of drought; severity of heat.	Highly Seasonal.
Municipal Water Distribution	1-2 months	Short-term water rationing (on the order of weeks); loss of revenue for water-use-dependent municipalities	Somewhat common.	Capacity and quality of distribution system; quality of conservation and mitigation practices; severity of drought; severity of heat.	Highly seasonal.
Agriculture	2-6 months	Crop failure; poor crop yield; depressed livestock prices due to sell-offs.	Severe drought-related losses struck 6-8 times since 1980 (note: highly variable by crop). Catastrophic failures occur 1-2 times per decade *on*	Timing of event versus crop cycle; availability and cost of irrigation water; agricultural techniques; conservation practices; crop	Highly tied to crop cycle; example: very dry Apr-May can help wheat

Timescale of Drought Vulnerability					
			average.	selection; drought-tolerant varieties.	harvest while destroying row crops.
Reservoir depletion	1+ years	Severe, prolonged rationing; widespread water shortages; irrigation denied		Effectiveness of conservation and mitigation practices; demand; size and engineering of reservoir.	Smaller reservoirs are more sensitive at shorter timescales.
Aquifer depletion	10+ years	Widespread farm & ranch failure;	Many aquifer levels are dropping in recent decades.	Financial / physical ability to drill deeper; demand.	Still little known about aquifer depletion

3.2.4.7. Vulnerable Populations:

Agriculture is an important industry in the State of Oklahoma. Historically, cotton was the leading cash crop, but this has been succeeded by wheat. Other leading crops include hay, peanuts, sorghum, and soybeans.

Livestock and livestock products make up the much of Oklahoma's yearly farm income. Most of the state's cattle ranches are concentrated in the Panhandle and northern portions of Oklahoma. Poultry and hogs are also significant sources of income and are raised primarily in the eastern half of the state. The cattle industry is the largest agricultural industry in Oklahoma. In all droughts, agriculture feels the impact, especially in non-irrigated areas such as dry land, farms and rangelands.

Other heavy water users, from landscapers to the local car wash, may also be negatively impacted. Water-related activities of residential users may be restricted such as watering lawns, filling swimming pools or washing vehicles.

Even the northeastern area of Oklahoma referred to as "Green Country", because of its forests, lakes and streams can still be impacted by drought. The big lakes in this area such as Keystone, Eufaula, Tenkiller, Broken Bow and Fort Gibson have been affected by low water levels which cause disruption in normal water supplies and recreation for numerous communities.

Power supplies throughout Oklahoma can be adversely affected by low water levels at hydroelectric dams. When this occurs, heavy electrical users may be affected if utilities have to resort to a more expensive replacement power.

3.2.4.8. Conclusion:

Interplay between the natural event (lack of rainfall), the demand people place on water supply, and human activities all serve to exacerbate the impacts of drought. However, improved agricultural practices such as crop selection have lessened the impact of drought. Conservation practices have improved dramatically since the 1930's when drought conditions led to the loss of much of western Oklahoma's topsoil. Two decades later, shelterbelts, terrace farming and retention ponds helped minimize topsoil loss due to erosion, practices which continue today.

Surface water storage was much more prevalent during the 1950's, compared to just two decades before. More dams were built in the 1950's than ever before or since in Oklahoma. Ironically, most of the structures were primarily intended for flood control, but have paid great dividends as irrigation sources.

State property managers can engage in drought mitigation through water conservation plans, practices, and educational programs. On a local level, conservation and education programs are the best ways to reduce municipal water use.

Improved remote sensing from satellites and radar as well as the use of thousands of precipitation measurements daily have improved the ability to monitor drought, but the most exciting developments in mitigating drought may be advances made in forecasting the conditions that *cause* drought. Meteorologists at the Climate Prediction Center (CPC) of the National Weather Service are using medium-range models to forecast soil moisture two weeks into the future. For the longer term, they are using statistical techniques and historical drought information to construct analogues to current conditions. They then create forecasts up to several seasons ahead. CPC is also using sophisticated computer models that link ground and ocean conditions to the overlying atmosphere to create forecasts of temperature, precipitation, and soil moisture months ahead of time.

3.3.5 Hail:

Hazard Priority # 5 (Hail)

Baseball size hail (quickly melting) following a severe thunderstorm in Moore, which also produced an EF4 tornado May 10, 2013. *(Credit: Alek Krautmann)*

3.2.5.1 Description:

While flooding is the most deadly severe thunderstorm hazard, hail is the most costly. In recent years, the average U.S. annual loss from hail due to property and crop damage has been about $1.5 billion. Hail size can range from smaller than a pea to, in rare cases, a softball or larger, and can be very destructive to buildings, vehicles and crops. The state record for hail stone diameter is 6”, which was observed May 23, 2011, two miles north of Gotebo, according to Oklahoma Climatological Survey. Large hailstones can fall at speeds faster than 100 mph.

Hail is a form of solid precipitation that consists of balls or irregular lumps of ice, which are individually called hailstones. Hail formation requires an atmospheric environment of strong, upward moving air, called an updraft, within the subfreezing region of a thunderstorm cloud. Large hail stones greater than an inch in diameter (quarter size), can result from a severe thunderstorm and require a very powerful updraft to form. Most large hail is the product of supercell thunderstorms, which have a sustained rotating updraft that moves growing hailstones a long distance through the height of the cloud before falling to the ground. Unlike ice pellets, hailstones are layered and can be irregular and clumped together. Hail is composed of transparent ice or alternating layers of transparent and translucent ice, which are deposited upon the hailstone by alternating wet or dry deposition processes as it travels upward through the cloud until it exits the updraft and falls to the ground.

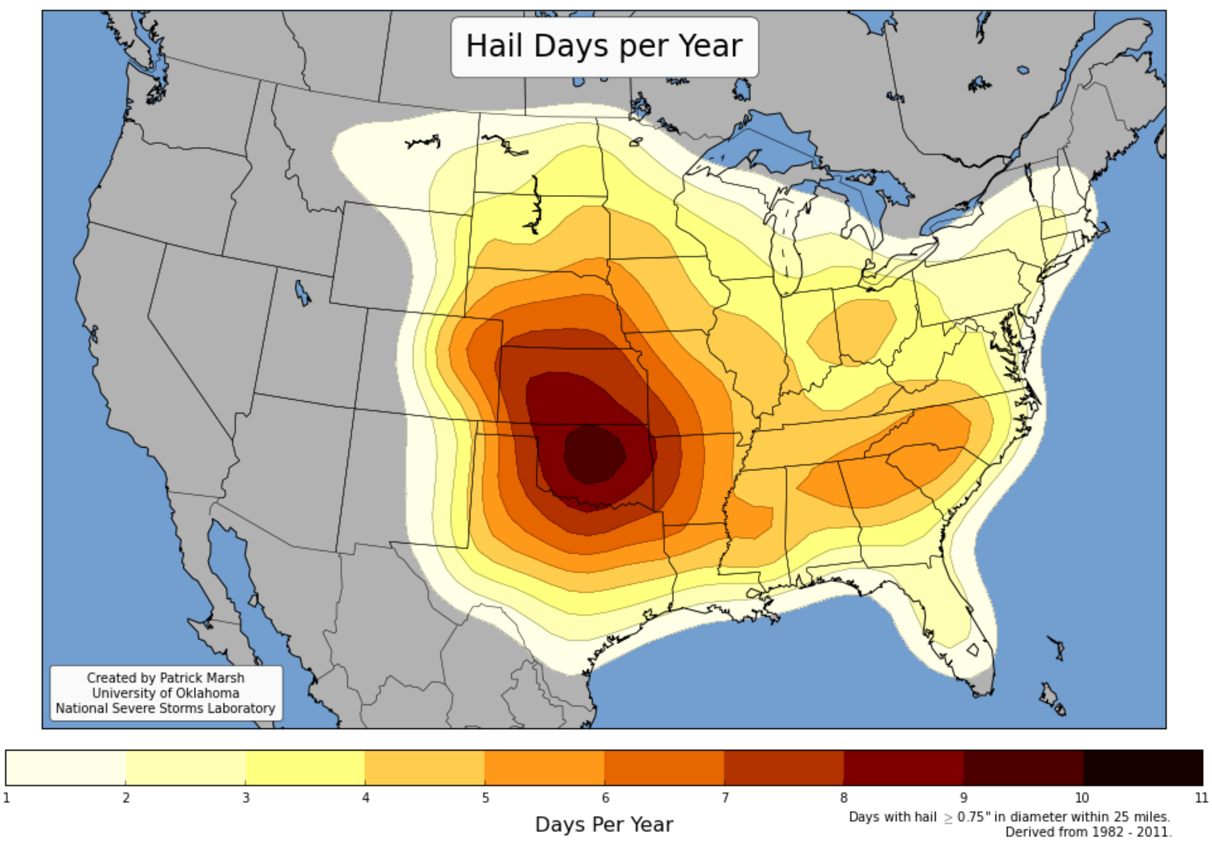
Weather radar imagery can detect the presence of hail in a thunderstorm. The National Weather Service issues a severe thunderstorm warning when hail one inch or larger in diameter is possible, as it can cause serious damage to man-made structures and farm crops. Hail typically falls for only a few minutes at a given location, but a sustained hail producing supercell thunderstorm can cycle through multiple rounds of production over many miles in length.

3.2.5.2 Location:

The entire State of Oklahoma is at risk from Hailstorms.

3.2.5.3 Extent

The map below depicts the average number of hail days per year, of size ¾ inch or greater within 25 miles of a given point. By this measure, Oklahoma observes the most large hail days per year of anywhere else in the country.



Combined NOAA/TORRO Hailstorm Intensity Scales

SIZE CODE	INTENSITY CATEGORY	TYPICAL HAIL DIAMETER (INCHES)	APPROXIMATE SIZE	TYPICAL DAMAGE IMPACTS
H0	Hard Hail	up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33-0.60	Marble	Slight damage to plants, crops
H2	Potentially Damaging	0.60-0.80	Dime	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
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

Even small hail can cause significant damage to young and tender plants. The peak periods for Oklahoma hailstorms, late spring and early summer, coincide with the agricultural growing season. The State of Oklahoma considers any hail of H4 or higher on the NOAA/TORRO hail scale to be a Major Severity and an H3 and below a minor severity.

3.2.5.4 Previous Occurrences:

The table below lists the 20 most damaging Oklahoma hail events since 1993, as reported by NCDC.

20 MOST DESTRUCTIVE HAIL EVENTS – 1993 - 2012

Location	Date	Time	Hailstone size	Deaths	Injuries	Property Damage $
1 Oklahoma City	05/29/2012	1919	3.00 in.	0	0	450M
2 Oklahoma City	04/21/2004	1541	2.75 in.	0	0	100M
3 Jenks	04/05/2005	1525	3.00 in.	0	0	65M
4 Norman	11/05/2008	1639	1.75 in.	0	0	40M
5 Tulsa	11/18/2003	0950	2.75 in.	0	0	20M
6 Waurika	03/29/1993	2305	2.75 in.	0	0	5M
7 Ada	04/02/1994	1842	2.50 in.	0	0	5M
8 Bromide	04/26/1994	1301	2.00 in.	0	0	5M
9 Altus	04/15/2000	1726	2.75 in.	0	0	2.6M
10 Poteau	01/21/1999	1815	1.75 in.	0	0	2.6M
11 Tulsa	03/26/2000	1630	2.50 in.	0	0	2M
12 Bartlesville	05/08/2000	2228	4.50 in.	0	0	2M
13 Tulsa	05/05/2000	2008	2.75 in.	0	0	1M
14 Bartlesville	05/20/2001	1845	1.75 in.	0	0	1M
15 Miami	05/04/2003	1700	2.75 in.	0	0	1M
16 Tulsa	04/08/2008	0227	1.75 in.	0	0	1M
17 Hennessey	04/21/1999		1.75 in.	0	0	1M
18 Tulsa	05/06/2000	0306	2.50 in.	0	0	500K
19 Owasso	05/06/2001	1705	1.75 in.	0	0	500K
20 Norman	07/30/2003	0512	1.75 in.	0	0	500K

3.2.5.5 Probability of Future Events:

The entire State of Oklahoma is at risk from hail and the probability of future events is **Highly Likely**.

Calculated Priority Risk Index (CPRI)

Hail = 3.1

Probability	4 Highly Likely
Magnitude/Severity	2 Limited
Warning Time	4 Less than 6 hours

Duration			1 Less than 6 hours	
The CPRI for the Hail hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (2 x .30)	+ (4 x .15)	+ (1 x .10)	= 3.1

Resources:
The National Weather Service
The Storm Prediction Center
National Climatic Data Center

3.2.5.6 Vulnerability and Impact

NCDC reports 22,442 Hail Records for the State of Oklahoma. Virtually all structures, infrastructure and individuals in Oklahoma are vulnerable to hail. Automobiles, roofs, windows and metal siding are severely damaged by large hail. This can result in heavy out-of-pocket costs for underinsured residents, and unexpected costs for municipalities. Oklahoma residents have suffered bruises from large stones. Large hail is also a threat to small mammals and it kills many birds. Large hail is generally two inches in diameter or larger and can cause a great deal of damage. Large hailstones can fall at speeds faster than 100 mph.

3.2.5.7 Vulnerable Populations:

People caught outside, engaging in recreational activities or attending sporting events are most vulnerable, as in many cases they are not notified before a hailstorm arrives. Farmer incomes are affected when crops suffer extreme damages. Oklahoma has a significant hazard due to its climate; the State is southeast of the Rockies which provide the cool air, north of the Gulf of Mexico that provides the moisture, and northeast of the dry hot air from the arid southwest. The highest period of hail is generally through the middle to late spring months of April, May and June, coinciding with Oklahoma's major tornado season.

3.2.5.8 Conclusion:

Oklahoma has significant exposure to hail events. Hail damage to automobiles, roofs, windows and farm crops is staggering although hard data is not available since most of that information is through private insurers. State-owned property is vulnerable to hail as any other property. Damage usually occurs to infrastructure such as power transmission lines and communications towers; however occasional damage can occur to structures. Early warning research is ongoing through the National Weather Service (NOAA) and other private organizations to improve warning and threat information for the public.

3.3.6 High Winds

Hazard Priority # 6

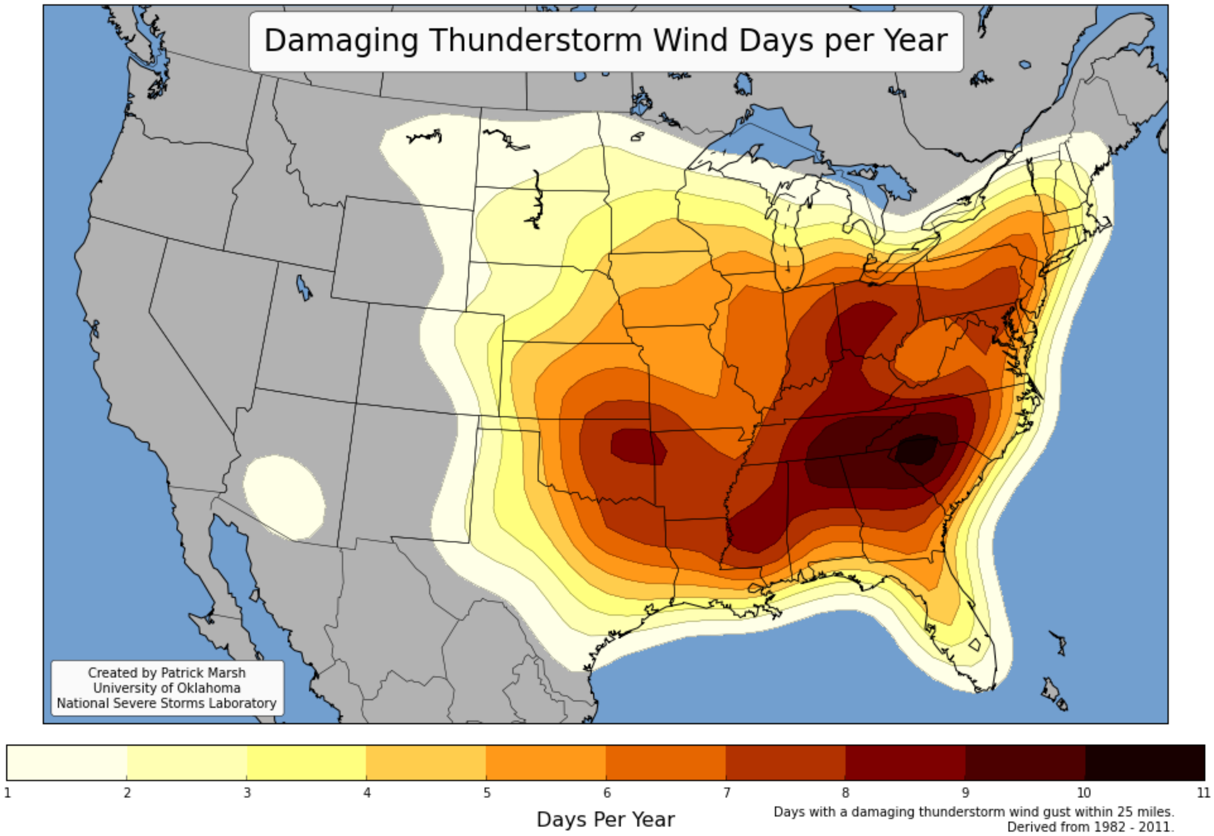
3.2.6.1 Description:

Wind is defined as the movement of air relative to the earth's surface. High winds can result from thunderstorms, strong cold front passages, or gradient winds between high and low pressure moving across Oklahoma. High winds, sometimes referred to as "straight-line" winds, are speeds reaching 58 mph or greater, either sustaining or gusting.

Downdraft winds are a small-scale column of air that rapidly sinks toward the ground, usually accompanied by precipitation as in a shower or thunderstorm. A downburst is the result of a strong downdraft associated with a thunderstorm that causes damaging winds near the ground. These winds can range from light breezes to sustained speeds of 80 to 100 mph. Any efforts made to mitigate for tornadoes or thunderstorm winds should address the hazard of high winds. After a thunderstorm, straight-line winds are sometimes erroneously attributed by the public to a tornado due the extensive damage that can result.

One type of high wind hazard unique to Oklahoma and other Great Plains state is a heat burst. Especially during the summer in dry conditions, dying evening thunderstorms sometimes no longer accompanied with rainfall can still produce damaging downdrafts. As the maintained downdraft travels to the surface, the air significantly warms. Sudden wind gusts after dark accompanied with a temperature increase of 10°F or more are the hallmarks of a heat burst.

The map below depicts the spatial extent of the average number of days per year of damaging thunderstorm winds within 25 miles of a given point.



3.2.6.2 Location:

The entire State of Oklahoma may experience high winds at any time.

3.2.6.3 Extent:

In April of 2010 NCDC has further defined high winds into three categories for their recording purposes.

High Wind:

- Sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer or winds (sustained or gusts) of 50 knots (58 mph) for any duration (or otherwise locally/regionally defined), on a widespread or localized basis. In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively. The High Wind event name will not be used for severe local storms, tropical cyclones, or winter storm events.

Strong Wind:

- Non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage. Consistent with regional guidelines, mountain states may have higher criteria. A peak wind gust (estimated or measured) or maximum sustained wind will be entered.

Thunderstorm Wind:

- Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. Maximum sustained winds or wind gusts (measured or estimated) equal to or greater than 50 knots (58 mph) will always be entered. Events with maximum sustained winds or wind gusts less than 50 knots (58 mph) should be entered as a Storm Data event only if they result in fatalities, injuries, or serious property damage. Storm Data software permits only one event name for encoding severe and non-severe thunderstorm winds. The Storm Data software program requires the preparer to indicate whether the sustained wind or wind gust value was measured or estimated.

The State of Oklahoma considers a wind gust of 58mph and above to be a major severity. Indications of a severe wind gust include large tree branches, trees uprooted, or structural damage. The Beaufort wind scale (not included) is sometimes used to attribute wind speeds to conditions observed. A wind gust of 58mph and below is considered a minor severity.

3.2.6.4 Previous Occurrences:

Little historical data exists for the hazard of non thunderstorm high winds. The vast majority of available data has been grouped with tornado or thunderstorm winds. The table below provided by the Oklahoma Climatological Survey provides a record of the top 10 wind speeds recorded by the Oklahoma Mesonet or ASOS weather stations between 1994 and 2012. Some of these gusts were likely recorded very near a passing tornado.

Top 10 wind speeds recorded by the Oklahoma Mesonet or ASOS weather stations (1994-2012).		
Location	Wind Speed (mph)	Date
El Reno	151113	05/24/2011
Oklahoma City	114	07/21/2000
Lahoma	113	08/17/1994
Rich	108	01/07/2010
Idabel	106	05/04/2006
Lawton	104	01/03/2003
Bowlegs	102	11/09/1998
Marshall	100	06/16/2005
Cherokee	98	06/05/2008
Guthrie	98	07/21/2000

THE 13 MOST DESTRUCTIVE WIND EVENTS 1993 - 2012		
CITY	DATE	$DAMAGE (MILLIONS)
Altus	6/5/2008	750.0
Moore/OKC	07/23/1995	50.0
Lawton	05/27/2001	11.0
Ft. Sill	05/27/2001	10.0
Kingston	02/09/2001	10.0
Beaver	09/12/1999	8.0
Lahoma	08/17/1994	7.0
Indiahoma	05/31/1999	5.0
Altus AFB	06/03/1995	5.0
Catoosa	04/24/1993	5.0
Healdton	05/08/1993	5.0
Prague	08/07/1994	5.0
Union City	06/03/1995	5.0
Waurika	03/29/1993	5.0

Provided through Oklahoma Climatological Survey

Significant Oklahoma High Wind Events Since 2005:
(Information provided by National Weather Service, Oklahoma Climatological Survey, and the National Climate Data Center)

November 10, 2012
As the morning progressed boundary layer mixing from a strong low level jet and an approaching low pressure center allowed a steady increase of surface wind gusts. By 9 AM CST wind gusts of 30 to 35 mph (26-30 kt) out of the southwest were already being reported in Oklahoma. The first High Wind report of 66 mph (57 kt) came in at 10:50 AM CST from the Oklahoma Mesonet site at Kenton (Cimarron County). Later in the day a max wind gust for the Oklahoma Panhandle of 67 mph (58 kt) at the Oklahoma Mesonet site in Kenton (Cimarron County). The Emergency Manager for Beaver County relayed a report of a large outbuilding in Clear Water area (Beaver County) being destroyed between 6 to 7 PM CST. Winds of 63 mph (55 kt) were estimated from radar and damage descriptions, and property damage was estimated as two thousand dollars. No reports of injuries or fatalities were reported with this damage, nor were any reported in relation to the high winds. The following is a listing of the highest wind reports from the Oklahoma Mesonet, media mesonets, and ASOS: Kenton (Cimarron County) 67 mph; Guymon (Texas County) 64 mph; Goodwell (Texas County) 60 mph; Oklahoma Panhandle State University in Goodwell (Texas County) 58 mph; Boise City (Cimarron County) 63 mph; Balko Independent School in Balko (Beaver County) 58 mph; and Hooker (Texas County) 59 mph.

June 9, 2011
A cold front entered far northwest Oklahoma, with a dry line extending south through the eastern Texas panhandle. Thunderstorms developed early in the evening, and with the large dew point depressions, strong downburst winds were reported. As the thunderstorms dissipated during the mid to late evening, heat bursts occurred, with damage reported in and around the Enid area. A wind gust of 66 mph was measured at Enid's Woodring Municipal Airport. A semi was blown onto its side on US 412 between 114th and 102nd Streets. The driver of the truck was uninjured. Farther west from the

airport, approximately 50 high-line power poles were snapped over a mile and a half stretch along Rupe Avenue, beginning at Garland Road. A tree fell on a car along Rupe Avenue. The driver of the vehicle escaped without injury. As many as 520 residents were without power for a short time. Monetary damages were estimated at $376K.

August 9, 2008

Thunderstorm winds measured by a storm spotter at 85 miles an hour overturned several camper trailers and severely damaged boat docks at Lake Eufaula State Park. Three boats were capsized by the wind. Four people were transported to the hospital with injuries. Property damage estimated to be $1 million.

June 5, 2008

Substantial wind damage was reported in Altus. One hundred and seventy-nine homes sustained some kind of damage, with two destroyed, five with major damage, 43 with minor damage, and 129 affected. Seventeen businesses were damaged, with two destroyed, four with major damage, and eight with minor damage. One hundred and seventy power poles and numerous trees were blown down. Sixty percent of the town was without power at one point. Roof damage was reported to several buildings. Part of the roof at Altus Junior High caved in. Several buildings on East Broadway had roofs blown off or collapsed. Highway 62 was closed on the east side of town due to debris. One injury was reported when a semi-truck was blown over injuring the driver. A train car also was overturned on the southeast side of town. No injuries were reported with it. Monetary damages were estimated at $750 million.

April 9, 2008

Thunderstorm winds estimated up to 100 mph and hail up to golf ball size damaged 477 homes and 25 businesses along a couple of mile wide swath near Muldrow. Over 30 power poles were blown down leaving thousands without power. Damage estimated at one million dollars.

January 8, 2008

A tin roof was removed from a mobile home after high winds hit the Wagoner area late Monday. At Lake Region Electric Cooperative in Hulbert, the storm knocked out power to 2,347 customers at its peak. They had 21 broken poles and cross arms with most of the damage being N of Tahlequah, in the area of Beggs, Moody and Lowrey.

October 17, 2007

Severe storms raked across Oklahoma on Wednesday, packing high winds, heavy rain, hail and a possible tornado. Kingfisher Co. EM reported an 86-mph wind gust came through about 8:15 A.M. and along with some localized street flooding. Other high-wind reports included a 73-mph gust at Weatherford and a 62-mph gust in west Tulsa, according to the weather service.

August 19, 2007

Many areas of Oklahoma remain impacted by high winds and flooding as the remnants of Tropical Storm Erin continues to move through the state. Two Watonga residents were injured after their home was destroyed by straight line winds or a possible tornado. The two were treated for reportedly non-life threatening injuries at the hospital in Watonga. OG&E reports 15,833 customers without power statewide. The Oklahoma Association of Electric Cooperatives reports 250 to 500 Cimarron Electric customers, primarily in the Watonga area, are without power. Numerous power poles are down in the area.

February 25, 2007
Two mobile homes were destroyed and 20 sustained minor damage when severe straight-line winds moved through Spiro. The Oklahoma Emergency Management said 3 people suffered minor injuries, and a shelter was opened at the Spiro Senior Citizens Center. Oklahoma Gas and Electric reported more than 10,000 homes were without power. The utility reported that the largest outages were 1900 in Durant, 1300 in Mannsville and 1200 in Norman. The Oklahoma Highway Patrol reported the northbound lanes of I-35 were shut down briefly in southern Oklahoma after high winds overturned a pickup with a travel trailer. Three lanes of I-44 also were shut down after a tractor-trailer overturned.

May 25, 2005
Thunderstorm winds estimated at 80 miles an hour damaged outbuildings and blew down power lines in Haskell County. The winds damaged several homes as well. In Keota thunderstorm winds estimated at 80 miles an hour damaged a house. Thunderstorm winds estimated at 70 miles an hour blew a mobile home over and blew down numerous trees in Le Flore County. Also a camper trailer and mobile home were destroyed as was the roof of a business in Poteau. In Heavener, 70 mile an hour winds blew down numerous outbuildings and power lines. At Hodgen, thunderstorm winds estimated at 70 miles an hour blew down large trees and demolished a home which was under construction. In Sequoyah County 80 mile an hour winds blew down trees and a large barn.

May 27, 2001
A very large severe line of thunderstorms formed during the late afternoon on May 27, 2001 in southwest Kansas and moved into Oklahoma during the evening. High winds from the line of thunderstorms resulted in $21 million in damages in Lawton and at Fort Sill. Late on that Sunday, a woman was killed during the event when a power pole fell on her while riding a motorcycle. Fort Sill's infrastructure was wrecked by the high winds and the Fort Sill Museum was hit hard as well. 1,800 people were still without power in Lawton the next day.

February 9, 2001
Heavy damage was suffered on this day at Lake Texoma as eight boathouses were sunk, and forty boats were damaged at Catfish Bay Marina. One boat capsized and sank, killing a man on board. Severe thunderstorms developed across southern Oklahoma during the late evening on the 8th and early morning hours of the 9th, resulting in the extensive damage. The worst of the damage occurred on the western shore of Lake Texoma.

September 12, 1999
Severe thunderstorms with high winds and large hail pounded the eastern parts of the central Oklahoma panhandle during the early morning hours of September 12, 1999. $6.5 million of the damage occurred to structures and $1.5 million to vehicles. 1400 homes in Beaver were damaged and two homes were completely destroyed. Fortunately, there were no injuries from the storm.

May 31, 1999
Seven tornadoes were reported during the afternoon and evening of May 31st, and the early morning of June 1st. The tornadoes, however, were not the cause of the most extensive damage. A very large swath of straight-line winds developed on the west side of Tom Steed Lake and expanded in coverage as it moved through southern Kiowa County. The straight-line winds covered a width of 10-15 miles at times. Three injuries resulted as the damaging winds made their way into Comanche County and were estimated to be in the 80 to 100 mph range for most of the event.

July 23, 1995
Power poles and trees were knocked down in several sections of Oklahoma City after hurricane-force winds moved through the city. Wind gusts 90+mph were reported at Will Rogers World Airport. Periodic power outages were also reported and two injuries occurred.

August 17, 1994
In an event that took many forecasters by surprise, the August 17, 1994 storm caused widespread damage in parts of Garfield, Alfalfa and Kingfisher counties. Baseball-size hail was reported along its destructive path. Lahoma was hardest hit by the storm. Several mobile homes were destroyed and the town suffered extensive damage. The Mesonet station recorded a wind speed of 113 mph at Lahoma as the storm moved through. Several injuries were reported, but none of them considered serious.

August 7, 1994
Winds estimated at 88 mph moved through Prague on this day causing considerable damage. Every barn in the western half of Prague was reportedly damaged or destroyed and extensive damage was suffered at Prague High School.

3.2.6.5 **Probability of Future Events:**

All counties in the State of Oklahoma are at risk from high winds and the probability is **Highly Likely** of future hazard events.

Calculated Priority Risk Index (CPRI)

High Winds = 3.1

Probability		4 Highly Likely		
Magnitude/Severity		2 Limited		
Warning Time		4 Less than 6 hours		
Duration		1 Less than 6 hours		
The CPRI for the High Winds hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (2 x .30)	+ (4 x .15)	+ (1 x .10)	= 3.1

3.2.6.6 **Vulnerability and Impact:**

State-owned property is vulnerable to severe weather the same as all other property. Special concerns may arise over critical facilities such as electric transmission lines, and communications towers being affected as well as highways that may be closed to debris on the highway. Some outbuildings such as garages or maintenance buildings that are made of metal materials could also receive damages.

High winds do not have to accompany a thunderstorm to be dangerous. Straight-line winds, downbursts and microbursts can all cause death, injury, and property damage. Very little available data exists separate from that of thunderstorm or tornado data. Houses and businesses, and government infrastructure often suffer extensive damage in high winds. Disruption of traffic flow and delays in delivery of critical service can occur due to trees and other debris in the roadways. Power outages can cause food spoilage and sanitation problems for communities.

3.2.6.7 **Vulnerable Populations:**

Property damage and loss of life from windstorms are increasing due to a variety of factors. Use of manufactured housing and mobile homes is on an upward trend, and this type of structure provides less resistance to wind than conventional construction. Older homes in poor condition are more susceptible to wind damage. Falling trees and branches can damage homes and automobiles, threatening the safety of occupants.

3.2.6.8 **Conclusion**

Uniform building codes for wind-resistant construction are not adopted by all states; however the State of Oklahoma adopted the International Residential Code, 2009 Edition on July 15, 2011; the International Building Code and the International Existing Building Code, 2009 Editions, on November 2, 2012. With the potential deterioration of older homes, and the increased use of aluminum-clad mobile homes, the impacts of wind hazards will likely continue to increase.

Hazard Priority # 7 (Lightning)

3.3.7 Lightning

Lightning near Norman August 8, 2011 photographed over a four minute exposure (*Credit: Ben Herzog*)

3.2.7.1 Description:

Lightning is a discharge of intense atmospheric electricity, accompanied by a vivid flash of light, from one cloud to another, or from a cloud to the ground. Lightning is formed by the separation of positive and negative charges that occur when ice crystals collide high up in a thunderstorm cloud. As lightning passes through the atmosphere the air immediately surrounding it is heated, causing the air to expand rapidly. The resulting sound wave produces thunder.

From 1959-2012 lightning has resulted in an average of 75 reported fatalities in the U.S. each year, with more than 300 estimated injuries. The odds of being struck by lightning in the U.S. in a given year are about one in a million and the odds of an individual being struck in a lifetime are about one in ten thousand.

3.2.7.2 Location:

The entire State of Oklahoma is at risk from lightning.

3.2.7.3 Extent:

"Each thunderstorm can vary greatly when it comes to lightning produced. There is no uniform scale or measurement used to identify lightning in storms, since lightning is so variable. The most dangerous lightning strikes are often the first and last from a storm. The first lightning bolt might occur before bad weather is apparent, catching people outside off guard. The last bolt might occur after the perceived threat has ended and people resume outside activity. Lightning is very unpredictable, which increases the risk to individuals and property. A lightning bolt can carry 100 million to 1 billion volts. There are roughly 5 to 10 times as many cloud-to-cloud flashes as there are cloud-to-ground strikes. Since lightning is so variable and can be cloud-to-cloud or cloud-to-ground, a higher flash rate in a particular storm does not necessarily correlate to a greater risk of damage, injury or death." (Source: Alek Krautmann, Research Associate, Southern Climate Impacts Planning Program, Oklahoma Climatological Survey)

The State of Oklahoma considers cloud-to-cloud lightning flashes and cloud-to-ground lightning strikes that cause no damage, injury, or death as events of minor severity. However, any lightning strike that causes death, injury or property damage would be an event of major severity.

3.2.7.4 Previous Occurrences:

NCDC records show that Oklahoma had 14 reported deaths, 87 injuries and at least $34 Million in damages from lightning since 1993.

Location or County	Date	Time	Type	Mag	Deaths	Injuries	Property Damage $
1 NE Oklahoma City	06/19/1994	1300	Lightning	N/A	2	1	0
2 Kansas	05/13/1995	1800	Lightning	N/A	1	0	0
3 Red Oak	06/23/1995	1140	Lightning	N/A	1	0	0
4 Guymon	07/08/1996	06:15 PM	Lightning	N/A	1	0	0
5 Claremore	07/21/1997	08:30 PM	Lightning	N/A	1	0	0
6 Boise City	08/18/1997	05:04 PM	Lightning	N/A	1	0	0
7 Wagoner	08/09/1998	07:05 AM	Lightning	N/A	1	0	0
8 Muldrow	04/24/1999	07:30 AM	Lightning	N/A	1	1	0
9 Hulbert	07/06/2002	06:45 PM	Lightning	N/A	1	1	0
10 Calera	04/19/2003	08:30 PM	Lightning	N/A	1	0	0
11 Eufaula	08/01/2003	07:00 PM	Lightning	N/A	1	0	0
12 Broken Arrow	07/23/2005	04:30 PM	Lightning	N/A	1	1	0
13 Ada	07/13/2012	09:00 PM	Lightning	N/A	1	O	O
TOTALS:					14	4	0

3.2.7.5 Probability of Future Events:

Oklahoma observes an average of one million lightning strikes in the state each year, with an average of 14.8 lightning strikes per square mile. This ranks the state as having the 6th most lightning strikes per square mile in the U.S. (Source: NOAA citing data compiled from a Vaisala report - http://www.lightningsafety.noaa.gov/stats/97-12Flash_DensitybyState.pdf).

The entire State of Oklahoma is at risk from lightning and the probability of future events is: **Highly Likely**.

Calculated Priority Risk Index (CPRI)

Lightning = 2.8

Probability			4 Highly Likely	
Magnitude/Severity			1 Negligible	
Warning Time			4 Less than 6 hours	
Duration			1 Less than 6 hours	
The CPRI for the Lightning hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (1 x .30)	+ (4 x .15)	+ (1 x .10)	= 2.8

3.2.7.6 Vulnerability and Impact:

Virtually all structures, infrastructure and individuals in Oklahoma are vulnerable to lightning. Lightning is the most frequent weather hazard impacting athletics events. Power systems are also heavily affected by lightning. Farmers suffer monetary loss and crops suffer extreme damages almost every year due to fires resulting from lightning strikes. Oklahoma has a significant hazard due to the frequent occurrence of thunderstorms in the state. The highest period of lightning is generally April, May and June, which also coincides with Oklahoma's major tornado season.

Lightning causes millions of dollars in structural damage each year and is a problem for all communities in Oklahoma. Electrical fires, electricity loss, and damage to equipment are a few of the hazards associated with lightning strikes. For the period of 2003-2012, Oklahoma was ranked 25th* for the number of deaths per million in population in the U.S. Additionally, more people are killed by lightning while participating in recreational efforts than any other activity. Lightning deaths are more frequent in August than during any other month.
* (Source: NOAA citing data compiled from a Vaisala report - http://www.lightningsafety.noaa.gov/stats/03-12_deaths_by_state.pdf)

3.2.7.7 Vulnerable Populations:

The vulnerability of the entire State of Oklahoma to future lightning damage is highly likely. People who are at outdoor sporting events are especially vulnerable to lightning strikes. When thunderstorms are in the area but not overhead, the lightning threat can still exist even when it is sunny, and clear sky is visible. A slogan used by the National Weather Service to promote lightning safety is, "When thunder roars, go indoors." Many lightning casualties occur in the beginning, as the storm approaches, because people ignore the precursors. Also, many lightning casualties occur after the perceived threat has passed. It is generally safe to resume outdoor activity after 30 minutes have passed since the last lightning flash or rumble of thunder.

3.2.7.8 Conclusion:

Oklahoma has significant exposure to lightning events. State-owned property is vulnerable to lightning as any other property, but the most serious threat of lightning strikes is to people gathered outdoors with no protective structures. When planning outdoor events, groups should designate a responsible person to monitor the weather and be prepared to initiate an evacuation process if appropriate. Monitoring should begin days and even hours ahead of scheduled events.

Early warning research is ongoing through NOAA in Norman, Oklahoma and other private organizations to improve warning and threat information for the public.

3.3.8 Wildfires

Hazard Priority # 8

3.2.8.1 Description:

A wildfire is an uncontrolled fire in a rural or wilderness area. The majority of wildfires in Oklahoma occur in the late fall through winter and into early spring, which coincides with dormant vegetation and the time of the year the state receives the least amount of precipitation. A wildfire often begins unnoticed and can spread quickly, lighting brush, trees and even homes. It may be started by a campfire that was not doused properly, a tossed cigarette, burning debris, lightning or arson.

There are three different classes of wildfires. A surface fire is common in grasslands or areas with open vegetation and can spread quickly. A ground fire is a dense, very hot fire that has a thick fuel source and significantly damages the soil health where it occurs. Crown fires are those that move by jumping along the tops of trees. Wildfires often begin unnoticed, but are usually signaled by dense smoke that fills the area for miles around.

Wildfire is a natural part of Oklahoma's ecosystem. Long before the State was settled, surface grassfires ran across the prairies, replenishing nutrients to the soils and controlling invasive plant species. With settlement, however, the interaction of wildfire and the environment has changed. Now, people and structures are at risk from flames spreading across the grasslands and forests of Oklahoma. Today, communities lie along side wildlands, creating an urban-wildland interface that is at risk of uncontrolled burns.

The development of such urban-wildland interfaces is part of a growing national problem. The urban-wildland interface is generally the first one block area on the edge of the built up area surrounding a community where structures and other human developments meet, or intermingle with, undeveloped wildlands which are most susceptible to wildfires. Fire losses and suppression costs have skyrocketed over the past decade. Federal Wildfire Appropriations to the Forest Service (of the U.S Department of the Interior) peaked at $4.76 billion in 2008; but have steadily decreased since, with a total cost of $2.76 billion in 2012. (Congressional Research Service Report #RL 33990)

Western states have been particularly hard hit, as prolonged, multi-year drought dried vegetation and forests, creating conditions ripe for raging infernos. As homes have encroached canyons and forestlands, often far away from water sources that can be used to extinguish flames, costs of fire control have mounted.

Native to Oklahoma is a large population of Red Cedar trees. Red Cedar tree leaves contain a highly flammable oil. When a grass fire gets close to a Red Cedar tree, the tree appears to explode into a ball of fire spreading the fire further and faster. Red Cedar eradication programs are in place but fail to keep pace with new growth.

Weather plays a major role in the birth, growth and death of a wildfire. Drought leads to extremely favorable conditions for wildfires, and winds aid wildfire progression. The combination of wind, temperature and humidity affects how fast wildland fires can spread.

3.2.8.2 Location:

Urban population centers, such as the Oklahoma City and Tulsa metro area, are most at risk for wildfires because cities and other large towns have incorporated areas with parcels of undeveloped land, creating a vast wildland-urban interface. Arson is the number one cause of wildfires in the state, and centers for high population are where many of these fires originate. The western and central Oklahoma landscape features occasional spotty areas of trees while eastern Oklahoma, east of Interstate 35, is generally forested. East of I-35 also receives more rain and has generally calmer winds, contributing to fewer wildfires compared to the western part of the state. The stronger winds and lack of trees across the western half of the state can contribute to drier surface conditions and make a ripe situation for wildfires. Western and central Oklahoma has seen the majority of FEMA's F-MAG (Fire Management Assistance Grant program) declarations. Fortunately, many of the large fires have been in rural areas with few structures in the path.

3.2.8.3 Extent:

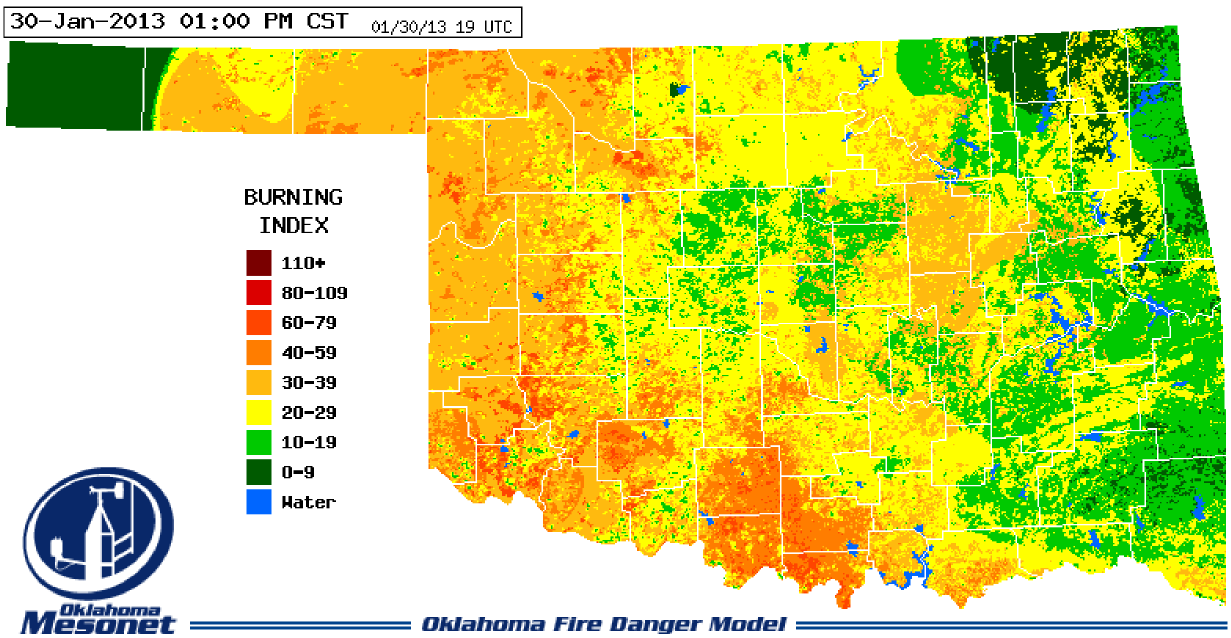
Since the threat of a wildfire results from a combination of fuel and weather conditions, there are several indices or rating systems that help to convey risk. Oklahoma can experience a range of wildfire conditions found in the Keetch-Byram Drought Index, which is useful for indicating the likelihood of wildfire based on soil moisture conditions. Spring days usually center on the 0-200 rating while July through December days are often drier and, depending on fuel and moisture, can rate in the 400-600 range. During extremely dry atmospheric conditions and or periods of drought, Oklahoma will be rated at 600-800.

Fire intensity is controlled by both short-term weather conditions and longer-term vegetation conditions. During intense fires, understory vegetation, such as leaves, small branches, and other organic materials that accumulate on the ground, can become additional fuel for the fire. The most explosive conditions occur when dry, gusty winds blow across dry vegetation. The National Fire Danger Rating System is used to convey the relative potential over a large area for fires to ignite, spread and require suppression action. Factors included in determining the class level on the rating system include local observations of fuel conditions, weather, and topography. In order to represent fuel and weather conditions, the rating system uses the Keetch-Byram Drought Index and another measure called the Burning Index.

The Keetch-Byram Drought Index (KBDI) ***fire danger rating system***	
0 – 200	Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.
200 - 400	Fires more readily burn and will carry across an area with no gaps. Heavier fuels will still not readily ignite and burn. Also, expect smoldering and the resulting smoke to carry into and possibly through the night.
400 - 600	Fire intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.
600 - 800	Fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn thorough the night and heavier fuels will actively burn and contribute to fire intensity

Fire Danger Rating System		
Rating	**basic description**	**detailed description**
CLASS 1: Low Danger (L) COLOR CODE: G**reen**	fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
CLASS 2: Moderate Danger (M) COLOR CODE: B**lue**	fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
CLASS 3: High Danger (H) COLOR CODE: Y**ellow**	fires start easily and spread at a rapid rate	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.
CLASS 4: Very High Danger (VH) COLOR CODE: O**range**	fires start very easily and spread at a very fast rate	Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
CLASS 5: Extreme (E) COLOR CODE: R**ed**	fire situation is explosive and can result in extensive property damage	Fires under extreme conditions start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.
source: http://www.wfas.net/content/view/34/51/		

The Burning Index is a short-term response to meteorological factors. The burning index includes real-time observations of temperature, relative humidity, wind speed and solar radiation. It applies those factors to a vegetation model, which includes the "relative greenness" – a satellite-derived measure of the health of the vegetation – and fuel models for native vegetation, assigned on a 1-kilometer grid across the State. The model uses these inputs to produce four indices: Spread Component, Energy Release Component, Ignition Component, and Burning Index. Burning Index is a synthesis of the Spread and Energy Release components, and infers fire line intensity and flame length. The higher the number, the more difficult it is to fight a wildfire.



Sample data analysis: OKFD Model Burning Index (BI) at 1:00 P.M. on **January 30, 2013**.
The BI yields expected flame height in tenths of feet. For example, values of 80-109 in much of Washita County suggest potential flame lengths of 8-11 feet. BI values are highly dependent on hour-to-hour weather changes. BI values can often exceeded 100 when windy and dry conditions are in place.

Flame Length (ft)	**Fire Line Intensity (Btu/ft/s)**	**Interpretations**
4 (BI <40)	<100	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.

4-8 (BI=40-80)	100-500	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold fire. Equipment such as dozers, pumpers, and retardant aircraft can be effective.
8-11 (BI=80-110)	500-1,000	Fires may present serious control problems—torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.
> 11 (BI > 110)	> 1,000	Crowning, spotting, and major fire runs are probable. Control efforts at head of fire are ineffective.

Fine fuels, such as small twigs and vegetation litter, respond quickly to changing weather conditions and can dry quickly following a rain. Locations with a higher average burning index most likely have experienced repeated episodes of high fire danger, although individual events can peak at locations that are not as prone to high fire danger. Nearly one in three of the 120 Oklahoma Mesonet stations, which have continuous records from July 1996 – present, have peaked in the upper category of the Burning Index (BI >110). Many of these locations are in western Oklahoma, where wind speeds are higher and humidity is lower, contributing to more favorable burning conditions.

The State of Oklahoma considers a Fire Line Intensity of < or = 500 to be a minor severity and a Fire Line Intensity of >500 to be a major severity.

3.2.8.4 Previous Occurrences:

Significant Oklahoma Wildfires

(*Information provided by National Weather Service, Oklahoma Climatological Survey, FEMA, Oklahoma Agriculture and Forestry Department and the National Climate Data Center*)

August 3, 2012

Very hot temperatures, low relative humidity, very dry fuels from severe drought, and gusty wind resulted in the spread of two large wildfires in Creek County. One of the fires burned 58,500 acres near Mannford and the other burned about 6500 acres near Drumright. Multiple state, tribal, and local agencies responded to these wildfires. Oklahoma Forestry Service's Type II Incident Management Team was activated to coordinate the response of all the agencies involved. Up to six Oklahoma Army National Guard helicopters were also used to battle the fires. Despite the best efforts of all the agencies involved, these two fires destroyed 376 homes and damaged 47 others. An unknown number of businesses, outbuildings, and vehicles were destroyed. Damages were estimated at $55 million.

Another fire burned in Cleveland County south of Lake Thunderbird. The fire burned 25 outbuildings or homes and included one fatality. The event resulted in a disaster declaration.

April 3, 2011

A large wildfire began six miles southwest of Guymon in Texas County near an irrigation pump. The wildfire consumed 501 acres, destroyed three homes, three businesses and numerous outbuildings. There were 12 people injured, including several firefighters who sustained eye injuries. Also, more than 500 homes had to be evacuated and the wildfire knocked out power to more than 1,500 customers. U.S. Highway 54 was closed southwest of Guymon for more than six hours. The Elks Addition, Sunset Area, and the Prairie Village Trailer Park and the Corral RV Park were evacuated. About $3.5 million in damage was caused by the wildfire with over $20 thousand to Tri County Electric Cooperative, and over $40 thousand in damages to PTCI phone company.

April 9, 2009

A strong area of low pressure moved into Oklahoma during the afternoon, pushing a dry line east of I-35. This boundary marked warm and moist air to the east, from hot and dry air to the west. Winds to the west of the dry line were from the southwest and west at 20-40 mph, with higher gusts. These winds and hot temperatures combined with dry ground and semi-dormant vegetation to create an environment favorable for rapid wildfire growth in central Oklahoma. Numerous, large grass fires developed, with several structures burned. The wind shifts made firefighting efforts difficult for several hours. The most costly fire occurred in the Midwest City area, with several homes burning to the ground. The event resulted in a disaster declaration.

August 16, 2006

In Murray County a massive wildfire in produced clouds of thick smoke forcing authorities to close a 15-mile section of I- 35 and U.S. 77, near the Arbuckle Mountains and Turner Falls Recreation Area. Officials estimated the fire in the sparsely populated area had burned more than 100 acres in about six hours. The fire eventually jumped I-35 near mile marker 50 and mostly burned land between the interstate and Highway 77. Campers in the area were evacuated while Interstate 35 between mile marker 40 and 59 and part of Highway 77 was shut down for about 7 hours. The traffic was diverted into the town of Sulphur, which caused a traffic jam approximately 15 miles long. The flames of the fire reportedly shot 80 feet into the air. Two planes, at least 3 helicopters, and 51 fire departments were used to fight this large fire. Only one structure was known to have been damaged.

April 2006

One of the worst wildfire days for the month was on April 6, due to strong winds, warm temperatures, and dry conditions. A fire near Cement in Caddo County caused the evacuation of the town and burned at least 7 homes. Another fire near Newcastle in McCain County caused an evacuation of some residents and burned 7 homes. This fire also caused the closure of portions of Interstate 44 and Highways 37 and 76 during rush hour. Several fires also burned homes and structures in Kingfisher and Oklahoma counties, with several other fires burning many acres across the area. The largest fire occurred in Roger Mills Co. where approximately 30,000-50,000 acres were scorched. This fire began just west of the Oklahoma - Texas state line in the Texas Panhandle. The strong westerly winds caused the fire to quickly spread east into Roger Mills Co. The fire burned an area between about 4 miles south of Reydon to 6 miles north of Sweetwater to within about 5 miles or less of Cheyenne. Despite the size of the fire, only three vacant homes were destroyed, a few head of livestock were lost, and no injuries or deaths occurred. Firefighters from 45 different departments in Oklahoma and Texas along with aircraft were used to fight this fire. Many of the wildfires that occurred on April 6 were believed to have been started by sparks from power lines blowing together in the strong winds.

January 2006

The prolific 2005-2006 Oklahoma wildfires continued, leaving 869 homes damaged - 300 of those destroyed since November. Nearly 2,800 fires have left more than 550,000 acres scorched across the state. Firefighting assistance also came from North Carolina, Alabama and Tennessee, in addition to BIA firefighters from within Okla. providing extra manpower, fire brush-pumpers and bulldozers. The BIA has also extended to Oklahoma the use of Single Engine Air Tankers. They are assisting National Guard Helicopters equipped with large buckets for carrying and releasing large amounts of water. Many federal, state, tribal, and local assets along with assistance from other states were used to fight the fires. Oklahoma wildfires from November through March were included in a disaster declaration.

November-December 2005

Wildfires occurred in nine eastern Oklahoma counties including Cherokee, Mayes, McIntosh, Muskogee, Okfuskee, Osage, Pittsburg, Tulsa and Wagoner. At least 60 homes were destroyed with numerous outbuildings also lost. Perhaps hardest hit was Mayes County, where 19 homes were destroyed in the Choteau and Mazie areas, with another 12 destroyed in rural portions of the county. More than 20 families in Mayes County were displaced by the fires. Also hard hit was McIntosh County where 29 homes were destroyed in the Shady Grove and Central High areas. Strong winds made November 27 an especially severe fire day. About 50,000 acres were reported to have burned across Oklahoma between November 27th and 30th including 5,000 acres in Okfuskee County alone. Three deaths and at least 17 injuries occurred during this period, with estimated damages nearly $6 million.

December 27, 2005

December 27 was another especially active fire day in the state. The Oklahoma Department of Emergency Management (OEM) received reports of wildfires in the following 20 counties Bryan, Canadian, Carter, Cherokee, Cotton, Garvin, Grady, Hughes, Johnston, Love, McCurtain, McIntosh, Muskogee, Oklahoma, Okmulgee, Pontotoc, Pushmataha, Rogers, Seminole and Tulsa.
The largest ongoing fires were in Seminole and Hughes counties to include the City of Wewoka. A Chinook helicopter equipped with a 1,320 gallon bucket was deployed to Wewoka to provide aerial fire suppression when 13 structures were threatened. Additionally, a Blackhawk helicopter (660 gallon bucket) was deployed when fires threatened Achille, a community of 506 in Bryan County. Forestry officials have also provided ground crews, brush pumpers, bulldozers and engines to the Wewoka and Achille fires. Eight fire units composed of 20 firefighters provided mutual aid at a fire southeast of Lindsay in Garvin County, which burned at least 1,000 acres.
Hughes County EM reported the Town of Yeager was evacuated**.** Johnston Co EM reported 5 fire departments responded to a fire south of Mill Creek. The fire spread rapidly due to the winds and an estimated 600 acres burned. The fire spread to the east-southeast and threatened several homes.

McIntosh Co EM experienced one wildfire when a little more than 500 acres were burned. Nine of the 15 area fire departments worked the fire.
Oklahoma City OCFD responded to 16 fires in the Oklahoma City metro area, including a mutual aid response in Mustang. Numerous homes and outbuildings were destroyed in the fires and 4 minor injuries were reported. Oklahoma Co EM advised 8 homes and 20 outbuildings destroyed, primarily in the Choctaw area.
Rogers Co - A fire in the NW portion of the county required mutual aid from numerous departments including Washington, Nowata and Tulsa. One mobile home was destroyed during the four large wildfires that occurred and at one point US 169 near Talala was closed briefly as flames jumped the road.
Seminole Co - portions of Wewoka remained evacuated due to fires.
Valliant reported Choctaw, and Pushmataha counties were hit hard by fires. Choctaw Co lost some homes in a 1,200 acre fire.

September 22, 2000

At least 31 homes were destroyed by wildfires that swept across Logan County. Crews in orange trucks worked on gravel roads that snaked through thick woods to replace burned utility poles. Black patches of burned earth cut across pastures and through woodland in random patterns. The fire destroyed five of six buildings at the Woodlands Equestrian Centre, including the home of the owners. The cross-country equestrian courses at the center were also ruined.

1996

The State received fire management assistance from FEMA for fires in Cleveland, Creek, Comanche, Leflore, Logan, Murray, Osage, Payne, Stephens, and Woods counties. The state was experiencing a drought period, contributing to prime fire conditions. In 1996, more than 633,000 acres – nearly 1,000 square miles – were burned in Oklahoma not including the cost of property and crop losses.

3.2.8.5 Probability of Future Events:

There is a **Likely** probability of future Wildfire events in Oklahoma.

Calculated Priority Risk Index (CPRI)

Wildfire = 2.75

Probability			3 Likely	
Magnitude/Severity			2 Limited	
Warning Time			4 Less than 6 Hours	
Duration			2 Less than one day	
The CPRI for the Wildfires hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (2 x .30)	+ (4 x .15)	+ (2 x .10)	= 2.75

3.2.8.6 Vulnerability and Impact:

In recent years, Oklahoma has experienced a surge in home construction on its rural landscape and in its small towns and cities. These areas of growth contribute to a growing urban-wildland interface. Residents within the interface are surrounded by fire fuels that, should they ignite, present a significant risk to homes and surrounding improvements. In Oklahoma, most rural residents depend on their local volunteer fire departments to protect their property from loss. Currently, Oklahoma has 925 volunteer fire departments, primarily in communities of less than 10,000 people. Since 1980, the Rural Fire Defense Program of Oklahoma Forestry Services has provided assistance in the form of technical advice, financial aid, grants and equipment for rural fire departments.

Wildfires can cause additional problems long after the last ember is extinguished. Post-fire events can trigger additional secondary consequences that cascade into other serious hazard events. The loss of ground-surface cover from a severe fire and the chemical transformation of burned soils make watersheds more susceptible to erosion from rainstorms. All vegetation may be destroyed and the organic material in the soil may be burned away or may decompose into water-repellent substances that prevent water from absorbing into the soil. Normal rainfall after a wildfire may result in unusual erosion or flooding from burned areas. Depending on the topography of the burned area, heavy rain can even produce destructive debris flows. Subsequent unchecked debris flows can then carry mud, rock, chemicals, and other debris into water supplies, reducing water quality.

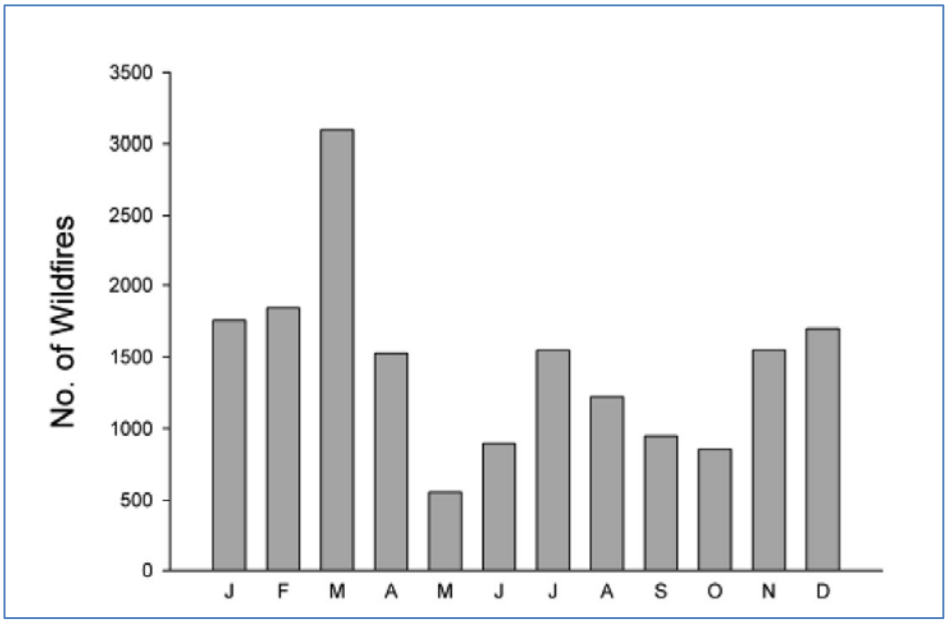
Houses and businesses often suffer extensive damage in wildfires. Disruption of traffic flow occurs particularly in the fire area. School bus and mail routes may also be disrupted due to smoke or roadblocks. Power outages and water shortages may also occur.

In drought conditions, wildfires can be easily started and are extremely dangerous. Protecting structures in the wildland from fires pose special problems, and can stretch firefighting resources to the limit. Weather conditions leading to wildfires can change rapidly. Thus, there are few measures, other than rapid-response, that can contain wildfires and limit their threat to property.

Economic impact from catastrophic wildfires includes disruptions to both consumption and production of local goods and services. Immediate effects may include decreased recreation and tourism traffic, and reduced timber harvest in the fire region, as well as disruptions and delays in transportation. Other effects include direct property losses (in the form of buildings, timber, livestock, and other capital), damage to human health, and possible changes in the long-term local economy. However, increased use of local goods and services for fire protection can have a small positive impact on local economies.

3.2.8.7 Vulnerable Populations:

Oklahoma has a significant wildfire hazard due to its climate, the types of fuels present and the cultural practices used. Holiday weekends, especially over July 4, typically result in many reports of fire due to private grilling, campfire, and firework celebrations. The state is far enough south that snowpack does not build in the winter, leaving grassy fuels exposed and vulnerable to fire in the dormant season. Oklahoma is far enough north of the Gulf of Mexico that it generally experiences a dry continental climate in the winter. Summers are hot and usually dry, with daytime highs in the mid-90s and generally less than 4 inches of rain in July and August. A primary time for Oklahoma wildfires is November through April when dry and windy weather can combine with dormant vegetation for ideal fire conditions. Another prime time for fires is often July and August when vegetation browns in the summer heat and dry conditions are in place. May and June typically have the lowest wildfire occurrence annually since these are typically the wettest months of the year in Oklahoma and green vegetation is thriving. Most at risk are those who make their homes in woodland settings in or near forests, rural areas, or hilly terrain. The most vulnerable counties by far are Oklahoma and Tulsa with an average of over 1000 fires per year each.



The number of wildfires reported monthly in Oklahoma 2000-2007, from the Oklahoma State University Division of Agricultural Sciences and Natural Resources.

3.2.8.8 Conclusion:

Oklahoma has a number of programs through the Oklahoma Forestry Services Department, and Oklahoma Climatological Survey to mitigate wildfires including:

Prescribed Burns – Oklahoma Forestry Services

Fire remains an excellent tool for managing forest and rangeland. Periodic burning helps control hardwood encroachment onto old fields and into managed pine stands. It also reduces the annual fuel accumulation in forests and grasslands reducing wildfire intensity. Periodic burning improves habitat for Oklahoma wildlife by modifying cover, food quality and volume. It also induces environmental changes that result in plant and animal communities that are adapted to fire.

Community Wildfire Preparedness Planning – Oklahoma Forestry Services

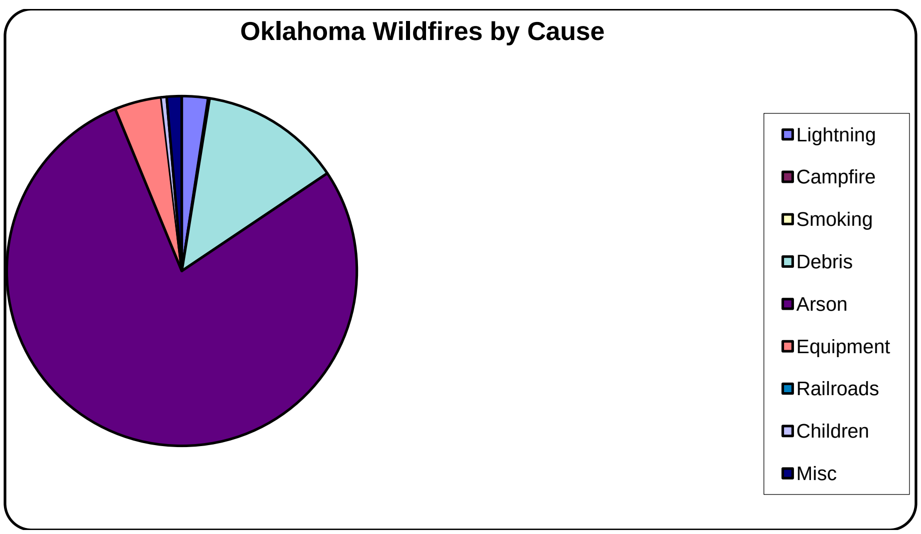
Oklahoma Forestry Services is assisting communities in the development of Community Wildfire Protection Plans and Firewise Plans. These wildfire mitigation plans help communities develop actions that will reduce the loss of property. This assistance includes:

- Grants for Development of Community Wildfire Protection Plans and Firewise Plans.
- Template for development of Community Wildfire Protection Plans
- Templates for writing Firewise Plans

<u>Oklahoma Mesonet – Oklahoma Climatological Survey</u>

The Oklahoma Mesonet is an invaluable tool for wildland fire management, and also allows emergency managers the ability to anticipate direction and speed of wind and precipitation that might disperse contaminants.

The vulnerability to wildfire in Oklahoma results in several thousand wildfires each year, but the exact number and acreage covered is highly variable based on weather conditions. Over 97% of these wildfires are human caused, either through arson or resulting from carelessly discarded cigarettes or unsupervised trash burning. In fact, Oklahoma's fire risk is more closely associated with the presence of people than with fire danger or fuel types. Since human activity accounts for such a high percentage of the wildfires, there is unlimited opportunity for mitigation through public awareness and education.



Various parts of the state are more susceptible at different times of the year depending on precipitation. During prolonged periods of drought, hundreds of thousands of acres will be vulnerable.   The majority of fires happen near urban population centers, but large wildfires have been known to happen especially in Central and Western Oklahoma where the wind frequently gusts.

Most state-owned facilities are not located in areas that are subject to wildfire hazards. However, critical facilities, especially transportation routes, pipelines, electrical transmission lines, communications towers and Forestry offices and annexes are often located in forest environments. At times smoke from wildfires may affect patients in healthcare facilities located nearby forcing evacuation if the smoke becomes extreme.

3.3.9 Dam Failure

Hazard Priority # 9

3.2.9.1 Description:

A dam is an artificial barrier usually constructed across a stream channel to impound water. Timber, rock, concrete, earth, steel or a combination of these materials may be used to build the dam. In Oklahoma, most dams are constructed of earth or concrete. Dams must have spillway systems to safely convey normal stream and flood flows over, around, or through the dam. Spillways are commonly constructed of non-erosive materials such as concrete. Dams should also have a drain or other water-withdrawal facility for control of the pool or lake level and to lower or drain the lake for normal maintenance and emergency purposes.

A dam that impounds water in the upstream area is referred to as a reservoir. The amount of water impounded is measured in acre-feet. An acre-foot is the volume of water that covers an acre of land to a depth of one foot. As a function of upstream topography, even a very small dam may impound or detain acre-feet of water. Two factors influence the potential severity of a full or partial dam failure: the amount of water impounded, and the density, type, and value of development and infrastructure located downstream.

Dam failures are generally catastrophic if the structure is breached or significantly damaged. There are 87,359 dams in the United States, according to the 2013 U.S Corps of Engineers' National Inventory of Dams, of which 27,132 currently pose a "high" or "significant" hazard to life and property if failure occurs.

Dam failure or levee breeches can occur with little warning. Intense storms may produce a flood in a few hours or even minutes for upstream locations. Flash floods occur within six hours of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching. Other failures and breeches can take much longer to occur, from days to weeks, as a result of debris jams or the accumulation of melting snow.

Dam failures are of particular concern because the failure of a large dam has the potential to cause more death and destruction than the failure of any other man-made structure. This is because of the destructive power of the flood wave that would be released by the sudden collapse of a large dam.

Dam failures are most likely to happen for one of these reasons:

- Overtopping caused by water spilling over the top of a dam
- Structural failure of materials used in dam construction
- Cracking caused by movements like the natural settling of a dam
- Inadequate maintenance and upkeep
- Piping when seepage through a dam is not properly filtered and soil particles continue to progress and form sinkholes in the dam

Dams are innately hazardous structures. Failure or mis-operation can result in the release of the reservoir contents--this includes water, mine wastes or agricultural refuse--causing negative impacts upstream or downstream or at locations remote from the dam. Negative impacts of primary concern are loss of human life, economic loss including property damage, lifeline disruption and environmental damage.

Some dams are considered to have a greater hazard potential than others. There are approximately 10,000 state-regulated "high hazard" potential dams in the U.S. "High hazard" is a term used to determine how hazardous a dam's failure might be to the downstream area. While the definition varies from place to place, it generally means if failure of a high hazard dam occurs, there probably will be loss of life. It must be emphasized that this determination does not mean that these dams are in need of repair--these dams could be in excellent condition or they could be in poor condition.

High hazard potential dams exist in every state and affect the lives of thousands downstream. The current issue and debate is over the increasing number of these high hazard structures--not because more high-hazard dams are being built, but that more development is occurring downstream. Dam safety regulators generally have no control over local zoning issues or developers' property rights.

Routine deformation monitoring of seepage from drains in and around larger dams is necessary to anticipate any problems and permit remedial action to be taken before structural failure occurs. Most dams incorporate mechanisms to permit the reservoir to be lowered or even drained in the event of such problems. Another solution can be rock grouting – pressure pumping Portland cement slurry into weak fractured rock.

The main causes of dam failure include spillway design error, geological instability caused by changes to water levels during filling or poor surveying, poor maintenance, especially of outlet pipes, extreme rainfall, and human, computer or design error.

Embankment dams overtop due to inadequate spillway discharge capacity to pass flood waters. National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for approximately 34% of all U.S. dam failures. This is one of the most common causes of dam failures and has nothing to do with the geology of the dam site. Any embankment dam will fail if the spillway is too small and flood waters rise high enough to flow over the top of the dam wall. The estimation of the size of the maximum flood a dam will have to survive during its life is a science which has undergone continuing evolution over the last century with the result that many dams built decades ago may now be judged to have inadequate spillways even though the spillways were designed to standards of safety which were accepted as adequate at the time of construction of the dam.

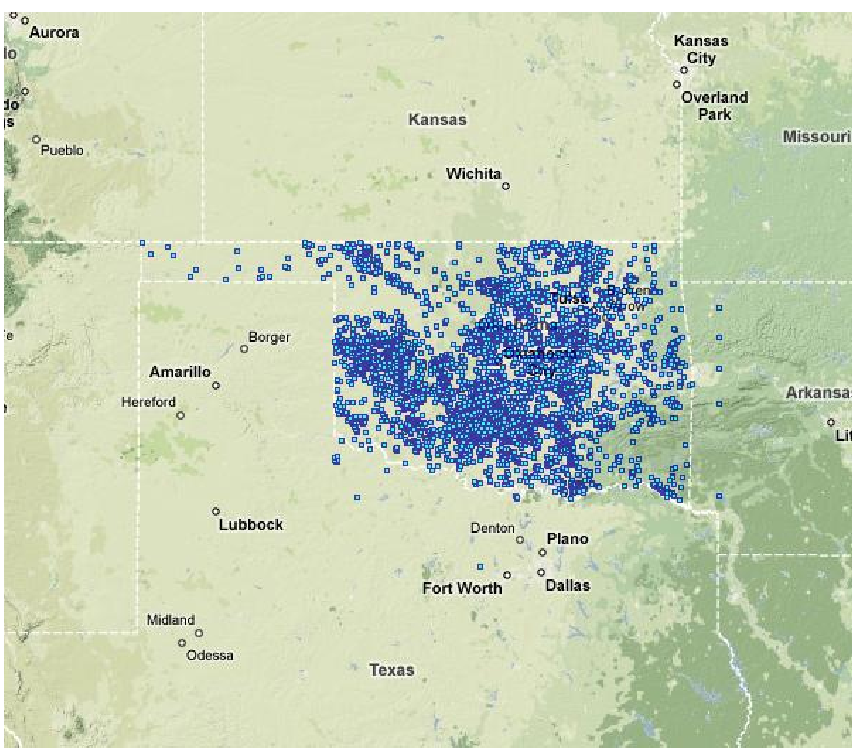
Foundation defects, including settlement and slope instability, cause about 30% of all dam failures.

Another 20% of U.S. Dam failures have been caused by piping (internal erosion caused by seepage). Seepage often occurs around hydraulic structures, such as pipes and spillways; through animal burrows; around roots of woody vegetation; and through cracks in dams, dam appurtenances, and dam foundations.

Earthquakes can certainly cause damage to dams but complete failure of a large dam due to earthquake damage appears to be very rare.

Other causes of dam failures include structural failure of the materials used in dam construction and inadequate maintenance.

3.2.9.2 Location:



According to the U.S Army Corps of Engineers' inventory, Oklahoma has 4,925 dams, many of which protect small farm and ranch ponds, and small lakes. Each dam in the inventory is assigned a downstream hazard classification based on the potential loss of life and damage to property should the dam fail. The three classifications are high, significant and low. With changing demographics and land development in downstream areas, hazard classifications are updated continually. Due to security concerns, the list of hazard classifications and dams is not included in this plan.

The hazard classification is not an indicator of the adequacy of a dam or its physical integrity. Dam failures typically occur when spillway capacity is inadequate and excess flow overtops the dam, or when internal erosion through the dam or foundation occurs.

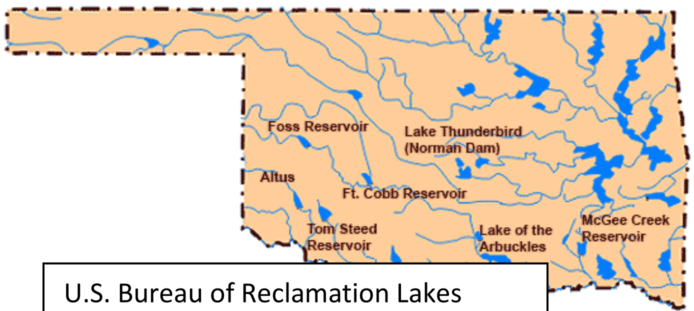
According to 2013 U.S. Army Corp of Engineers statistics, Oklahoma has 397 high hazard dams and 219 significant hazard dams. Although dams are not a natural hazard, the flooding that could occur from a dam could be. Even a small earthquake in the right location could cause a dam to begin leaking and eventually break. These initial hazard classifications are based upon current conditions, including population and land-use patterns below the dams. Such conditions can shift over time, such that a structure that is not considered high hazard may receive such designation in the future, should, for example, dwellings are built within the floodplain below the dam. Other high hazard dams may have such designation lowered should land use patterns change, reducing the threat of loss to life or property. Mitigation aspects, such as relocations of vulnerable properties, can reduce the number and magnitude of high hazard dams.

The Oklahoma Water Resources Board (OWRB) coordinates the Oklahoma Dam Safety Program to ensure the safety of more than 4,755 dams in the state that fall within its jurisdiction, especially those that could impact downstream life and property. Dams falling within the OWRB's jurisdiction are non-Federally constructed and maintained dams which are: 1) greater than 6 feet in height with storage capacities of 50 acre-feet or more; and/or 25 feet or greater in height with storage capacities of 15 acre-feet or more. The program requires inspections every five and three years for low and significant hazard structures, respectively. It requires annual inspection of the State's high hazard dams, so designated due to the presence of one or more habitable structures downstream with loss of life likely to occur if a dam were to fail. The 361 high hazard dams in Oklahoma include federally constructed and maintained dams that are not regulated by the OWRB. For security reasons, these dams and their locations are not listed in this plan.

The Natural Resources Conservation Service (NRCS) is involved in rehabilitation of a number of Oklahoma dams. Oklahoma has many dams that need major rehabilitation. According to the NRCS there are:

- 80 dams build to protect agricultural lands now have homes or other structures built downstream that were not there when the dam was constructed.
- 110 dams need repairs that if not corrected, will have significant adverse environmental, economic and social impacts.
- An estimated $53 million is needed to rehabilitate these dams.
- There are 2,094 upstream flood-control dams in 126 watersheds. These dams provide flood protection for more than 2 million acres and make up close to a $2 billion infrastructure.

Additional dams are operated on federally built and controlled lakes throughout Oklahoma that are under control of federal agencies including the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation.



U.S. Bureau of Reclamation Lakes

For the purpose of this plan, dams located on the Arkansas River, Neosho (Grand) River and the North Canadian are highlighted. Two of these rivers merge with the Arkansas in eastern Oklahoma. These three rivers are some of the most active rivers in the state. The impact of the dams on the Arkansas, Neosho and North Canadian mirror the effects the other dams in the state would have on the economy and the population if there was a dam breach. **Impact is assessed in several ways: the benefits to human society arising from the dam (agriculture, water, damage prevention and power), the harm or benefits to nature and wildlife (especially fish and rare species), the impact on the geology of an area – whether the change to water flow and levels will increase or decrease stability, and the disruption to human lives (relocation, loss of archeological or cultural matters underwater).** The lakes formed by the dams also provide recreational activities for local citizens as well as tourists and travelers. A dam failure anywhere in the state could be an economic disaster for Oklahoma.

Officials with Oklahoma's conservation districts said the state's dam control system is flooded with problems and desperately needs money to fix them.

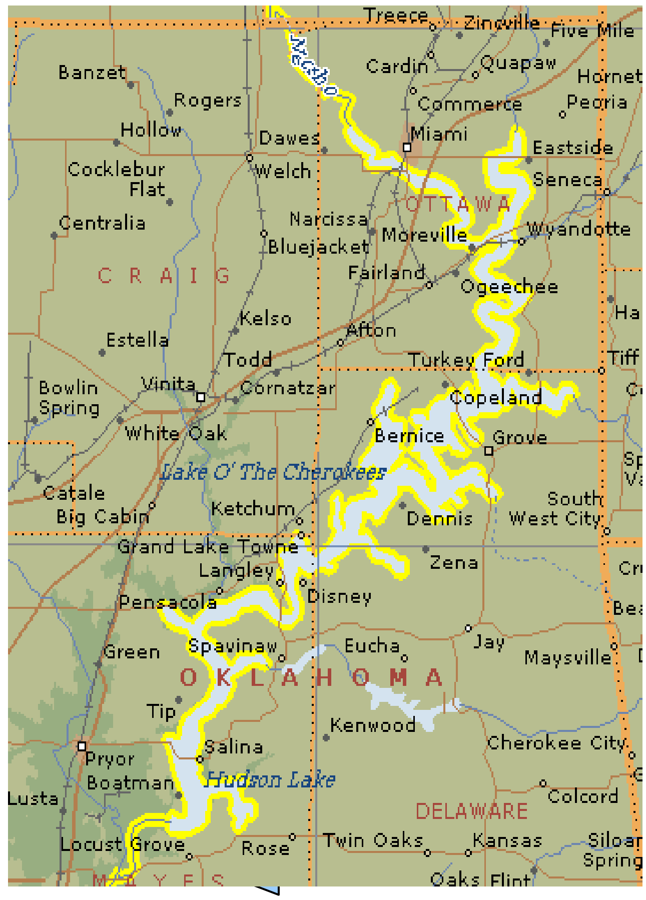
The OACD received $30 million, half of which is to fix dams, officials said. The other half will go to fix breached farm ponds and washed-out roads, terraces and waterways.

Resources:
Assoc. of State Dam Safety Officials (ASDSO)
U.S. Army Corps of Engineers
Oklahoma Association of Conservation Districts

NEOSHO (GRAND) RIVER AND DAMS

The Neosho River flows through Kansas entering Oklahoma in extreme northeastern Craig County northwest of Miami, Oklahoma. In Ottawa County the river turns south-southwest for the remainder of its course through Oklahoma. It meets the Arkansas River near the city of Muskogee, about a mile downstream of the confluence of the Arkansas River and the Verdigris River.

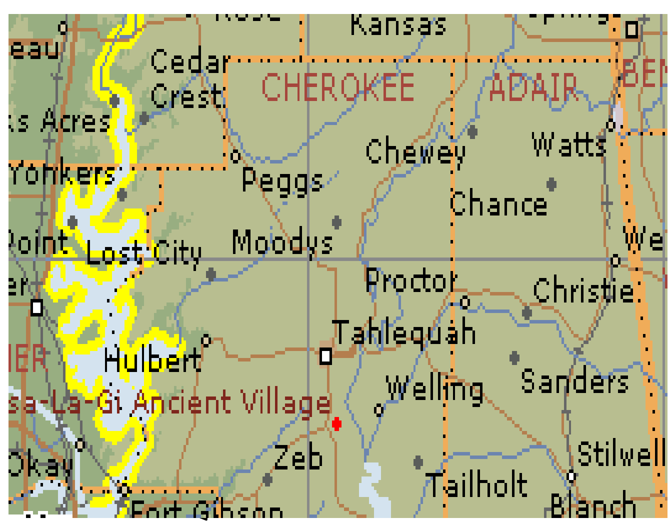
In Oklahoma, the Neosho ends at its union with Spring River at Grand Lake. From that point on it has been the Grand River since the early 1800s. The Neosho has been dammed at several points along its course, in most cases by the U.S. Army Corps of Engineers. In Oklahoma, a dam at Langley forms the Neosho's largest reservoir, the Grand Lake of the Cherokees. A dam near Locust Grove forms Lake Hudson (also known as Markham Ferry Reservoir), and a dam upstream from Fort Gibson forms Fort Gibson Lake. Tributaries in Oklahoma include the Spring River in Ottawa County and the Elk River in Delaware County.



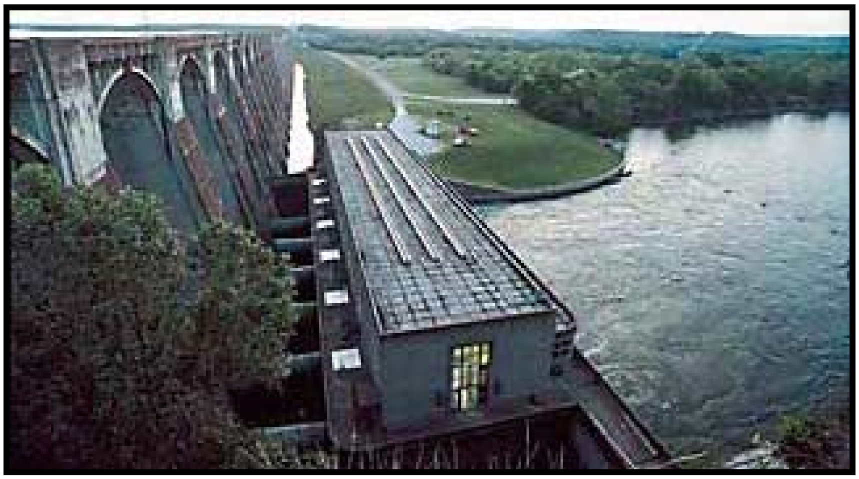
There are three dams located along the Neosho (Grand) River in Oklahoma:

1 – Pensacola Dam – Grand Lake
2 – Markham Ferry Project – Lake Hudson Lake
3 – Fort Gibson Dam – Ft. Gibson Lake

The Neosho (Grand) River joins the Verdigris River and Arkansas River at a point near Hyde Park, Oklahoma southwest of Ft. Gibson Dam and north of the City of Muskogee.



1 - Pensacola Dam



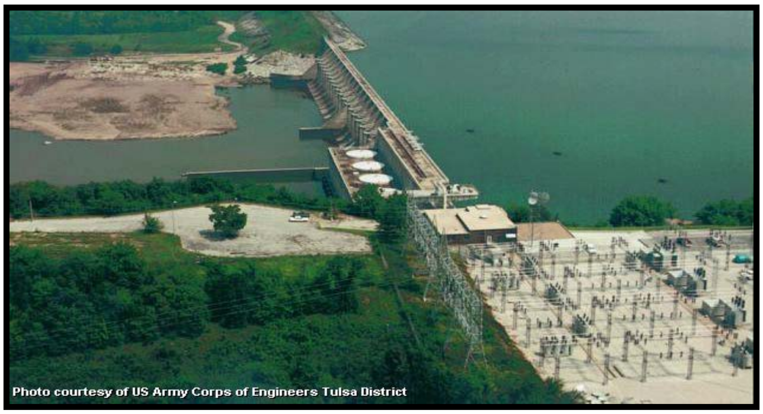
In 1935 the Grand River Dam Authority (GRDA) was created when the 15th Oklahoma legislature passed State Senate Bill 395 (the Grand River Dam Authority Enabling Act). Not only did this authorize construction of the **Pensacola Dam**, which would impound Grand Lake, but it also created a state agency that helped bring thousands of jobs to northeastern Oklahoma. In 1941 with the threat of World War II looming on the horizon, the federal government, via the Federal Power Act, took control of Pensacola Dam. All the country's resources, including electricity, were to be directed toward the war effort. In 1945, with World War II coming to an end, GRDA officials began the long and grueling process to regain control of the dam from the government. By July of 1946, after a year and a half of struggles, Congress passed a bill authorizing the return of the dam to GRDA and the people of the State of Oklahoma.

GRDA built Pensacola Dam between December 1938 and March 1940, when depression-era labor was abundant. Pensacola Dam was the first hydroelectric facility constructed in Oklahoma. It is located between the communities of Langley and Disney, spanning a mile across the Grand River Valley and holding back the 43,500 acres of water that initially formed Grand Lake O' the Cherokees. It is located in Mayes and Delaware Counties. Pensacola Dam generates power for the Grand River Dam Authority to provide electric service in 24 counties and businesses both in and outside the State of Oklahoma. The generating units at Pensacola Dam have a combined generation capacity of approximately 1,274 megawatts (MW). The dam has 21 floodgates on the main spillway and 21 on the east spillways.

The Pensacola Dam remains today a true wonder as the largest multiple arch dam in the world, spanning 6565 feet long with 51 arches and 21 spillways. Rising 150 feet above the river bed, the dam holds the waters that form Grand Lake's 1,300 mile shoreline, surrounding approximately 60,000 surface acres of water and a surface elevation of 742 feet above sea level. Plus, of course, the dam also provides flood control for the Grand (Neosho) River. Should a breach occur in the Pensacola Dam, power would be lost to 24 Oklahoma counties and countless businesses in and out of Oklahoma. Following are the cities and towns that would be impacted by the resulting flood waters: Pensacola, Hoot Owl, Strang, Tip, Salina, and Boatman near the Lake Hudson (Robert S. Kerr) Dam northeast of Locust Grove causing catastrophic losses. Because of the large influx of water into Hudson Lake, some unincorporated communities around the Lake would also receive flooding. Highway 20 in the town of

Salina, a major connector highway for commercial traffic for Delaware Adair and eastern Mayes County to and from Highways 69 and 169; and Will Rogers Turnpike near Tulsa would likely be flooded and unusable. Highway 82, a major north south route through the town of Salina, would also be unusable due to flood waters. This highway is a major commercial connector between I-40 near Vian north to Will Rogers Turnpike north to Joplin, Missouri and the northeastern U.S.

2 – Robert S. Kerr Dam (Markham Ferry Project)



In 1962 after much controversy, Grand River Dam Authority (GRDA) won the authorization tug-of-war with the U. S. Corps of Engineers and began construction of the Markham Ferry Project (**Robert S. Kerr Dam**). Lake Hudson was created in 1964 with GRDA's completion of the Markham Ferry Project (also known as Robert S. Kerr Dam). Not only did this project add to hydroelectricity production of Pensacola Dam on Grand Lake, but also furthered flood control for Grand (Neosho) River. This was the second hydroelectric facility constructed by GRDA. Kerr Dam's powerhouse houses four generators that combine to produce 114 total megawatts of electricity and with an average water year can provide 211,000,000 kWh. Kerr Dam has 17 floodgates and a total discharge potential of 599,000 cubic feet per second.

Lake Hudson, located in the heart of Cherokee Nation, is 2nd in a chain of three lakes along the Grand (Neosho) River, Lake Hudson is nestled between Grand Lake and Fort Gibson Lake at the foothills of the Ozarks. Significantly smaller than its "big sister," Grand Lake O' The Cherokees, Lake Hudson has 12,000 surface acres of water surrounded by 200 miles of shoreline. Hudson has an average elevation of 619 feet above sea level. Besides Grand, it is the only other major lake in the state where residents can own lakefront property on the water's edge.

Should a dam breech occur at the Robert S. Kerr Dam (Markham Ferry) the towns of Pin Oaks Acres, Cedar Crest, and Taylor Ferry would be inundated. These small towns and would likely be totally or mostly destroyed. Highways 412, 82, 51, 80 and 251A would be inundated and commerce in the area would be severely affected. Because of the large influx of water into Ft. Gibson Lake, unincorporated communities around the Lake would also receive flooding.

3 - Fort Gibson Lake Dam

One of Oklahoma's many man-made lakes, **Fort Gibson Lake** is located in Eastern Oklahoma on the Grand (Neosho) River about five miles northwest of historic Fort Gibson, Oklahoma, from which it draws its name. It is about 7.7 miles above the confluence of the Grand (Neosho) and Arkansas Rivers. This 26 mile long body of water lies in Wagoner, Cherokee, and Mayes Counties and extends upriver to the Markham Ferry Dam (Lake Hudson). Fort Gibson is the downstream unit of a three-lake system for flood control and hydroelectric power. Pensacola Dam on Grand Lake and Markham Ferry Dam on Lake Hudson are the other two units in the system. The first two are owned and operated by the Grand River Dam Authority (GRDA), a State of Oklahoma agency, while Fort Gibson was built and is operated by the U.S. Corps of Engineers.

The Fort Gibson project was authorized by the Flood Control Act of 1941 and incorporated in the Arkansas River multiple-purpose plan by the River and Harbor Act of July 1946. The project was started in 1942, suspended during World War II, and completed in September 1953. Constructed by the Corps of Engineers, Fort Gibson Dam was built for flood control and hydroelectric power generation. It is one of eight Corps of Engineers Lakes in Oklahoma that provide hydroelectric power.

Lake Fort Gibson is the seventh largest Oklahoma lake by surface area. At normal level, Lake Fort Gibson is 20,000 acres in size and approximately 35 miles from the dam to the upper headwaters**.** The top of the flood pool for Lake Fort Gibson spillway is 636 feet. Flood control pool storage filled is 34190 acre-feet which is equivalent to 0.06 inches of runoff over the entire drainage basin. The streambed elevation is 554.00 feet with the top of the dam elevation being 645 feet.

A breach in this dam would have little effect on towns downstream. There would however be massive flooding in Fort Gibson (4.054), Hyde Park (2,847) and Muskogee (36,635) due to the influx of water. Additionally 7 miles downstream the Grand (Neosho) River joins with the Verdigris and Arkansas and the arrival of water from Lake Fort Gibson as far north as the Robert S. Kerr Dam would cause massive problems along this 7.7 mile stretch of the Grand (Neosho) River. It should be remembered that the Verdigris River is the access point for commercial shipping traffic from the Mississippi River and New Orleans to the Port of Catoosa for the McClellan-Arkansas Navigation System. At the convergence point and down the Arkansas, massive flooding would continue to occur. Cities and towns southeast of the convergence point on the Arkansas include the towns of Gore and Webbers Falls. Tamara, which is at the mouth of the Robert S. Kerr Lake, would also be inundated. Continued flooding downriver into Arkansas and the Mississippi River also would be probable.

CONVERGENCE POINT OF VERDIGRIS, NEOSHO AND ARKANSAS

A worst case scenario for a dam failure on the Fort Gibson Dam would be a period of “historically heavy” rains and flooding along the lower Arkansas River basin.

NORTH CANADIAN RIVER

The **Beaver (North Canadian) River** flows through the full length of Oklahoma from its entry point in the panhandle 30 miles west of Boise City. It is dammed near Canton forming Canton Lake in Blaine County and from that point is known as the **North Canadian River** and becomes a significant river in Oklahoma. It then flows to Oklahoma City where both Lake Hefner and Lake Overholser receive water from Canton Lake through the North Canadian. In 2004 a seven-mile portion of the river was renamed the Oklahoma River and has several low water dams creating a series of small lakes. From Oklahoma City the North Canadian continues to meander through central Oklahoma, where it enters Lake Eufaula northeast of Stidham. It converges with the Deep Fork and South Canadian Rivers ending its 500+ mile journey through Oklahoma which forms Lake Eufaula; then flows to the Arkansas River through the Robert S. Kerr Lake into Arkansas.

Three dams are addressed in this plan on the Canadian:

1 – Canton Lake Dam – Canton Lake
2 – Overholser Dam - Overholser Lake
3 – Eufaula Dam – Lake Eufaula

Optima Lake is an artificial lake in Texas Co. The lake is located near the town of Hardesty in the Oklahoma Panhandle. The lake has never reached more than 4 percent of its design capacity, and now is effectively empty. Rapid declines in stream flow (related to large-scale pumping from the High Plains Aquifer) coincided with the completion of dam construction to make this lake a dramatic example of unanticipated environmental impacts. Due to the fact this lake has never reached more than 4% of its design capacity, the **Optima Lake Dam** will not be considered in the Hazard Mitigation plan.

1 – Canton Dam

Canton Dam is located in northwest Oklahoma on the North Canadian River, two miles north of the town of Canton. The construction of Canton Dam was completed in 1948. Dams along the North Canadian River are in place to aid in water management and the prevention of flooding. Primary functions are flood control and recreation. Canton Lake Dam located in Blaine County is an earthen embankment with a gate controlled concrete gravity chute-type spillway located on the right abutment. The dam is a 15,140-foot-long structure with a 640-foot gated, concrete spillway which rises to a maximum height of 68 feet above the streambed. State Highway 58-A extends across the embankment and spillway. The total amount of water stored in Canton Lake is 114,370 acre-feet, and the total drainage area for the lake is 12,483 square miles (including upstream projects). The spillway discharges are controlled by 16 tainter gates. The dam provides flood control protection as well as water storage on the Canadian River in Oklahoma. Oklahoma City obtained water rights to Canton Lake so water from Canton flows to Oklahoma City's Lake Hefner and Lake Overholser.

The stability of the Canton Dam spillway and the amount of floodwater the dam could safely hold has been the subject of concern and discussion for over 30 years. Restrictions on the amount of water the dam can safely hold affected the dam's ability to provide flood protection to the level for which it was designed. Due to these restrictions, downstream flooding could occur. This potential flooding could impact even downtown Oklahoma City. About 60,000 people live downstream of the dam and could be affected by an uncontrolled release of water with potential economic losses between $1.75 and $2.84 billion. In 2005 the Corps of Engineers received funding to make the appropriate adjustments in the dam to stabilize its operation.

If a breach occurred in this dam, several communities downstream would be affected and some possibly destroyed. Much of the area between Canton and Oklahoma City is agricultural and several highways and two railroads would be unusable so the economic loss would be huge as highlighted above. The Town of Canton (625) is located only two miles below the Dam and would likely be inundated with floodwaters. Other towns that would be affected include Greenfield (93) Watonga (5,111), parts of El Reno (17,510), parts of Yukon (24,128) and parts of downtown Oklahoma City.

2 - Lake Overholser Dam

In 1910, Oklahoma City's population was 32,000, a growing meatpacking industry was in place, and the City had been newly designated as the state capital. From the Land Run forward, Oklahoma City had depended on raw water from the North Canadian and a handful of water wells. But it was now clear to City leaders that wells would not produce enough water to satisfy the needs of future growth. In 1913, the United States Reclamation Service (now the U.S. Bureau of Reclamation) recommended a dam and reservoir be built upriver from the City. In 1916, under the leadership of Mayor Ed Overholser, citizens voted to build a dam and reservoir at a location that was then eight miles west of town. In 1917, the **Overholser Dam** was built to impound water from the North Canadian River and to serve the growing City.

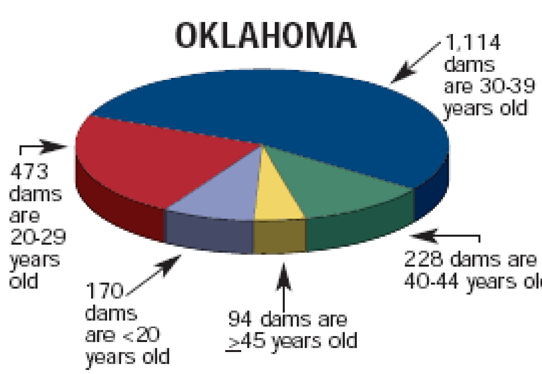
The dam is 62 feet high and 1,258 feet long using concrete buttresses to support a slab of concrete that holds back the water. Today, Lake Overholser is a 'backup' reservoir, tapped during the summer to meet the increased seasonal demand. The dam was added to the National Register of Historic Places in 2007. The lake is owned by Oklahoma City and covers 1700 surface acres with an average depth of six feet and only 13 feet at the deepest point. Shoreline length is seven miles. In August 2007, even though the flood gates were fully opened, water still flowed over the dam due to Tropical Storm Erin.

A breach in the Overholser Dam would cause flooding in part of downtown Oklahoma City (599,199), Spencer (3,927), parts of Jones (2,703), and part of Harrah (5,398). Flooding could continue as far as McLoud (4,053) and Shawnee (30,649). The effects of a dam failure would be catastrophic to the area around Oklahoma City, whether it was from Canton Lake Dam or Lake Overholser Dam.

3 - Eufaula Lake Dam

Lake Eufaula, an entirely manmade lake, began when the River and Harbor Act was approved July 24, 1946. The U.S. Army Corps of Engineers constructed the dam for flood control, water supply, and hydroelectric power and navigation resources. Power was first generated in July, 1964. The project was completed for full flood control operation on February 10, 1964. Formed by the South Canadian River, North Canadian River and Deep Fork River, the lake is located approximately 40 miles south of the City of Muskogee. The lake located in McIntosh, Pittsburg, and Haskell Counties has over 600 miles of shoreline and 102,000 surface acres of water (223 square miles). Construction of the 3,199 ft. long rolled earth dam began in 1956 and was completed in1964. The dam rises to a maximum height of 114 feet above the streambed and holds back a lake area of over 256 square miles. The maximum discharge rate is 465,000 cubic feet per second. The hydroelectric power station is capable of generating 90,000 kilowatts of power. The dam elevation is 612 feet, and it and is is owned by the U.S. Army Corps of Engineers.

Lake Eufaula is the largest lake located entirely in the State of Oklahoma. Nicknamed the "gentle giant," it is located on the Canadian River, 27 miles upstream from its confluence with the Arkansas River. Oklahoma State Highway 71 crosses the crest of the dam. The lake's maximum depth is 87 feet, and the mean depth is about 23 feet. Should the Eufaula Dam breach, the small towns of Hoyt and Whitefield (231) are the only towns between the dam and its drainage area at the Arkansas River just before it enters Robert S. Kerr Lake.



3.2.9.3 Extent:

The State of Oklahoma considers a dam failure when seepage or small breach where the water stays within the downstream river channel, to be a minor severity. A breach large enough to exceed the capacity of the river or creek channel and overflow causing damage to homes, businesses, critical facilities, state buildings and putting people at risk is considered a major severity. This includes situations where the dam flow control manager releases more water than can be contained in the banks of the downstream river or creek channel.

3.2.9.4 Previous Occurrences:

The Oklahoma Water Resources Board related there have been two high hazard dam breaks in Oklahoma since 1950. The dams at Sapulpa Lake and Cedar Lake failed; however, both were slow seepage failures which caused minor downstream flooding which caused only property damage with no loss of life occurring.

During recent flood events, several small earth dams on farm and ranch ponds broke due to erosion caused by the heavy rains.

3.2.9.5 Probability of Future Events:

The Water Resources Board requires submittal and subsequent approval of plans and specifications prior to dam construction or modifications to ensure the structures will meet minimum dam safety standards. OWRB staff also coordinates periodic training sessions and workshops on dam safety issues and regulations for dam owners and engineers. The Natural Resource Conservation Service offers technical assistance in the construction of small farm ponds and related structures.

The potential for future dam breaks, while **unlikely**, is possible considering the age of many of the dams in the state.

Calculated Priority Risk Index (CPRI)

Dam Failure = 2.65

<table>
<tr><td colspan="3">Probability</td><td colspan="2">1 Unlikely</td></tr>
<tr><td colspan="3">Magnitude/Severity</td><td colspan="2">4 Catastrophic</td></tr>
<tr><td colspan="3">Warning Time</td><td colspan="2">4 Less than 6 hours</td></tr>
<tr><td colspan="3">Duration</td><td colspan="2">4 More than one week</td></tr>
<tr><td colspan="5">The CPRI for the Dam Failure hazard for the State of Oklahoma is:</td></tr>
<tr><td>Probability</td><td>+Magnitude/Severity</td><td>+ Warning Time</td><td>+ Duration</td><td>= CPRI</td></tr>
<tr><td>(1 x .45)</td><td>+ (4 x .30)</td><td>+ (4 x .15)</td><td>+ (4 x .10)</td><td>= 2.65</td></tr>
</table>

Resources: Oklahoma Conservation Commission; Oklahoma Association of Conservation Districts; Oklahoma Water Resources Board ; U.S. Army Corp of Engineers; U.S. Natural Resources Conservation Service

3.2.9.6 Vulnerability and Impact:

Houses and businesses, and government infrastructure could suffer extensive damage in a major loss of water from high hazard or significant hazard dams, as well as the death of citizens, wildlife and livestock. Disruption of citizens' day-to-day traffic as well as critical services such as emergency police, fire, and ambulance could also occur. School bus and mail routes would also be disrupted due to damaged or destroyed roads and bridges. Power and water outages would likely occur which would cause food spoilage and sanitation problems for communities. Schools, hospitals, grocery stores and other critical need and economically important facilities could be damaged and closed for extended periods. Employment is often affected because of businesses that close due to the flood damage and loss of business.

As with any man-made structure, potential dam failures could place lives and property at risk. The best way to minimize the risk potential is to identify dams whose failure could cause the greatest loss of life and/or property, and to require a rigorous inspection regimen. Such is the case in Oklahoma. From a hazard management perspective, the most noteworthy structures are those categorized as High Hazard dams.

This designation relates solely to potential impacts of a structural breach; it is not an indication of the quality of construction or maintenance. Dam failures can result from any one or a combination of the following causes:

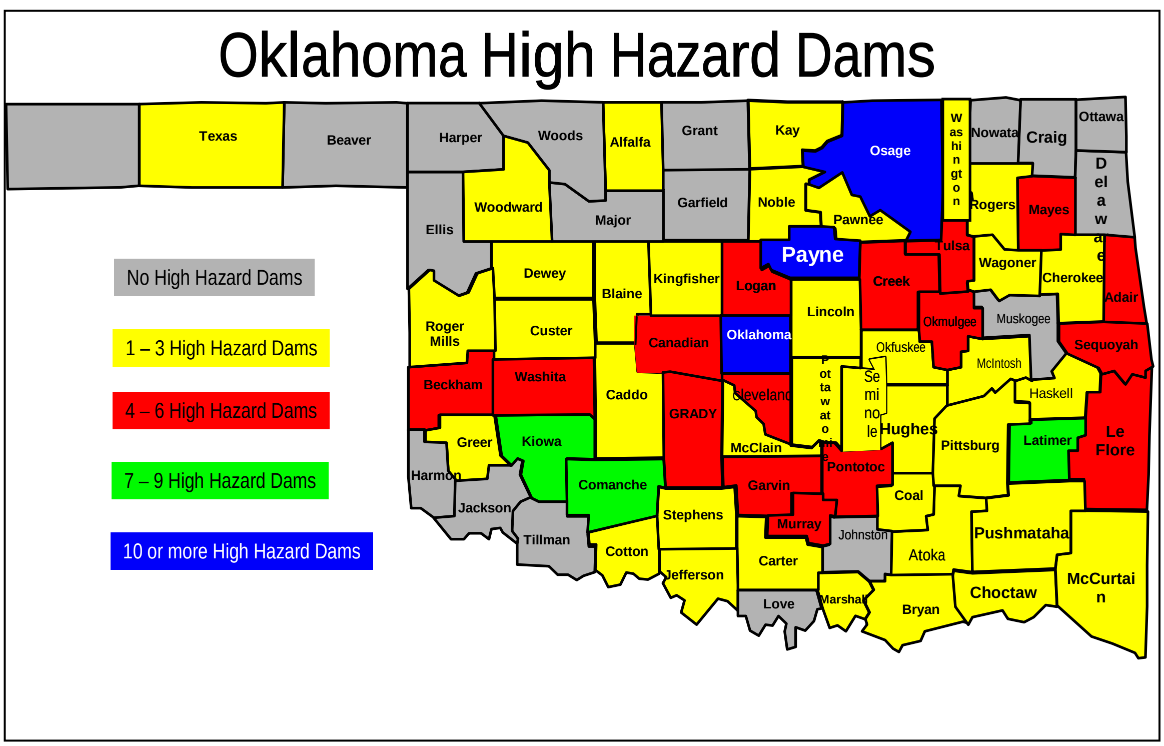
- Prolonged periods of rainfall and flooding, which causes most failures;
- Inadequate spillway capacity, resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross section of the dam and abutments;
- Improper design, including the use of improper construction materials and construction practices;
- Negligent operation, including failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway;
- Landslides into reservoirs, which cause surges that result in overtopping;
- High winds which can cause significant wave action resulting in substantial erosion, and
- Earthquakes, which typically cause longitudinal cracks at the tops of embankments that weaken entire structures.

3.2.9.7 Vulnerable Populations:

Many of the larger lake dams in Oklahoma were constructed through federal projects and come under the control of the U.S. Army Corps of Engineers.

Oklahomans living below any dam structure, whether small or large, should have plans in case of a break or major overflow of the dam. All structures and persons in these locations are vulnerable to a dam failure.

The following map depicts the number of High Hazard dams by county, for the State of Oklahoma. Osage, Payne, and Oklahoma counties have the highest vulnerability to the hazard of Dam Failure.
(Source: U.S. Army corps of Engineers)



3.2.9.8 Conclusion:

Oklahoma has hundreds of High Hazard and Significant Hazard dams that could possibly put people and structures at risk, but there have been only two recorded dam failures in the State of Oklahoma since 1950. Flooding potential exists if dam failure should occur at these high hazard dams.

The OWRB coordinates the Oklahoma Dam Safety Program to ensure the safety of dams that could impact downstream life and property. The program requires inspections every five and three years for Low and Significant Hazard structures, respectively. It requires annual inspection of the state's High hazard dams.

A number of programs from Dam Safety to Dam Rehabilitation projects have been and continue to be produced throughout Oklahoma by state and federal agencies.

<u>Education:</u>

Because many of these dams are very old structures that need periodic repair, the OWRB requires submittal and subsequent approval of plans and specifications prior to dam modifications. This agency also coordinates periodic training sessions and workshops on dam safety issues and regulations for dam owners and engineers. The Natural Resource Conservation Service (NRCS) offers technical assistance in the construction of small farm ponds and related structures.

<u>Oklahoma - Watershed Program Leader</u>:

Oklahoma leads the nation in the number of small watershed upstream flood control dams constructed with 2,101. The State has always been a leader in flood control beginning with the construction of the first flood control dam in the nation in 1948, Cloud Creek Dam Number 1. The dam located near Cordell, Oklahoma, is in the Cloud Creek Watershed, a tributary to the Washita River and was built by local watershed project sponsors with assistance from the USDA Soil Conservation Service (now Natural Resources Conservation Service). Funding and technical assistance was authorized by the Flood Control Act of 1944 (Public Law 78-534).

Legal Controls:

State Law 785:25-7. Warning and evacuation plans.

- Owners of existing or proposed dams classified as high hazard, regardless of the size of such dams, and any other dam as determined by the Board, shall provide an adequate warning system and written evacuation plan to protect downstream lives and property, with a written description of said system and written evacuation plan to be approved by and filed with the local Civil Defense authorities.
- Additionally, the written description of the warning system and approved evacuation plan shall be filed with the OWRB.

Rehabilitation:

Many of the early-constructed flood control dams in the state were built with a designed life span of 50 years. Oklahoma has 59 dams that were 50 years old by 2003. By 2005, that number was 132; by 2010 it was 463; and by 2015, 1,090 or more than half of the dams will have reached or exceeded their design life. Some dams need rehabilitation to ensure they continue to function as they were designed and remain safe.

Today many dams are in a far different setting than when they were originally constructed. Population has grown; residential and commercial development has occurred both upstream and downstream from dams; land uses have changed; sediment pools have filled; and concrete and metal components have deteriorated. Today some dams do not meet current dam safety regulations that have been enacted and revised with more stringent requirements than when the dams were built.

NRCS has undertaken rehabilitation of some of the dams. The federal government provides 65 percent of the funding for rehabilitation projects and project sponsors provide 35 percent. Projects are selected on a priority basis with those with high safety and health concerns receiving the highest priority. Oklahoma was the first state to complete a rehabilitation project. Sergeant Major Creek Dam Number 2 in Roger Mills County was rehabilitated as part of a pilot project in July 2000. Sergeant Major Creek Dam Number 1 was rehabilitated a few months later. Sandstone Creek Dam Number 17A in Roger Mills County was the first dam in the nation to be rehabilitated under the 2000 Watershed Rehabilitation Amendments. The project was completed in June 2003.

By 2005 Oklahoma had rehabilitated six watershed dams and 19 more were in various stages of planning, design or construction. Another 34 dams had initial rehabilitation studies completed. It is estimated that it will take $30 million to rehabilitate the highest priority dams in the next five years. Additional funding is provided through the State legislature and facilitated by the Oklahoma Association of Conservation Districts, and the Rural Economic Action Plan (REAP).

Most state-owned facilities are not located in floodways or areas that would be affected by dam failure. It is difficult to estimate costs associated with dam failure because only two minor occurrences have occurred in Oklahoma.

3.3.10 Extreme Heat

Hazard Priority # 10

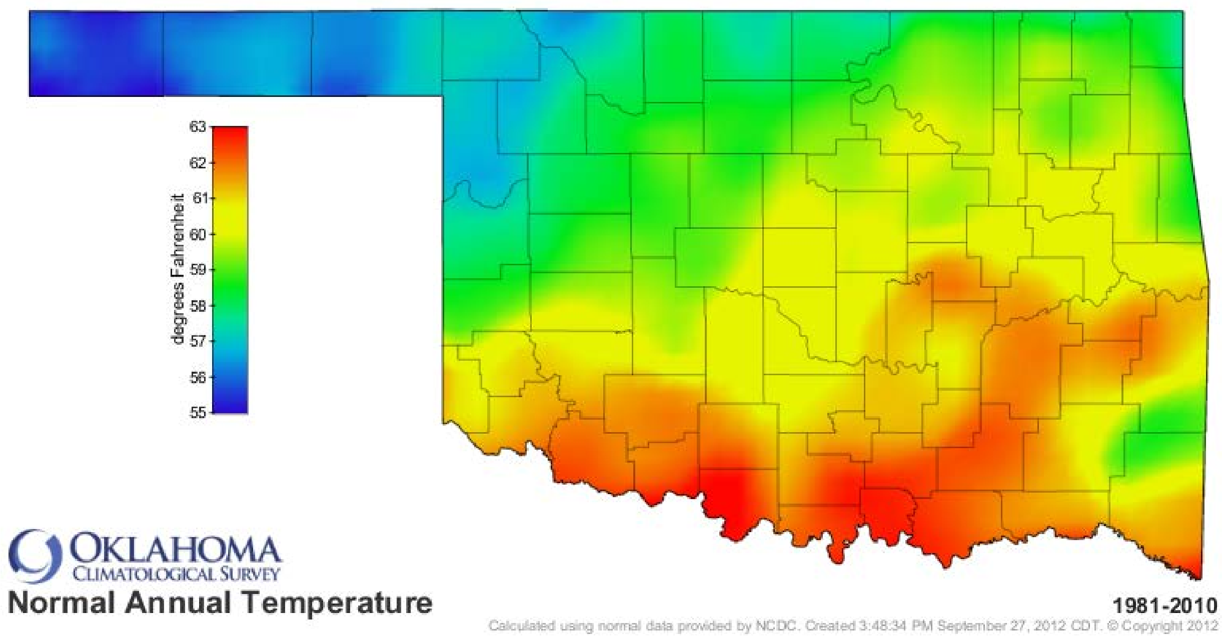
3.2.10.1 Description:

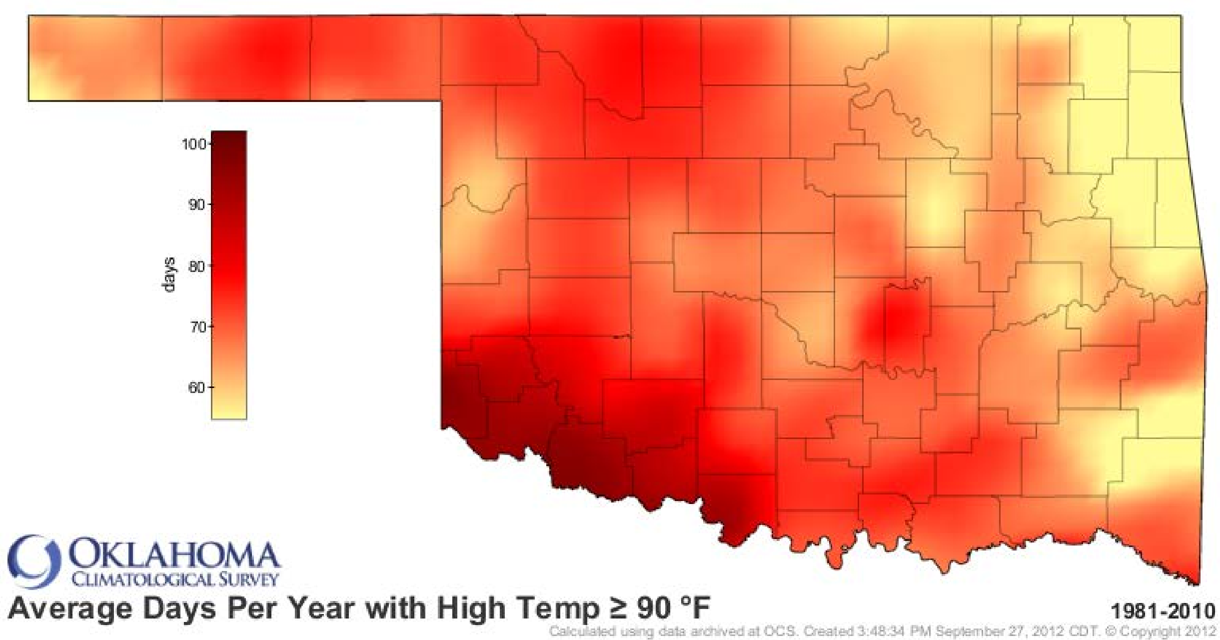
Oklahoma summers, along with the rest of the Southern Great Plains, are prone to extreme heat. Summertime temperatures routinely climb above the 100-degree mark and when combined with high dew point temperatures can create very uncomfortable conditions. Temperatures that hover 10°F or more above the average high temperature for the area and last for several days or longer is one measure of extreme heat, sometimes called a heat wave. Humid or muggy conditions can persist and air quality can deteriorate during the summer when a dome of high atmospheric pressure creates a temperature inversion that traps a stagnant air mass near the ground.

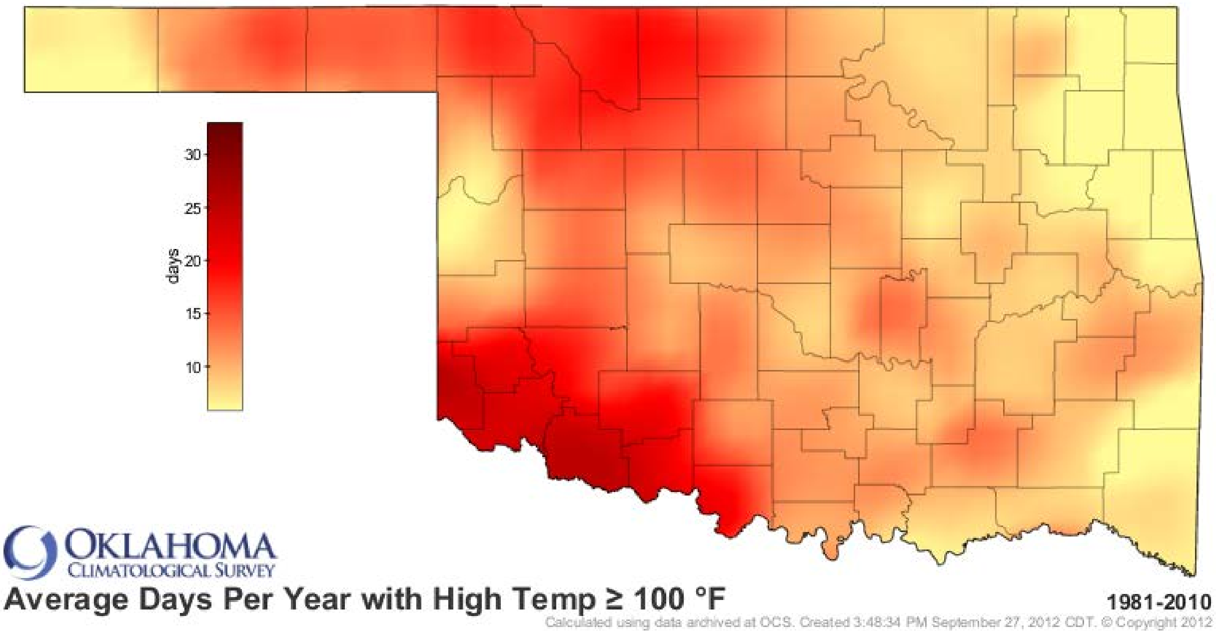
There is no uniform set of attributes that define a heat wave, but events involving persistent hot extreme temperatures can produce negative impacts on ecosystems, the local economy, and human morbidity and mortality. The onset of a heat wave can be subtle and does not result in structural damage like other meteorological events. Extreme heat waves in urban areas can be particularly harmful due to the urban heat island environment in which they occur. Even in rural areas extreme temperatures can significantly damage crops, especially if too hot of temperatures occur during critical growth periods. Certainly hot temperatures dramatically increase the rate of evaporation off crop fields and farmers must irrigate at much higher rates to maintain growth. Meteorologists use different ways to describe heat waves, including daytime high and overnight low temperatures, duration, moisture, and relation to the climate variability observed at a given location.

Depicted below are annual temperature maps for Oklahoma. The mean annual temperature over the state ranges from 63 F along the Red River to near 55 F in the Panhandler. Temperatures of 90 F or greater occur on average about 60 days per year in eastern Oklahoma. In the southwest, the average is about 100 days per year. Temperatures of 100 F or higher occur, frequently during some years, from

May through September, and very rarely in April and October. The southwestern part of the state observes an average of 30 days with temperatures 100F or higher, while the eastern part of the state and the western Panhandle average about 10 days. The hottest months of the year in Oklahoma are July and August. The gradually shortening days and the occasional arrival of cooler weather from the north frequently bring the state modest relief from summer heat by late August.






30
25
20
15
10
days
OKLAHOMA
CLIMATOLOGICAL SURVEY
Average Days Per Year with High Temp ≥ 100 °F
1981-2010
Calculated using data archived at OCS. Created 3:48:34 PM September 27, 2012 CDT. © Copyright 2012

3.2.10.2 Location:

The entire State of Oklahoma may experience extreme heat.

3.2.10.3 Extent:

A measure of extreme heat that incorporates both temperature and moisture values is the heat index. The heat Index is the temperature the human body feels when heat and humidity are combined. When coupled with hot temperatures, high humidity can impeded the human body from cooling by lack of evaporation off the skin. The State of Oklahoma considers any reading on the Heat Index Chart of 105 degrees and hotter to be a major severity and a reading of 104 degrees and below a minor severity.

Heat Index Chart

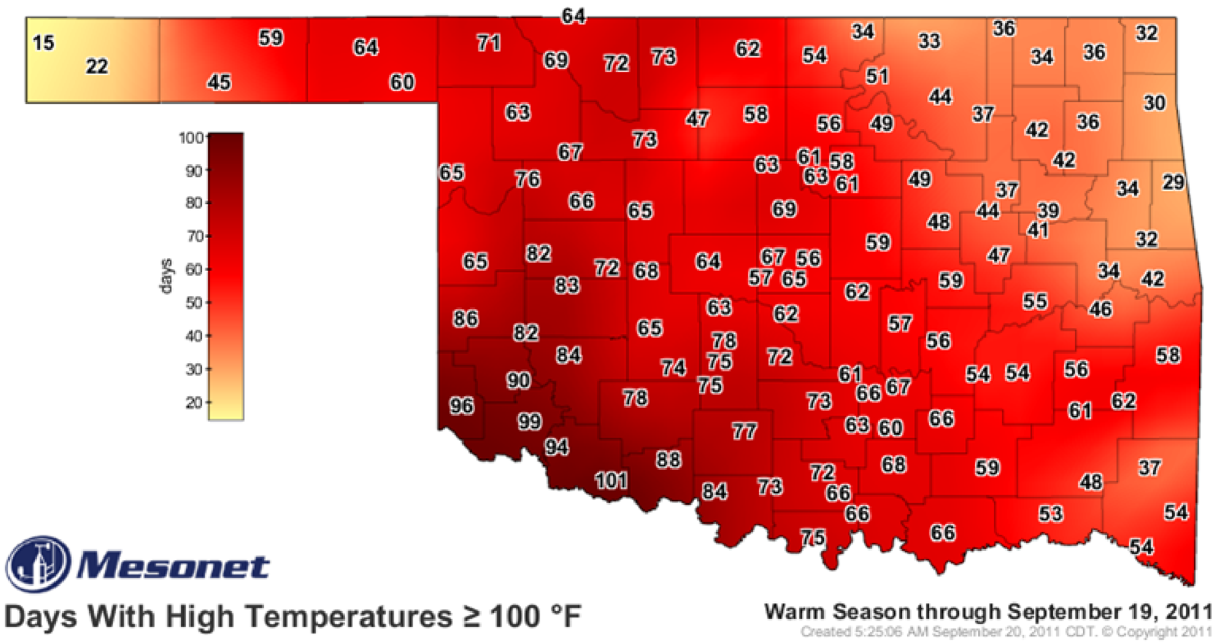
% Relative Humidity

Temperature	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
110	108	112	117	123	130											
105	102	105	108	113	117	122	130									
100	97	98	102	104	107	110	115	120	126	132						
95	91	93	95	96	98	100	104	106	109	113	119	124	130			
90	86	87	88	90	91	92	95	97	98	100	103	106	110	114	117	121
85	81	82	83	84	85	86	87	88	89	90	92	94	96	97	100	102
80	76	77	78	78	79	79	80	81	82	83	84	85	86	87	88	89

Legend	
80-89 degrees	Fatigue is possible with prolonged exposure and/or physical activity.
90-104 degrees	Sunstroke, heat cramps and heat exhaustion are possible with prolonged exposure and/or physical activity.
105-129 degrees	Sunstroke, heat cramps and heat exhaustion are likely. Heat stroke is possible with prolonged exposure and/or physical activity.
130+ degrees	Heatstroke/sunstroke is highly likely with continued exposure.

3.2.10.4 Previous Occurrences:

Summer heat waves, extreme temperatures and their impacts have a storied history in Oklahoma, as demonstrated by the state records. Oklahoma holds the record for the hottest month of any state on record since 1895, with a statewide average high temperature during August 2012 of 93.4F. The hottest day of 2012 was August 3rd with a high temperature of 113 degrees. The hottest Oklahoma summer on record was in 2011 with a statewide average of 86.8 F. Below is a map of the number of days a temperature of 100 F or above was recorded by Oklahoma Mesonet sites during the summer of 2011. The state record daily maximum temperature of 120°F has been recorded six times: 7/18/1936 in Alva, 7/19/1936 and 8/12/1936 in Altus, 8/10/1936 in Poteau, 7/26/1943 in Tishomingo, and 6/27/1994 in Tipton.



Significant Oklahoma Extreme Heat
(Information provided by National Weather Service, Oklahoma Climatological Survey and the National Climate Data Center)

Summer 2012
Oklahoma experienced a very hot summer in 2012, along with much of the middle of the country do to a persistent ridge of high pressure and severe drought conditions. Extremely hot temperatures and high humidity combined to produce dangerously hot weather conditions at times across Oklahoma. Daily heat index values climbed into the 105 to 115 degree range with little relief occurring at night as temperatures only fell into the upper 70s to mid 80s. August 2, 2012 was the fourth hottest day in Oklahoma history, only behind historic days in 1936, with a statewide average temperature of 94.9 F. Oklahoma City tied its all time record high temperature of 113 F August 3. More than 88 people were reported as treated at hospitals for heat illness.

Summer 2011
An abnormally strong ridge of high pressure over the south central US dominated the summer and severe drought resulted in prolonged hot temperatures. High temperatures routinely climbed over 100 under mostly clear skies. This heat combined at times with fairly high relative humidity values resulted in afternoon heat index values, or apparent temperatures, in the 105 to 110 degree range. Very little relief was realized during the overnight period as temperatures only fell into the mid to upper 70s. Oklahoma experienced the hottest summer on record for the state. The statewide average high temperature over the entire summer was 100.5 F. Over 296 people were hospitalized for heat illness and the Oklahoma Office of the Chief Medical Examiner reported 33 heat related deaths in the state.

Mid July - August 2010
Temperatures were above normal with daytime readings regularly reaching the upper 90s to near 102 and overnight temperatures only falling into the mid to upper 70s. Due in part to heavy rains in June and

early July, very humid conditions resulted in afternoon heat index values between 105 and 115 degrees. As Oklahoma slowly dried out through July, the high heat index values were traded with higher ambient temperatures. At least 127 people were treated for heat-related illness.

July – August 2008
A prolonged period of excessive heat occurred across much of central and eastern Oklahoma during the early part of August. Daytime high temperatures reached the 100 to 105 degree range, daily maximum heat index values reached the 105 to 115 degree range, and morning low temperatures only fell into the upper 70s to lower 80s. Two direct fatalities resulted from this heat in Tulsa County and dozens of others were treated for the heat by EMSA. One man died due to a heat-related illness while driving a tractor six miles north of Lone Wolf. Another person hospitalized after collapsing from heat exhaustion in Oklahoma City. There were also at least 47 hospitalizations for heat illness.

August 2007
Temperatures were in the upper 90s and heat indices were around 103. A 47 year old railroad worker collapsed of heat exhaustion after working all day in the summer heat. The man died shortly after being transported to a hospital. A strong ridge of high pressure developed over the south central United States resulting in abundant sunshine and hot temperatures. The humidity was also high as a result of the spring rains that continued well into the summer. The combination of hot temperatures and high humidity resulted in daytime heat index values from 105 to 113 degrees across much of eastern Oklahoma. Overnight temperatures remained above 75 degrees, which didn't allow much relief from the heat. Two hundred other people were treated by EMSA in Tulsa for heat related illnesses. Many of those victims were in attendance at the PGA Championship.

July - August 2006
Temperatures reached triple digits across Okla. Starting in mid-July and continued through the end of the month. Many locations at times reached 105 degrees of greater with higher heat index values. Overnight lows remained warm for much of this time also with most locations only falling to 75+ degrees. The heat caused 24 reported fatalities and at least 100 hospitalizations during this time period. Many fatalities occurred in homes that did not have fans or working air conditioners. Paramedic services also made numerous calls for heat-related illnesses during this time. The heat also caused a portion of Interstate 44, on the W side of Oklahoma City, to buckle. The heat also caused a strain on several power grids causing local authorities to ask people to minimize the consumption of power during the hottest parts of the day to prevent brown outs.

July 2001
An extended period of excessive heat affected all of western and central Oklahoma in July. Daily mean temperatures ranged from the mid 80s to near 90 degrees, which is four to five degrees above normal. Most areas regularly experienced high temperatures at or above 100 degrees, particularly western and north central Oklahoma. In addition to the excessive heat, rainfall averaged about one-third of normal, resulting in a drought.
During the middle of July strong high pressure in the upper atmosphere became anchored over the south central part of the United States. This high pressure brought extreme heat to parts of NE Okla. At the Tulsa International Airport eight days out of eleven from July 16 to July 26 had high temperatures above 100. Meanwhile, on six of those days the low temperature did not fall below 80. Humidity was also a problem with dew points generally in the lower to mid 70s. This resulted in afternoon heat indexes around 115. There were nine reported heat fatalities during this time.

Late August – Early September 2000
There were 12 days in a row at or above 100 degrees in Oklahoma City with three heat fatalities during this time.

Late July 1999
A period of very hot temperatures with highs ranging from the upper 90s to near 105 and lows ranging from the lower 70s to near 80, affected portions of central and southwest Oklahoma. Eight people died from the excessive heat. Except for one fatality in Altus (Jackson Co.), the majority of persons who died from the heat owned an air conditioner, but it wasn't being used, and the windows of their homes were closed.

Summer 1998
Extreme heat affected western and central Oklahoma from May through early October with the most intense heat and severe drought conditions occurring from mid-June through early September across central and southern Okla. There were 19 reported heat fatalities and at least 452 hospitalizations during this summer. In the wake of a thunderstorm in Tulsa in the early morning of June 21, about 25,000 PSO customers in Tulsa lost electricity on Monday evening, June 22. The loss of air conditioning left many people vulnerable to afternoon temperatures of 96 degrees and heat indices in excess of 105 degrees. In July temperatures in some portions of SE Oklahoma rose above 100 degrees on all but two days. August 2 marked eleven days in a row with high temperatures of at least 105 degrees in McAlester.

Early July 1996
High temperatures topped the century mark in central Oklahoma through the first week of July. On July 1, the high in Oklahoma City (at OKC) reached 102 degrees, then 104 on the 2nd, 103 on the 3rd, 105 on the 4th, 108 on the 5th, 110 on the 6th, and 106 on the 7th. During this prolonged period of hot temperatures statewide there were 7 deaths attributed to the excessive heat. All of the victims were elderly and all but one were in their homes without air conditioning.

June 27, 1994
Temperatures climbed to above 110 degrees in SW Okla. with readings in excess of 100 in NW and central Okla. The high temperature of **120 degrees** from the Oklahoma Mesonet four miles S of **Tipton** tied the record for the highest temperatures ever recorded in the state. Additional high temperatures included 119 degrees three mi. S of Altus, 116 degrees three mi. W of Gould, in Hollis and in Chattanooga and 115 in Frederick. An 84-year-old man who was working on his car in NW Oklahoma City during the afternoon hours died from the heat.

Summer 1980
A very hot Oklahoma summer resulted in Oklahoma City exceeding 100 degrees 50 times during the season.

1930s
Prolific summer heat coincided with the Dust Bowl drought in Oklahoma, especially during the historic summer of 1936. The top three statewide hottest days on record were all in the summer of 1936. The state's all time high temperature of 120 F was reached four times that summer as well. Oklahoma observed 22 consecutive days of 100+ F heat from August 4 to August 25, 1936, a record that still stands. Scientists have related the extreme heat in part to human actions resulting in vegetation loss and the addition of soil aerosol dust to the atmosphere.

3.2.10.5 Probability of Future Events:

The probability is **Likely** that Extreme Heat will continue to be a major concern throughout Oklahoma.

Calculated Priority Risk Index (CPRI)

Extreme Heat = 2.4

Probability			3 Likely	
Magnitude/Severity			2 Limited	
Warning Time			1 24+ Hours	
Duration			3 Less than one week	
The CPRI for the Extreme Heat hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (2 x .30)	+ (1 x .15)	+ (3 x .10)	= 2.4

Resources:
Federal Emergency Management Agency
National Weather Service
Oklahoma Climatological Survey

3.2.10.6 Vulnerability and Impact:

The entire State of Oklahoma is at risk for extreme heat.

Oklahoma has a significant Extreme Heat hazard due to its climate. Summers are hot and usually dry, with daytime highs in the mid-90s or higher, and generally less than 4 inches of rain in July and August. Power supplies throughout Oklahoma are often adversely affected due to high use by the population. Roads are also affected by extreme heat. Asphalt roads tend to “melt” or soften with continued heat. Many of these roads are used by school buses and mail carriers. Concrete roads “explode” and crack due to the heat.

Agriculture is an important industry in Oklahoma and extreme heat can be extremely damaging to various crops during the summer months.

Livestock and livestock products make up the majority of Oklahoma’s yearly farm income and the industry suffers when grass dries up and ranchers are unable to properly feed their livestock. Most of the state’s cattle ranches are concentrated in the Panhandle and northern portions of Oklahoma. Beef producers are especially concerned with the lack of moisture, short forage supplies, the distance they have to go to find hay, and the price they have to pay when they find it. They are also concerned about the impact the high daily temperature and humidity have on their cattle.

Cattle have an upper critical temperature that is 20 degrees cooler than humans. At 82 degrees and 75% humidity, humans may start to feel a little uncomfortable, but cattle will be in the danger zone for heat stress. At 90 degrees and 65% humidity, cattle are at extreme risk for heat stress. The humidity makes it difficult for cattle to dissipate body heat at these temperatures. The Heat Index can however be

The drought of 2006 will long be remembered for a variety of reaso
temperatures. However, most beef producers will be more concerned with t
distance they had to go to find hay, and the price of it when they could f

cattlemen face is the ever
and humidity, and the imp

Cattle have an upp
cooler than humans. At 8
may start to feel a little un
percentage cattle) will be
degrees and 65% humidity
is the humidity that makes
heat at these temperatures

The heat index wh
temperature and humidity
be used to determine when cattle can be safely handled without losing them t
process for fall born calves can be stressful enough on the calves in pleasant
temperature-humidity index it can be fatal. The following suggestions may h
be worked for one reason or another during the high temperatures and humid

used to determine when cattle can be safely handled without losing them to heat prostration. The Cattle Comfort Index, developed and accessible through the Oklahoma Mesonet, is an apparent temperature index specially designed for cattle sensitive thresholds.

Prolonged periods of high temperatures present a hazard to life and property which can lead to water shortages, intensify fire potential, and prompt excessive demands for energy. Extreme heat often causes power power due to air conditioners. Food spoilage and sanitation problems beg out for more than a few hours. Disruption of traffic flow occurs, and wate again due to overuse or low water supplies because of lack of precipitation.

Air pollution can also be a problem during summer months in Oklahoma. In the upper atmosphere, a naturally occurring gas called ozone forms a protective layer that shields against the sun's ultraviolet rays. At ground level, ozone is a harmful air pollutant and a primary constituent of urban smog. Ozone is produced when air pollutants from automobile emissions and manufacturing operations interact with sunlight, with the reaction even more effective during hot weather. Long-term exposure to high concentrations of ozone can cause a significant reduction in lung function, inflammation of the airways, and respiratory distress. The stagnant, dirty, and toxic air does not move away until a weather front arrives to disperse it.

Damage to property during extreme heat is largely related to expanding and contracting soil and is covered under Hazard # 14, "Expansive Soils".

3.2.10.7 Vulnerable Populations:

Some elderly citizens who lack air conditioners or fans (or who choose not to use them due to economic concerns) may become victims of the severe temperatures. People working outside are also vulnerable to extreme temperatures. Both groups can become victims of heat exhaustion or heat stroke, which can be fatal. A potential scenario that could put a great deal of the population in jeopardy would be summer storms knocking out electric utilities followed by hot temperatures. Especially in one of the state's larger cities, many people normally accustomed to air conditioning would not easily acclimate to extended time in the heat.

The portion of the population that is chronically ill, elderly, very young, disabled, or socially isolated are more likely to become victims. Heat kills by pushing the human body beyond its limits. Under normal conditions, the body's internal thermostat produces perspiration that evaporates and cools the body. However, in extreme heat and high humidity, evaporation is slowed and the body must work extra hard to maintain a normal temperature. City heat wave plans that target these groups, like with neighborhood checks or utility bill relief, can be very effective.

3.2.10.8 Conclusion:

While extreme heat is a hazard for Oklahomans, efforts are being made throughout the state to mitigate the effects of the Extreme Heat hazard. The National Weather Service issues Excessive Heat Warnings when the combined effect of high temperatures and high humidity result in daytime heat indices or nighttime ambient temperatures greater than established local thresholds.

State infrastructure can be damaged by extreme heat conditions. Roadways and highways can be damaged as can some equipment. Workers may be affected by extreme heat and some activities may have to be reduced or halted during heat situations.

Most heat-related deaths involve the elderly who are either unable or unwilling to use fans and air conditioners. Community service agencies often have programs to distribute fans and air conditioners, while other groups and communities are establishing “cooling stations” and shelters where individuals can go during high heat periods.

3.3.11 Expansive Soils

Hazard Priority # 11

3.2.11.1 Description:

A little known but damaging hazard in Oklahoma is Expansive Soils. Expansive Soils have been identified as a hazard in 113 local and tribal Jurisdiction Hazard Mitigation Plans. Expansive or swelling soils, as their name implies, are soils that swell when subjected to moisture. These swelling soils typically contain clay minerals that attract and absorb water. Another category of expansive soil known as swelling bedrock contains a special type of mineral called clay stone.

When water is added to these expansive clays, the water molecules are pulled into gaps between the clay plates. As more water is absorbed, the plates are forced further apart, leading to an increase in soil pressure or an expansion of the soil's volume.
Soils containing expansive clays become very sticky when wet and usually are characterized by surface cracks or a "popcorn" texture when dry. Therefore, the presence of surface cracks is usually an indication of an expansive soil.

Changes in soil volume present a hazard primarily to structures built on top of expansive soils. The most extensive damage occurs to highways and streets. The effect of expansive soil is most prevalent in regions of moderate to high precipitation, where prolonged periods of drought are followed by long periods of rainfall. Expansive soils can be recognized either by visual inspection in the field or by conducting laboratory analysis.

The following pictures are examples of expansive soil damage to structures:

Create (1996) reported that uninsured losses to property owners throughout the nation might be as high as $6 billion per year. However, because the hazard develops gradually and seldom presents a threat to life, expansive soils have received limited attention, despite their costly effects in Oklahoma. Most engineering problems caused by volume changes in swelling soils result from human activities that modify the local environment. They commonly involve swelling clays beneath areas covered by buildings and slabs or layers of concrete and asphalt, such as those used in construction of highways, walkways, and airport runways.

3.2.11.2 Location:

113 Hazard Mitigation Plans from all parts of the State of Oklahoma have identified expansive soils as a hazard in their communities. Expansive soils may occur anywhere in the State of Oklahoma.

3.2.11.3 Extent:

There is little risk of fatalities or injuries unless the soil situation causes a partial or full collapse of a building.

State of Oklahoma Expansive Soils

Expansion Potential	Area	% of Total State
Very High	**7.34**	**3.66**
High	**54.37**	**27.12**
Moderate	**49.1**	**24.45**
Low	**83.2**	**41.5**
Water	**4.9**	**2.44**

The State of Oklahoma considers High and above on the above chart to be a major severity.

3.2.11.4 Previous Occurrences:

Oklahoma does not have disaster information on Expansive Soils because a catastrophic event has not and probably won't occur. This hazard develops gradually and is difficult to attribute dollar amounts to this hazard. No history is available because there are no reported losses which identify the presence of expansive soils as the direct cause.

3.2.11.5 Probability of Future Events:

The potential for serious Expansive Soil events in Oklahoma is **likely** but could occur under the right soil conditions. The counties of McCurtain, Choctaw, Pushmataha, Bryan, Atoka, Marshall, Johnston, Love and Carter are the most susceptible to severe Expansive Soils while other counties could have isolated areas that could experience problems.

Calculated Priority Risk Index (CPRI)

Expansive Soils = 2.2

Probability			3 Likely	
Magnitude/Severity			1 Negligible	
Warning Time			1 24+ Hours	
Duration			4 More than one week	
The CPRI for the Expansive Soils hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (1 x .30)	+ (1 x .15)	+ (4 x .10)	= 2.2

Resources: Oklahoma Department of Transportation (ODOT); U.S. Department of Agriculture, Natural Resources Conservation Services (NRCS)

3.2.11.6 Vulnerability and Impact:

Houses and single story commercial buildings are more apt to be damaged by the expansion of swelling clays than are multi-story buildings which usually are heavy enough to counter swelling pressures. The principal geologic units in the state that have high shrink-swell potential are the cretaceous shales in southern Oklahoma.

Considerable information on soil and/or rock properties is available for building foundations designed to withstand the effects of the existing soil conditions. ODOT and the NRCS have evaluated the expansive properties of soils and shale formations in Oklahoma, and ODOT has released a series of district reports containing information on engineering characteristics. At this time, there is not enough data available for the State of Oklahoma to estimate losses due to this hazard. The southern and eastern part of the state including McCurtain, Pushmataha, Choctaw, Atoka, Bryan, Johnston, Marshall, Carter and Love Counties as being most vulnerable to expansive soil.

The most obvious manifestations of damage to buildings are sticking doors, uneven floors, and cracked foundations, floors, walls, ceilings, and windows. If damage is severe, the cost of repair may exceed the value of the building. The most extensive damage from expansive soils occurs to highways and streets.

3.2.11.7 Vulnerable Populations:

Because the expansive soil hazard develops gradually, it seldom presents a threat to life.

3.2.11.8 Conclusion:

Some counties in Oklahoma are at higher risk to expansive soils than others, but a dollar amount for damages is difficult to assign to this particular hazard since very little incident record keeping is done. State buildings are built to stronger building codes because they host the public. Although no records exist concerning damage to state buildings from expansive soils, some damages due to this may have occurred. Highways probably are most susceptible to damage from soil problems but those are usually resolved by using improved construction methods.

Soil engineers and engineering geologists test soils for swell potential when designing a building's foundation. Simple observation often can reveal the presence of expansive soils. Soils with a high percentage of swelling clay usually have cracks or a puffy appearance when dry and are sticky when wet. There are several methods of dealing with Expansive Soils:

"Engineered" fills include: replacing existing soil with an impermeable soil, or by compacting the soil. Contractors may replace the top 3 to 4 feet of soil with a non-expansive, impermeable soil. In this case, the main landscaping problem is dealing with a soil that does not take in water. The normal treatment for impermeable soil is to increase permeability with soil amendments. However, this leaves the foundation vulnerable to damage. Contractors also may compact the soil to reduce permeability and minimize the shrink-swell action. In this case, do not try to increase permeability.

Chemical soil treatments are not common in residential construction. They are mostly used on commercial building sites and roads.

3.3.12 Special Events

Tar Creek Remedial Site

Hazard Priority # 12

3.2.12.1 Description:

Congress created the Superfund program in 1980 to remediate the nation's uncontrolled hazardous waste sites. Occasionally, a man-made event occurs of such magnitude that it develops into a Natural Hazard event.   Such is the case with the Tar Creek Site in northeastern Ottawa County, dubbed by the EPA as one of the most problematic such sites in the country. The Tar Creek site involves a 40-square mile area. Abandoned mines continue to leak water containing lead, zinc and cadmium into Tar Creek, turning the water a rusty orange.

3.2.12.2 Location:

The communities of Picher (pop. 1640), Cardin (pop. 150), Commerce, (pop. 2,645), North Miami (pop 443), and Quapaw (pop. 984) make up the Tar Creek Superfund Site. Ottawa is the most vulnerable county to the hazards associated with Tar Creek but other counties are vulnerable due to storm water runoff and flooding. These counties include Delaware, Mayes, Wagoner, Cherokee, Muskogee, Sequoyah, Haskell, and Leflore.   The runoff from Tar Creek empties into the Arkansas River creating problems for Oklahoma, Kansas and Missouri, although this plan deals only with Oklahoma issues.

3.2.12.3 Extent:

EPA declared the Tar Creek area a Superfund Site with a projected remediation cost of $167 million. Oklahoma considers the Tar Creek event to be a major severity.

3.2.12.4 Previous Occurrences:

Lead and zinc mining came to northeastern Oklahoma in the Picher area in 1891. During the peak mining years of 1907 through 1946, almost two million tons of lead and zinc were mined in the area.

But what once brought economic prosperity to the far northeast part of the state soon led to a legacy of human health and environmental calamity.

Tangible natural resource threats were first realized in 1979 when metals-laden mine water began discharging to surface streams in the Tar Creek watershed. The 40-square mile site was added to the first National Priorities List (NPL) in 1983.

3.2.12.5 Probability of Future Events:

The potential of additional problems with flood waters flowing into and out of contaminated areas into recreational waterways is **Possible**.

Calculated Priority Risk Index (CPRI)

Special Events (Tar Creek Project) = 2.05

<table>
<tr><td colspan="3">Probability</td><td colspan="2">2 Possible</td></tr>
<tr><td colspan="3">Magnitude/Severity</td><td colspan="2">2 Limited</td></tr>
<tr><td colspan="3">Warning Time</td><td colspan="2">1 24+ Hours</td></tr>
<tr><td colspan="3">Duration</td><td colspan="2">4 More than one week</td></tr>
<tr><td colspan="5">The CPRI for the Special Events hazard for the State of Oklahoma is:</td></tr>
<tr><td>Probability</td><td>+Magnitude/Severity</td><td>+ Warning Time</td><td>+ Duration</td><td>= CPRI</td></tr>
<tr><td>(2 x .45)</td><td>+ (2 x .30)</td><td>+ (1 x .15)</td><td>+ (4 x .10)</td><td>= 2.05</td></tr>
</table>

3.2.12.6 Vulnerability and Impact:

With the abandonment of mining activities in the county by the 1950's, the area was left with hundreds of open or unsafely capped mine shafts, thousands of disintegrating air shafts, large areas of subsidized land and land areas with the potential of subsidence, huge chat piles and contaminated ground water. Recent floods added to the contaminated runoff problems. Concerns about flooding from the Neosho River and any consequent contamination of parks, particularly Riverview Park are a primary concern.

A 2006 report showed that the EPA was part of a multi-state effort to study sediment and surface water throughout the Spring and Neosho river basins. The Neosho River is huge and muddy. Metals attach to mud and settle out. The study was created to deal with surface mining and discharges. Additionally runoff from chat piles can enter the streams and flood events causing health and environmental concerns. The study area was divided into eight areas: upper Spring River, the Spring River main stem, Center Creek, Shoal Creek, Turkey Creek, Lost Creek, Neosho River and Tar Creek. Different rivers and creeks feed into the Spring River and Neosho Rivers, and eventually flow into Grand Lake.

Acid Mine Drainage into Tar Creek at Douthat Bridge

In the study, 241 locations were sampled during a five-day period and turned up sediment samples, including zinc, lead and cadmium.

3.2.12.7 Vulnerable Populations:

Several public health concerns are presented by the Superfund site, including mine shaft hazards, poor air quality due to lead-laden dust, acid mine drainage, soils contamination associated with chat piles and mine waste, and exposure of children and other susceptible populations to contaminated materials. Additional health risks are associated with consumption of fish and other wild food from the Tar Creek Superfund Site, as well as the Neosho River and Spring River watershed. Environmental and human health concerns were examined by the EPA, the Oklahoma Department of Environmental Quality (ODEQ), Oklahoma Department of Human Services, and other state and local agencies.

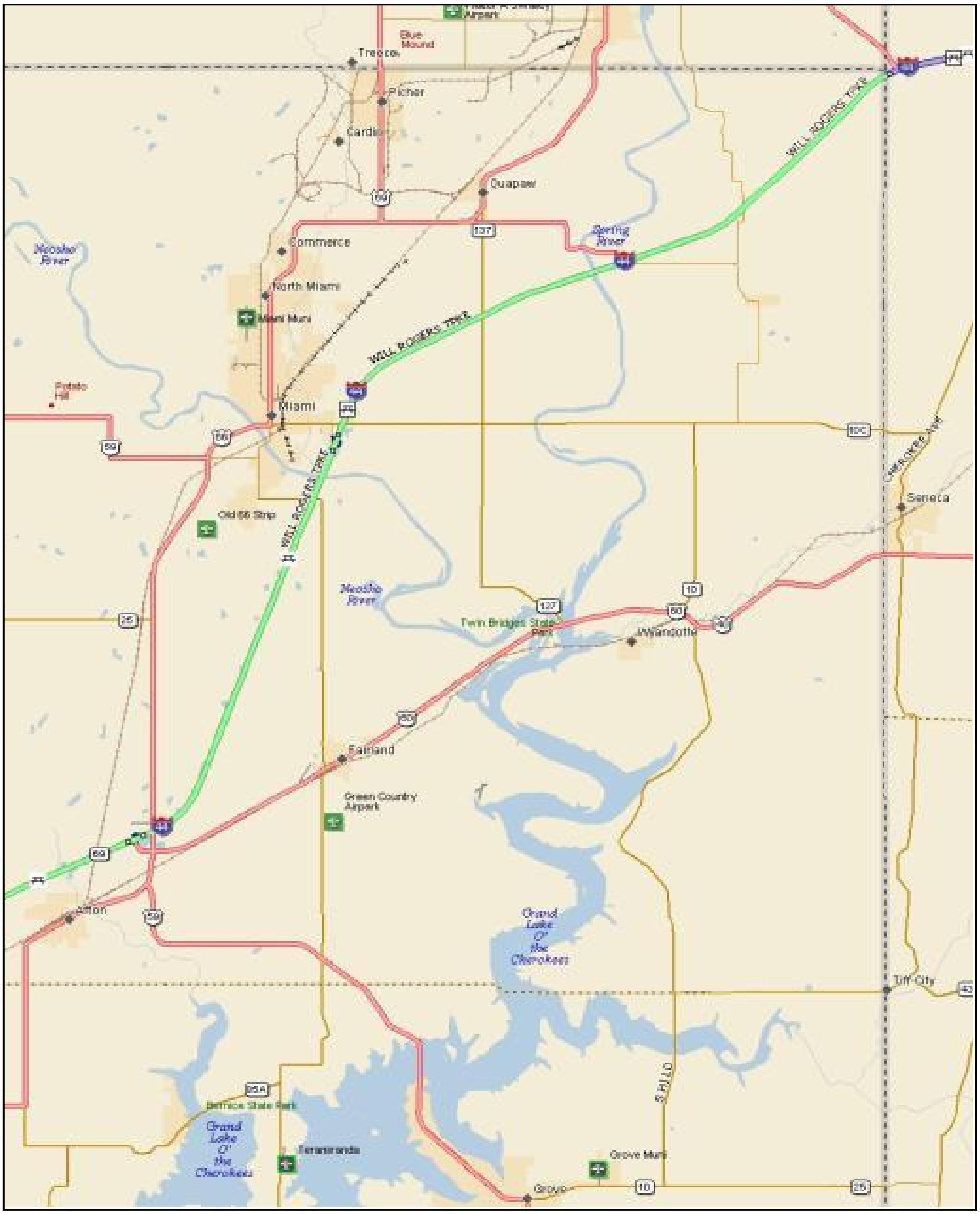
3.2.12.8 Conclusion

It's been more than 100 years since mining began in the tri-state district and more than 20 years since cleanup began at the nation's longest-standing Superfund site. Tremendous challenges remain. The State of Oklahoma recognizes that there are secondary hazards associated with the approximately 30,000 acres of abandoned land which was mined prior to the passage of the 1977 Federal Surface Mining Control and Reclamation Act.

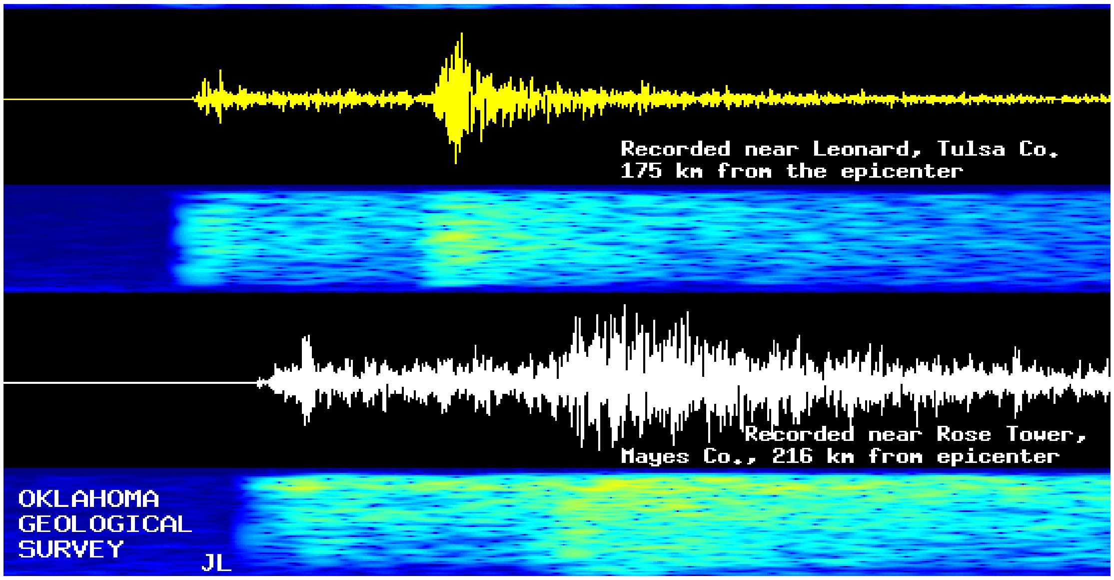
In 2003, three federal agencies, the Environmental Protection Agency, the U.S. Department of the Interior, and the U.S. Army Corps of Engineers, signed a Memorandum of Understanding (MOU) to respond to the risks posed at the Tar Creek Superfund Site. Elected officials and community leaders coordinated long-term options for residents and property owners at the site which involved relocation of families with children, and removal of topsoil from 2,295 residential yards and public areas.

On Saturday, May 10, 2008, an EF-4 tornado struck the town of Picher, part of the Tar Creek Superfund site. EPA responded to the scene and conducted air monitoring and soil sampling and determined that there was no immediate adverse health risk, but the tornado sped up the demise of the end of the town of Picher, and the town officially ceased to exist in September 2009.

By 2011, over $150 million had been spent to clean up Tar Creek and relocate families. Close-out of the Tar Creek project was completed by ODEQ on November 23, 2011, but the EPA and the State of Oklahoma will continue to address remediation at the site. The EPA continues to provide funding to the Ottawa County Health Department for community health education and blood lead screening for the county. (Source: EPA Newsletter #OKD980629844, dated April 11, 2013).



3.3.13 Earthquake

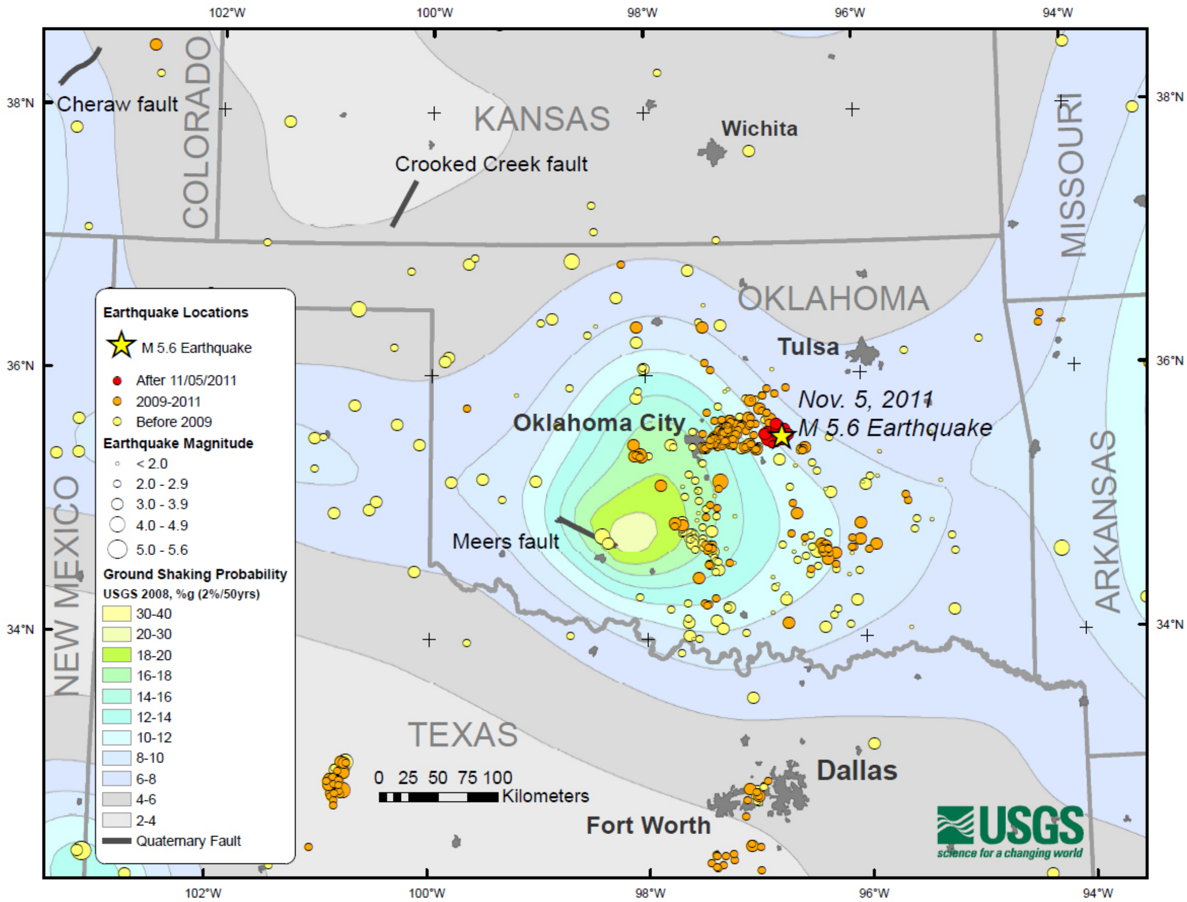


Hazard Priority # 13

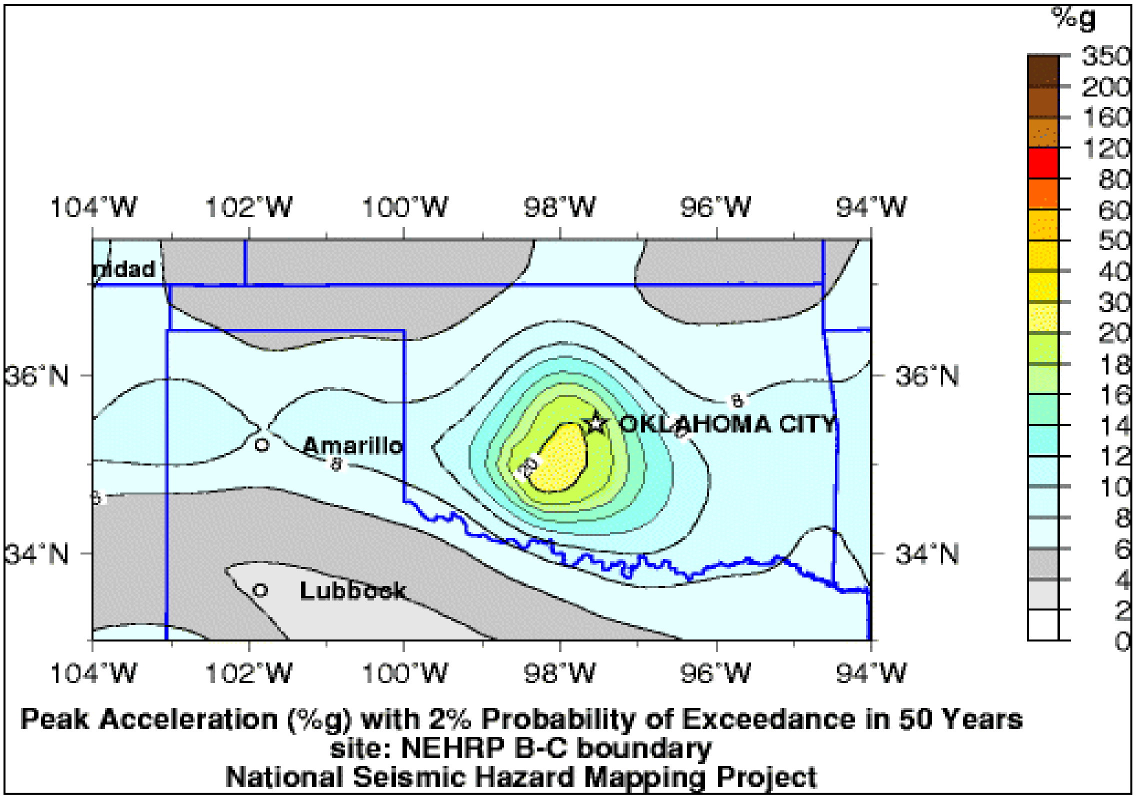
3.2.13.1 Description:

Most earthquakes occur as the result of slowly accumulating pressure that causes the ground to slip abruptly along a geological fault plane on or near a plate boundary. The resulting waves of vibration within the earth create ground motion at the surface that vibrates in a very complex manner.

Oklahoma Geological Survey



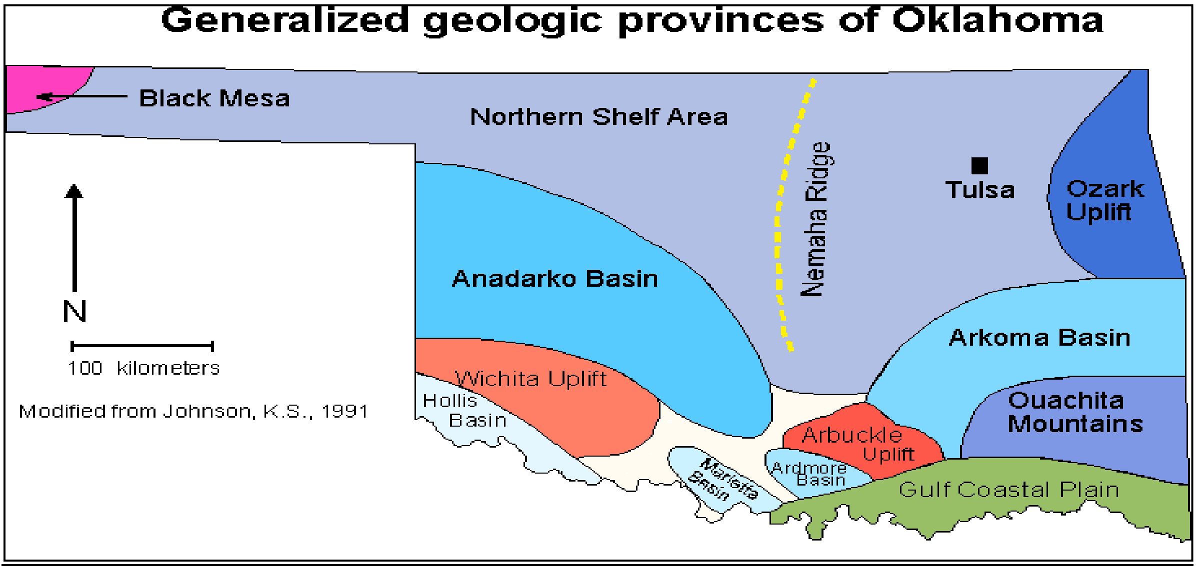
The above graphic shows the location and magnitude of earthquakes recorded by the USGS in the Oklahoma and surrounding area, and the probability of future quakes.



The above chart indicates the Peak Acceleration which is the area of increased activity within Oklahoma over the last few years. A review of the earthquake event map on the previous page would bear out that the area shown on the map is almost exactly the boundaries of the event location map between 1977 and 2013.

Between 2009 and September 2013, at least nine earthquakes of magnitude 3.5 have occurred in this area. A magnitude 4.1 quake occurred in southeast Lincoln County near Sparks on February 27, 2010. This was topped by a 4.7 earthquake, rated the second strongest in the history of Oklahoma, on October 13, 2010. But according to Oklahoma Geological Survey, the strongest quake to be recorded occurred November 5, 2011 near the town of Prague (latitude 35.522; longitude -96.78) which was determined to be of a 5.7 magnitude.

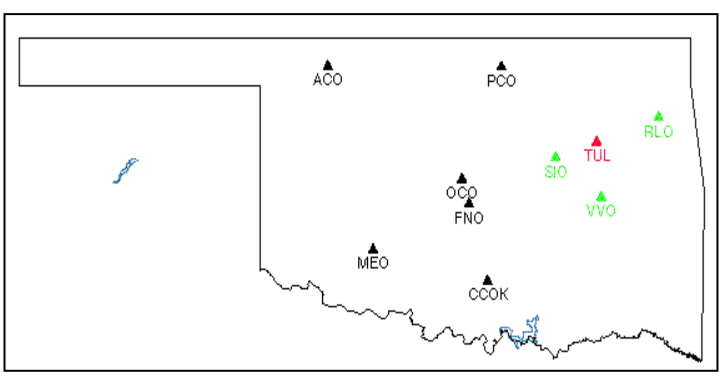
3.2.13.2 Location:

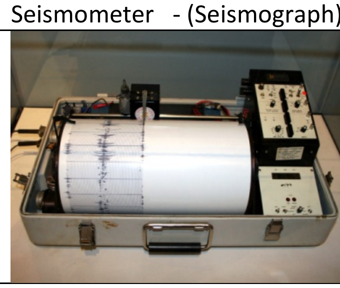


Oklahoma is at moderate risk for an earthquake, as a result of the State's proximity to the New Madrid Seismic Zone. **Seven main regions of earthquake activity exist in Oklahoma:**

- *the El Reno-Mustang area in central Oklahoma*;
- *Love and Carter Counties*;
- an area in *southeastern Oklahoma north of the Ouachita Mountains in the Arkoma Basin*;
- *the Meers Fault, located near Meers on the eastern edge of the Anadarko Basin;*
- *the area around Lindsay in Garvin County;*
- *the area near Ada in Pontotoc County;*
- *the area in eastern Oklahoma County near Jones (Memorial Rd. / Indian Meridian Rd.)*

The Oklahoma Geological Survey Observatory (OGS) in rural Tulsa County is a comprehensive geophysical observatory which records, identifies, and locates 30 to 167 Earthquakes in Oklahoma each year, and also records about five worldwide earthquakes per day. The (OGS) operates a statewide network of earthquake detecting equipment. The Oklahoma Geophysical Observatory operates eight satellite seismograph stations and records seismological data. Earthquake data has been recorded for the State of Oklahoma since January 1, 1962.



OKLAHOMA SEISMOGRAPH STATION LOCATIONS		
STATION	**LOCATION**	**EQUIPMENT UTILIZED**
TUL	Near Leonard Okla. (Tulsa Co.)	Oklahoma Geological Survey Observatory
RLO	Rose Lookout (Mayes Co.)	Telemeter remote location – (sends to Leonard)
SLO	Slick (Creek Co.)	Telemeter remote location – (sends to Leonard)
VVO	Vivian (McIntosh Co.)	Telemeter location – (sends to Leonard)
CCOK	No information	No information
ACO	Alabaster Caverns (Woods Co.)	Seismometer - volunteer operated
PCO	Ponca City (Kay Co.)	Digitizers communicating with SCREAM software running on PCs. SCREAM send packets over the internet to Leonard.
OCO	Oklahoma City (Oklahoma Co.)	Seismometer - volunteer operated
FNO	Franklin (Cleveland Co.)	S-13 Seismometer - volunteer operated
		Seismometer - (Seismograph)
		

The earthquake database can be used to develop numerical estimates of earthquake risk, which gives the theoretical frequency of earthquakes of any given size for different regions of Oklahoma. Numerical risk estimates are used in the design of large-scale structures, such as dams, high-rise buildings, and power plants, as well as providing information required for establishing insurance rates.

3.2.13.3 Extent:

Earthquake: Richter scale, Mercalli Scale

Magnitude / Intensity Comparison:

Magnitude and Intensity measure different characteristics of earthquakes. Magnitude measures the energy released at the source of the earthquake. Magnitude is determined from measurements on seismographs. Intensity measures the strength of shaking produced by the earthquake at a certain location. Intensity is determined from effects on people, human structures, and the natural environment. The following table gives intensities that are typically observed at locations near the epicenter of earthquakes of different magnitudes.

Magnitude	**Typical Maximum Modified Mercalli Intensity**
1.0 - 3.0	**I**
3.0 - 3.9	**II – III**
4.0 - 4.9	**IV – V**
5.0 - 5.9	**VI – VII**
6.0 - 6.9	**VII – IX**

Abbreviated Modified Mercalli Intensity Scale

Modified Mercalli scale (MMI) = effects of earthquake

MMI = roman numbers ~ R = Richter scale ~ J = energy measured in Joule

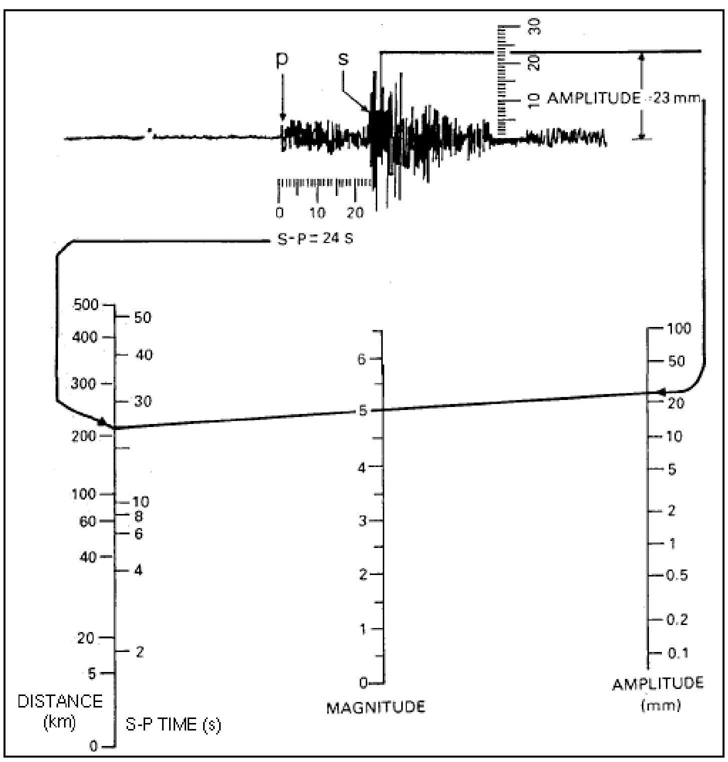
I. Instrumental R < 3.5 J < 1.6 E+7	Not felt by many people unless in favourable conditions.
II. Feeble R 3.5 J 1.6 E+7	Felt only by a few people at best, especially on the upper floors of buildings. Delicately suspended objects may swing.
III. Slight R 4.2 J 7.5 E+8	Felt quite noticeably by people indoors, especially on the upper floors of buildings. Many do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV. Moderate R 4.5 J 4 E+9	Felt indoors by many people, outdoors by few people during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rock noticeably. Dishes and windows rattle alarmingly.
V. Rather Strong R 4.8 J 2.1 E+13	Felt outside by most, may not be felt by some outside in non-favourable conditions. Dishes and windows may break and large bells will ring. Vibrations like large train passing close to house.
VI. Strong R 5.4 J 5.7 E+11	Felt by all; many frightened and run outdoors, walk unsteadily. Windows, dishes, glassware broken; books fall off shelves; some heavy furniture moved or overturned; a few instances of fallen plaster. Damage slight.
VII. Very Strong R 6.1 J2.8 E+13	Difficult to stand; furniture broken; damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by people driving motor cars.
VIII. Destructive R 6.5 J 2.5 E+14	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture moved.
IX. Ruinous R 6.9 J 2.3 E+15	General panic; damage considerable in specially designed structures, well designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X. Disastrous R 7.3 J 2.1 E+16	Some well built wooden structures destroyed; most masonry and frame structures destroyed with foundation. Rails bent.
XI. Very Disastrous R >8.1 J >1.7 E+18	Few, if any masonry structures remain standing. Bridges destroyed. Rails bent greatly.
XII. Catastrophic R > 8.1	Total damage - Everything is destroyed. Total destruction. Lines of sight and level distorted. Objects thrown into the air. The ground moves in waves or ripples. Large amounts of rock move position.

From World Press.com

Masonry A: Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.
Masonry B: Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.
Masonry C: Ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners, but neither reinforced nor designed against horizontal forces.
Masonry D: Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

The State of Oklahoma considers a reading of 5.4 and below on the Richter scale a minor severity and 5.5 and above to be a major severity.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. This scale is referred to by news media when making public reports. The diagram below shows how to use Richter's original method to measure a seismogram for a magnitude estimate.

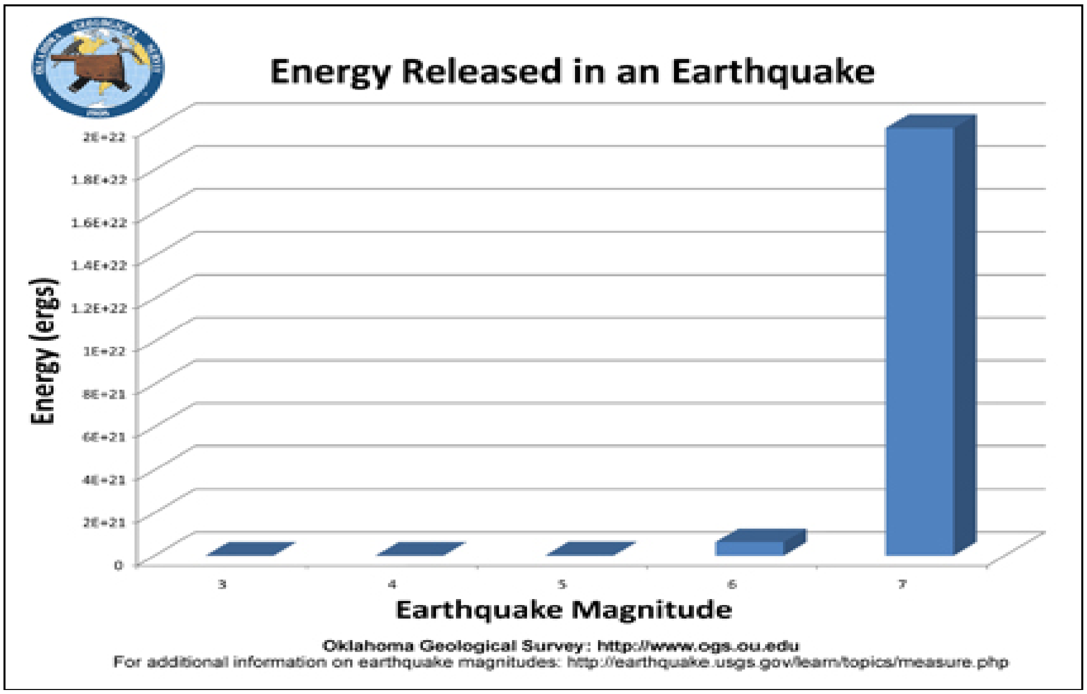


The scales in the diagram above form a **nomogram** that allows you to do the mathematical computation quickly by eye. The equation for Richter Magnitude is:

$$M_L = \log_{10} A(mm) + (Distance\ correction\ factor)$$

Modified Mercalli Intensity Scale:

The scale currently used by the scientific community in the United States is the Modified Mercalli (MM) Intensity Scale. It does not have a mathematical basis; instead it is an arbitrary ranking based on observed effects. An abbreviated description of the 12 levels of Modified Mercalli intensity and both scales are shown on the table above.

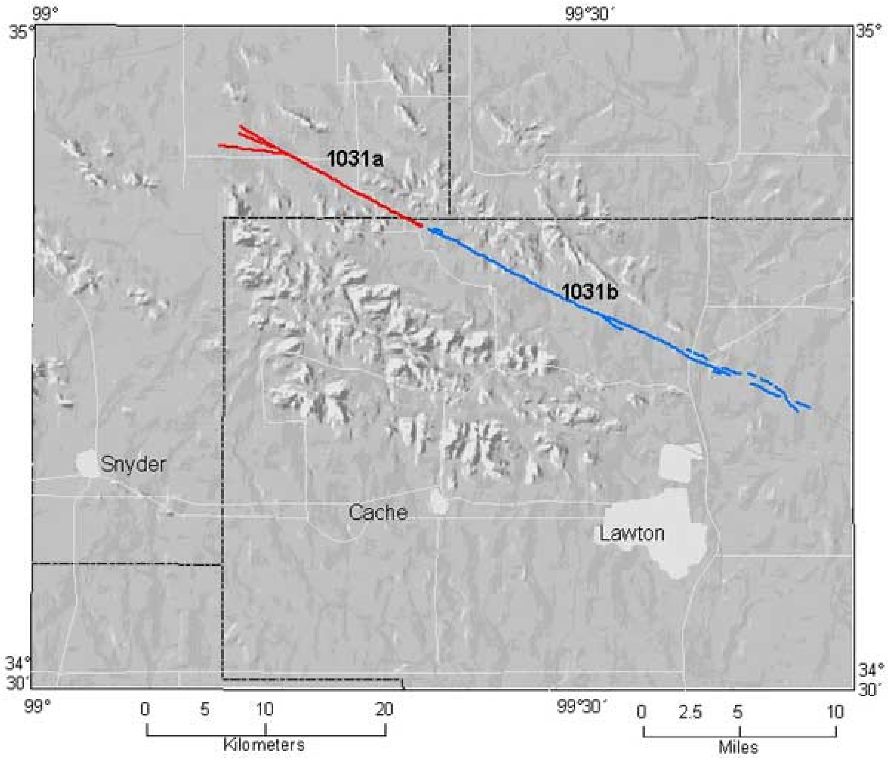


3.2.13.4 Previous Occurrences:

The Meers Fault

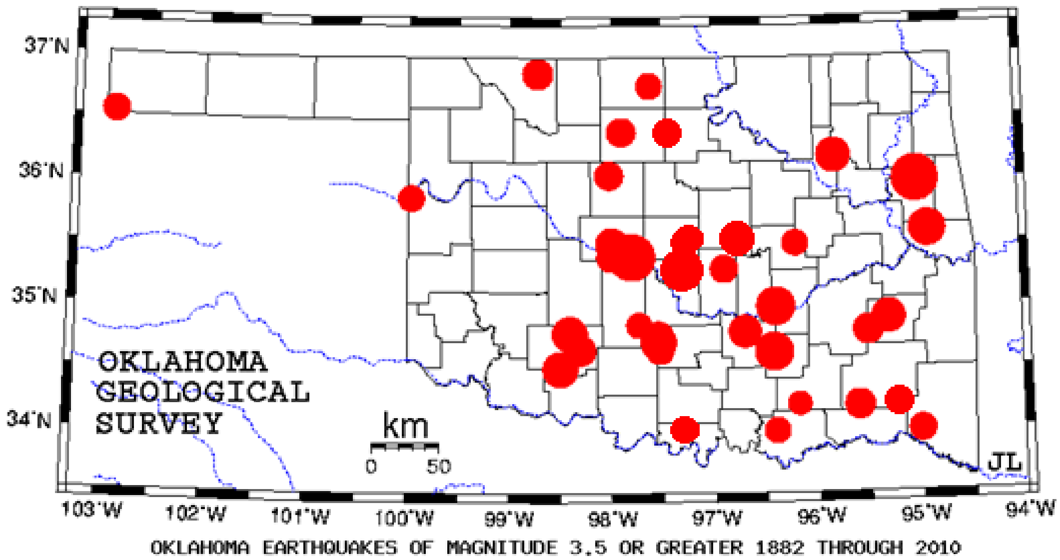
An earthquake that occurred approximately 1200 years ago created the Meers fault and it is one of the many visible faults in the United States. The fault is considered a profound structural dislocation, and forms the frontal fault zone between the Wichita Uplift to the south and the Anadarko Basin to the north. The Meers fault is part of the Pennsylvanian Frontal Fault System that stretches from the southeast to the northwest through south central and southwest Oklahoma and into the Texas Panhandle.

A distinct fault trace is visible for 15 miles from near Saddle Mountain to Cache Creek. The Meers fault would appear to belong in California, where young faults are plentiful, but it is the only surface-breaking rupture east of the Rocky Mountains. The Meers fault is the first documented movement of a fault in the last 10,000 years in the Central Mid-Continent region of the United States - Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota. Recent studies show the time of the last major movement occurred 500 to 2000 years ago, and that the Meers fault could produce a magnitude 7.0 earthquake in the future. The Meers fault has been extremely quiet, with only one small quake occurring in 1981. This quietness makes some scientists uncomfortable, but most believe there is little cause for immediate concern. In geological time, 1,500 to 2,000 years is a short period.

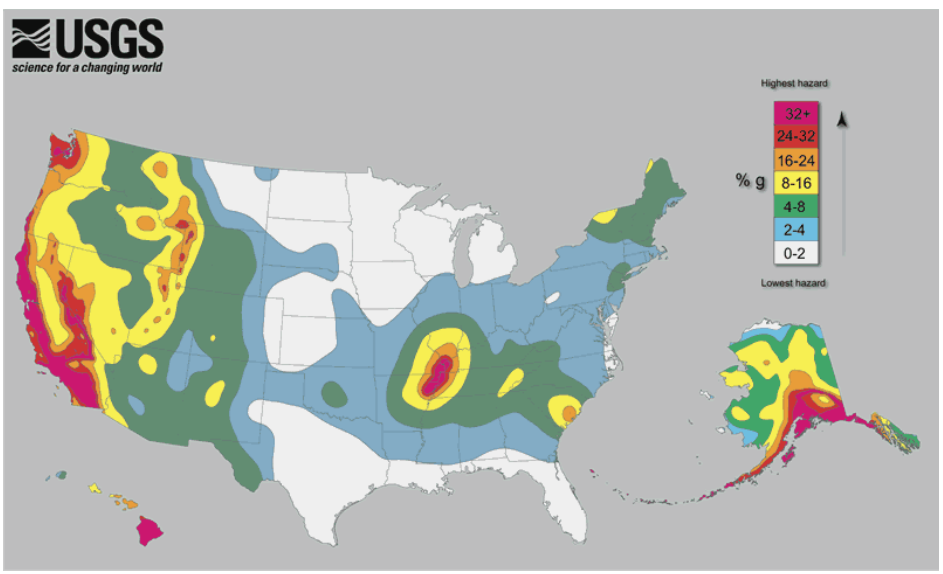


New studies suggest that earthquakes occur in the Meers fault at very long intervals. It could be another thousand years before another major quake occurs.

"Felt" earthquakes in Oklahoma are those that tend to concern people the most. The map shown below plots the locations of earthquakes from 1882 through 2010 that were 3.5 magnitude or greater. Although there have been significant events in the area of the Meers Fault, there has been significant activity in other areas also. One particularly active area since 2008 is in eastern Oklahoma County, near Jones. Between 2009 and September 2010, at least nine earthquakes of magnitude 3.5 have occurred in this area. A magnitude 4.1 quake occurred in southeast Lincoln County near Sparks on February 27, 2010. This was topped by a 4.7 earthquake, rated the second strongest in the history of Oklahoma, on October 13, 2010 which occurred just south of the aforementioned active area and was felt widely across much of the eastern two thirds of the State and into the Dallas-Fort Worth area. A little more than a year later, according to Oklahoma Geological Survey, the strongest quake to be recorded also occurred in Lincoln County on November 5, 2011 near the town of Prague (latitude 35.522; longitude -96.78) which was determined to be of 5.7 magnitude.



The map below appears to indicate the activity in Eastern Oklahoma could be a part of the low intensity area of the New Madrid Fault in Missouri.



Oklahoma Earthquakes with Magnitude 4.0 or Greater			
Date	County	Nearest Town	Magnitude
November 5, 2011	Lincoln	Prague	5.7
October 13, 2010	Cleveland	Norman	4.7
June 1, 1939	Hughes	Spalding	4.4
September 6, 1997	Coal	Stonewall	4.4
June 20, 1926	Sequoyah	W Marble City	4.3
June 17, 1959	Comanche	NE Faxon	4.2
January 18, 1995	Garvin	Antioch	4.2
April 28, 1998	Comanche	NW Richards Spur	4.2
October 30, 1956	Rogers	Catoosa	4.1
February 27, 2010	Lincoln	Sparks	4.1
April 27, 1961	Latimer	Wilburton	4.1
December 27, 1929	Canadian	El Reno	4.0
June 15, 1959	Pontotoc	Ada	4.0
November 15, 1990	Garvin	Lindsay	3.9

SIGNIFICANT OKLAHOMA EARTHQUAKE HISTORY
JANUARY 1918 – OCTOBER 13, 2013
(Information provided by Oklahoma Geological Survey and Oklahoma Emergency Management)

DATE	DESCRIPTION	PROP. DAMAGE	FATALITIES	INJURIES
Nov 5, 2011	**Earthquake –** The Prague earthquake sequence of 2011, along the Wilzetta Fault zone, included a significant foreshock, a main shock of magnitude 5.7 and numerous aftershocks. It was rumored to have been triggered by fluid injection, but the Oklahoma Geological Survey concluded that the event was the result of natural seismic causes. St. Gregory's University in Shawnee reported extensive damage to its historic Benedictine Hall after a brick turret toppled to the ground. No injuries were reported at the campus, but building repair costs were estimated to be $1.5 million.	Unknown	0	2
Oct 13, 2010	**Earthquake –**The second strongest earthquake in the history of Oklahoma struck about 8 miles southeast of Norman, south of Lake Thunderbird near E Post Oak Road and 84th Avenue SE. Official reports rated the 9:06 a.m. quake as magnitude 4.7 It was heard as a low rumble for about 20 seconds at the OEM office north of the Capitol, and evidence could be seen	Unknown	0	2

SIGNIFICANT OKLAHOMA EARTHQUAKE HISTORY JANUARY 1918 – OCTOBER 13, 2013 (Information provided by Oklahoma Geological Survey and Oklahoma Emergency Management)				
	as a slight shaking seen in a cup of coffee. USGS received reports of it being felt all over the eastern 2/3rds of the state, mainly east of highway U.S. 281 and west of U.S. 269. Residents and emergency managers confirm the earthquake was felt in Bryan, Caddo, Canadian, Cleveland, Coal, Comanche, Garvin, Johnston, Kingfisher, McClain, Muskogee, Nowata, Oklahoma, Osage, Pontotoc, Pottawatomie, Stephens, Tulsa and Washington counties. OEM has received a few reports of minor damage, primarily to windows and due to items falling from shelves. EMSA reports two patients suffering from a fall required medical care. USGS reports the shaking was felt south of Dallas-Fort Worth and into NW Arkansas, with a few reports in Wichita. No reports of fatalities have been received and damage is very minor, with isolated reports of broken windows and items that fell from shelves.			
Jan 7, 2008	**Earthquake -** The Oklahoma Geological Survey says an earthquake was reported in south-central Okla. It happened at about 1:43 p.m. About 4 miles SE of Purdy in Garvin County. Only one person reported feeling the quake, saying she heard windows rattling and her dog was 'acting berserk'. The quake was a magnitude 2.0, which is one of the smallest felt by humans. It's the first earthquake in Garvin Co. in nearly 17 months. Garvin Co is the most active in the state when it comes to earthquakes, registering 319 temblors since 1997.	Unknown	Unknown	Unknown
Oct. 19, 2002	**Earthquake** - This earthquake occurred at 9:18PM. The epicenter was about 6 miles N of Darwin, 19 miles E of Atoka (Atoka Co.), or 40 miles NE of Durant (Bryan Co.). The magnitude was 3.4 on the mbLg scale (one version of the Richter scale). The earthquake was felt widely in Bryan County and Atoka County. It was also felt in Coleman (Johnston Co). It reportedly sounded like	Unknown	Unknown	Unknown

SIGNIFICANT OKLAHOMA EARTHQUAKE HISTORY JANUARY 1918 – OCTOBER 13, 2013 (Information provided by Oklahoma Geological Survey and Oklahoma Emergency Management)				
	an explosion or sonic boom, sometimes accompanied followed by a slight shaking and rattling of dishes and windows. Flower pots were knocked off a shelf 9 mi S. of Bentley (Atoka Co.). The Bryan Co., Sheriff's office, and the Atoka Co. S.O. received some calls concerned that the loud boom might have been a terrorist explosion.			
Jun 19, 2002	**Earthquake:** Cimarron Co. Earthquake had an epicenter 7.2 mi. W of Felt and 26 mi. SW of Boise City (both in Cimarron Co.). This is very near the point where the borders of Oklahoma, Texas, and New Mexico meet. The earthquake was also felt in Dalhart TX, and Clayton NM. This was the first earthquake in Cimarron Co. in 26 years. The only known previous earthquakes in Cimarron Co. were a magnitude 2.1 and magnitude 2.7 on March 30, 1976. Cimarron Co. residents have felt some earthquakes with epicenters outside their county. The magnitude 5.7 earthquake centered W of Okla. City in Canadian Co. was felt in all Oklahoma Counties in 1952.	Unknown	Unknown	Unknown
Nov. 15, 1990	Earthquake: Meers Geological Survey station (Comanche Co.) recorded a trembler, magnitude 3.6 in northern Garvin Co., about 55 miles E of Meers. It rattled windows in Lindsay (Garvin Co.) and Rush Springs (Grady Co.). It was the largest earthquake in Oklahoma since December 8, 1987 when a magnitude 3.7 occurred in Kingfisher County.	Unknown	Unknown	Unknown
May 2, 1969	**Earthquake** - A magnitude 4.6 earthquake caused some cracked plaster at Wewoka (Seminole Co). Intensity V effects were reported at several other towns in the region. The total felt area was in eastern Oklahoma.	Unknown	Unknown	Unknown
Oct. 14, 1968	**Earthquake** - An earthquake caused minor damage at Durant (Bryan Co.). Walls cracked and glass in two structures broke. The press reported that a 5 ft. tall advertising stand fell over, and canned	Unknown	Unknown	Unknown

SIGNIFICANT OKLAHOMA EARTHQUAKE HISTORY JANUARY 1918 – OCTOBER 13, 2013 (Information provided by Oklahoma Geological Survey and Oklahoma Emergency Management)				
	goods fell from a rack in a supermarket. Slight foreshocks were felt at Durant (Bryan Co.) on Oct. 10 and 11. Intensity IV effects from the area were felt.			
June 17, 1959	**Earthquake** - A broad area of SW Okla. and the adjacent portion of Texas were affected by an early morning shock. Slight damage, consisting of cracks in plaster, pavement, and a house foundation, occurred in Comanche Co. and Stephens Co. Houses were shaken, buildings swayed, and many persons alarmed. Dishes were reported broken and a trembling motion was observed.	Unknown	Unknown	Unknown
Oct. 30, 1956	**Earthquake** - An area in northeastern Oklahoma was shaken. The maximum intensity of VII was reported W. of Catoosa (Rogers Co.), where a slippage of the formation caused an oil well to be shut down. Minor damage occurred at Beggs (Okmulgee Co.) and Tulsa Co.; and an isolated felt report was received from Electra, Texas.	Unknown	Unknown	Unknown
Apr. 2, 1956	**Earthquake** – SE Okla. was disturbed by an earthquake that produced thundering, rattling, and bumping noises that were heard by many citizens. Buildings shook and objects fell at Antlers (Pushmataha Co.), alarming many. Minor effects were reported from other nearby towns.	Unknown	Unknown	Unknown
Feb. 16, 1956	**Earthquake** – a shock at Edmond broke windows and cracked plaster. It was also felt strongly in Logan Co. and Pawnee Co.	Unknown	Unknown	Unknown
Mar. 17, 1953	**Earthquake** -Minor damage to a building foundation and plaster at Concho resulted from two earthquakes about an hour apart. The felt area included Canadian Co., parts of Oklahoma Co. and Grady Co.	Unknown	Unknown	Unknown
Oct. 7, 1952	**Earthquake** - felt at Holdenville (Hughes Co.) and Wewoka (Seminole Co.) apparently was unrelated to the April 9th event. Homes and buildings shook and some persons were awakened in Canadian Co. Felt reports were also received from Kingfisher Co., Oklahoma Co., and Tulsa Co.	Unknown	Unknown	Unknown

SIGNIFICANT OKLAHOMA EARTHQUAKE HISTORY JANUARY 1918 – OCTOBER 13, 2013 (Information provided by Oklahoma Geological Survey and Oklahoma Emergency Management)				
Apr. 9, 1952	**Earthquake -** The largest Okla. Earthquake ever recorded was the El Reno earthquake, with a magnitude of about 5.7 on the Richter scale. (There has been some debate as to whether it was a 5.5 or 5.7.) The event was caused by slippage along the Nemaha fault. This earthquake caused moderate damage in El Reno (Canadian Co.), Oklahoma Co., and Ponca City (Kay Co.), including toppled chimneys and smokestacks, cracked and loosened bricks on buildings, and broke windows and dishes. One crack in the State Capitol at OKC was 15 meters long. Slight damage was reported from many other towns in Okla. and some towns in Kansas, Arkansas, Iowa, Kansas, Missouri, Nebraska, and Texas. Aftershocks were felt on April 11, 15, and 16, July 16, and August 14.	Unknown	Unknown	Unknown
Dec 27, 1929	**Earthquake -** another tremor centered in the El Reno area was felt in portions of central and western Oklahoma. Some plaster cracked and at least one chimney fell at El Reno. In addition, clocks stopped, objects moved, and some reports indicated the walls and floors seemed to sway. In several cities, people rushed from their homes in alarm.	Unknown	Unknown	Unknown
Sep. 10 1918	**Earthquake -** The first known to have been centered in the State. A series of shocks at El Reno produced only minor effects; the strongest was intensity V. Objects were thrown from shelves. Other shocks occurred on the next day.	Unknown	Unknown	Unknown

On average, there are about 50 measurable earthquakes each year in Oklahoma with only a few of these having shaking strong enough to be felt. A total of 43 felt earthquakes in 2009 was an exceptional year for seismic activity in Oklahoma. 27 of the felt earthquakes occurred in Oklahoma County, and another 7 were located in Lincoln County.

The increasing number of felt earthquakes occurring northeast of Oklahoma City may seem unusual to some, but seismologists say there is no reason for alarm. Small earthquakes such as these can occur anywhere in the world. The U.S. Geological Survey (USGS) estimates that there are as many as 3,000 small earthquakes occur every day. Earthquake swarms like this can go on for many months and usually do not lead up to a major earthquake. The USGS and the Oklahoma Geological Survey are working together to study and measure eastern Oklahoma County's earthquakes.

3.2.13.5 Probability of Future Events:

The potential of future Earthquake events is a threat in most of Oklahoma although slight because of slow geological movement. The most likely areas are in the counties shown on the map above. The danger of additional earthquakes in Oklahoma is **Possible.**

Calculated Priority Risk Index (CPRI)

Earthquake = 1.9

Probability			2 Possible	
Magnitude/Severity			1 Negligible	
Warning Time			4 Less than 6 Hours	
Duration			1 Less than 6 hours	
The CPRI for the Earthquake hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(2 x .45)	+ (1 x .30)	+ (4 x .15)	+ (1 x .10)	= 1.9

Resources: United States Geological Survey (USGS) and Oklahoma Geological Survey (OGS)

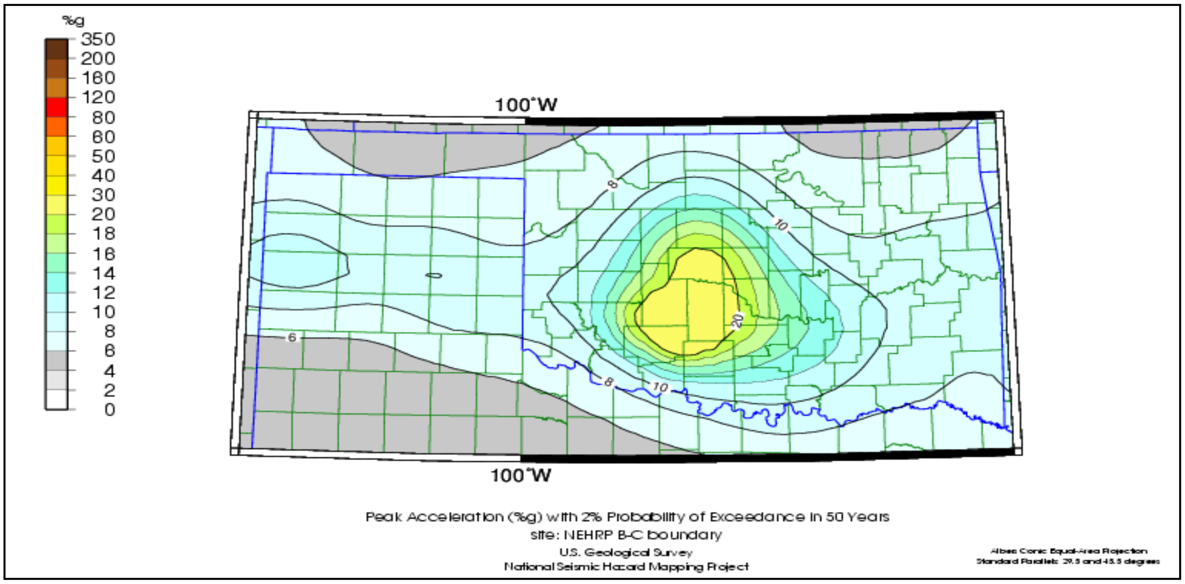
3.2.13.6 Vulnerability and Impact:

Buildings with foundations resting on unconsolidated landfill and other unstable soil, and trailers and homes not tied to their foundations are at risk because they can be shaken off their mountings during an earthquake. The effect of earthquakes on state-owned property and critical facilities is largely unknown due to the fact that there have not been any serious earthquakes since 1952.

Although Oklahoma is within the stable interior of the United States and experiences on average 58 minor earthquakes each year and most are too small to be felt, that could change. Even small magnitude earthquakes can cause damage. Should an earthquake as large as or larger than the 1952 El Reno earthquake occur in the future, houses, businesses, and government infrastructure would suffer extensive damage, and death and injury from falling debris would be a possibility. Disruption of traffic would affect routine commuting as well as impede critical services such as police, fire, and ambulance service. School bus and mail routes would also be disrupted due to damaged or destroyed roads and bridges. Power and water outages as well as broken sewer lines could cause public health problems. Schools, hospitals, grocery stores and other critical need and economically important facilities would likely be damaged and be closed for extended periods. Employment and the economy would be affected because of business closures.

3.2.13.7 Vulnerable Populations:

When an earthquake occurs in a populated area, it may cause deaths and injuries and extensive property damage. The following map shows peak ground acceleration with a probability of exceedance in 50 years. The counties of Canadian, Caddo, Grady, Comanche, Stephens, and McClain are the most vulnerable to the hazard of earthquake.



3.2.13.8 Conclusion:

Oklahoma averages about 50 to 100 recorded earthquakes per year but only about one or two, on average, are felt and no damage estimates are available by facility. Several counties within the State of Oklahoma are at higher risk than others, but the probability of a future event of any significance along the Meers fault is still being debated by scientists.

3.3.14 Subsidence (Previously classified as Sinkholes)

A mine inspector is shown viewing the damage caused by a 1967 mine collapse in Picher.

Hazard Priority # 14

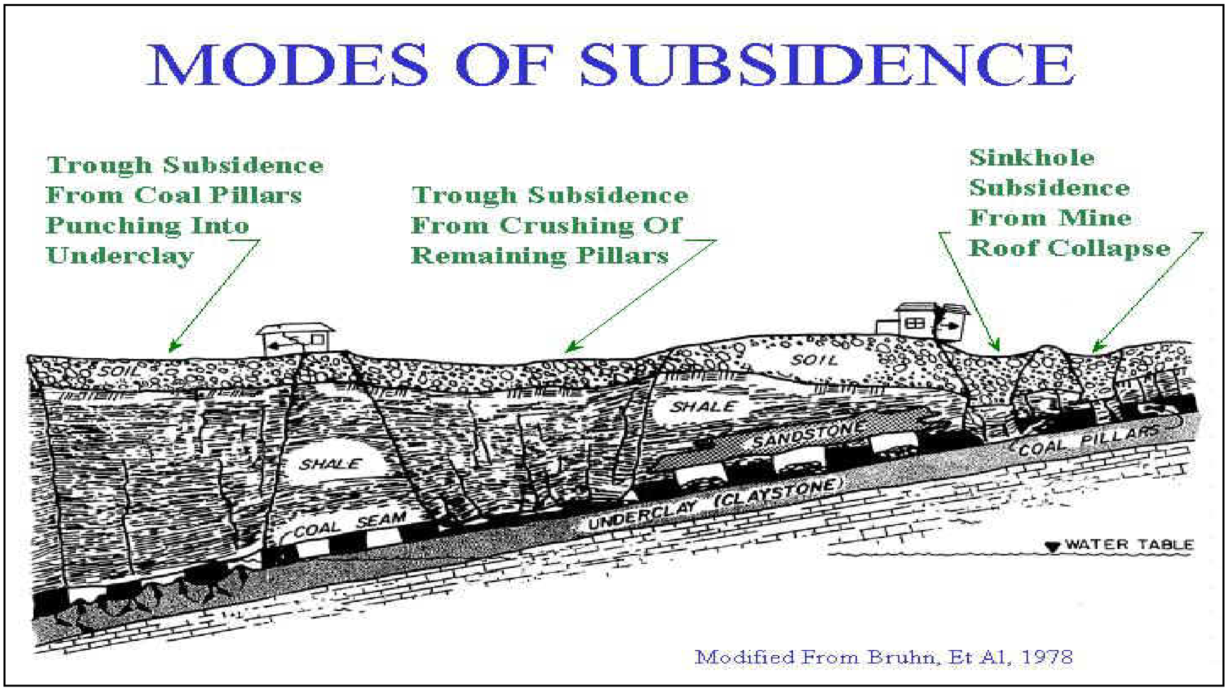
3.2.14.1 Description:

In the first quarter of the 20th Century, the town of Picher in Ottawa County was a boomtown. The Picher mine field produced over half of the lead and zinc used in World War I. When mining operations ceased in 1967, the landscape was dominated by mounds of toxic mine tailings (“chat”), abandoned equipment, and dangerous sink-holes and mine openings. Abandoned underground mines became filled with contaminated water causing cave-ins to occur.

Picher, Oklahoma sinkhole, 2008 (AP Photo/Charlie Riedel)

Cave-ins caused by mine subsidence are commonly referred to as sinkholes, but the term *subsidence* is the more correct term and is used in this Plan to differentiate cave-ins from abandoned mining operations from naturally-occurring sinkholes that form in limestone deposits, which are not currently recognized as a hazard to life and property in Oklahoma, but which will be reviewed and if warranted, included in the next Plan Update.

According to Oklahoma Geological Survey, there are two primary categories of subsidence associated with underground mining. The first category is called “chimney” or “plug” subsidence, which is characterized by shearing, steep-sided depressions, and large-differential displacements. The second category of subsidence is termed “trough subsidence” and is characterized by broad, shallow, trough-shaped depressions that form above a mine opening when the overlying strata sag into the mine void. Although it is likely that trough subsidence has occurred in the Picher Mining Field, it is currently not well recognized or mapped. Chimney subsidence is considered to be the primary category of subsidence in the Picher area, and imposes the most threat to the area.



Mining-induced subsidence is nearly always localized to the surface above the mined area, plus a margin around the outside. The vertical magnitude of the subsidence itself typically does not cause problems except in the case of drainage (including natural drainage) - rather it is the associated surface compressive and tensile strains, curvature, tilts and horizontal displacement that are the cause of the worst damage to the natural environment, buildings and infrastructure.

3.2.14.2 Location:

Subsidence is recognized to occur in the Picher area, as well as in portions of eastern Oklahoma which were active coal mining areas from the late 1800's until the mid 1900's. Latimer County experienced significant coal mining operations from 1896-1950 after which the mines were closed. Eastern Oklahoma State College in Wilburton began as the Oklahoma School of Mines and Metallurgy. Unfortunately, the City of Wilburton and parts of Red Oak along with other rural areas of Latimer County have experienced subsidence events on private and public property, as well as roadways.

The Oklahoma Conservation Commission recognizes 16 counties at risk for subsidence from abandoned coal mining operations. They are: Atoka, Coal, Craig, Haskell, Latimer, LeFlore, Mayes, McIntosh, Muskogee, Nowata, Okmulgee, Pittsburg, Rogers, Sequoyah, Tulsa, and Wagoner Counties.

3.2.14.3 Extent:

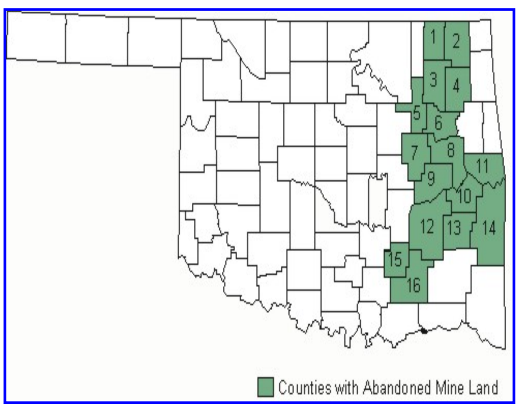
The Oklahoma Conservation Commission's Office of Surface Mining defines a subsidence emergency as any event that causes sudden danger or impairment that presents a high probability of substantial physical harm to the health, safety, or general welfare of people before the danger can be abated. Oklahoma's **Abandoned Mine Land** (AML) Program exists to remediate hazards associated with abandoned mining operations. Of all the hazards associated with abandoned mining operations, the most common is subsidence.

On February 17, 1998, the Oklahoma Conservation Commission became the State agency responsible for the AML Emergency Program in Oklahoma. After an emergency complaint is received, AML Program staff makes a site investigation. If conditions warrant, appropriate emergency assistance organizations and local authorities are notified to ensure that immediate steps are taken to protect the public until abatement can be initiated. Once protective steps have been taken, AML Program staff submits a Complaint Investigation Report, based on criteria established during the site investigation, to the Office of Surface Mining Reclamation and Enforcement (OSM) Tulsa Field Office. The OSM Tulsa Field Office makes a declaration of either emergency or non-emergency. An emergency is declared by the signing of a Finding of Fact/Funding authorization.

Once an emergency has been declared, the AML Program staff identifies the scope of work and a cost estimate, prepares the solicitation package and contacts potential contractors, coordinates a pre-bid meeting at the site, awards the contract, monitors the construction, performs a final inspection upon construction completion, and submits a final inspection report to the OSM Tulsa Field Office.

The AML Program is 100% funded federally funded from tax on active coal mine production. A one-year grant is issued by OSM each year. Any unused funds are returned to the account at the end of the year.

Oklahoma Counties in the Abandoned Mine Land Area:



1 – Nowata	9 - McIntosh
2 – Craig	10 - Haskell
3 – Rogers	11 - Sequoyah
4 – Mayes	12 - Pittsburg
5 – Tulsa	13 - Latimer
6 – Wagoner	14 – Le Flore
7 - Okmulgee	15 – Coal
8 - Muskogee	16 – Atoka

3.2.14.4 Previous Occurrences:

At the conclusion of the US EPA remediation effort in Picher mining field, approximately 1,064 abandoned lead and zinc mine shafts that were identified, 481 shafts were either open or in some stage of collapse, according to Oklahoma Geological Survey.

In 1989, the city of Wilburton in Latimer County experienced a large cave-in on a well-traveled city street. The subsidence opened a shaft to a mine that had been abandoned for nearly 80 years. A contract for repairs was quickly procured and the emergency reparations were federally funded.

Since the last Plan Update, there have been no reports of subsidence-related events that caused death or injury in Oklahoma. From February 11, 2011 to August 30, 2013, AML Abandoned Mine Land) records indicate the completion of ten emergency remediation projects: five in Latimer County; four in Pittsburg County; and one in LeFlore County.

It should be noted that while AML categorized all ten projects as Emergency/High Priority events, the Agency's reports do not indicate the specific hazards addressed. In addition to subsidence, AML also recognizes the following hazards to be associated with abandoned mine land: dangerous highwalls; water-filled strip pits; toxic waste dump sites; hazardous equipment and building sites; acid mine drainage; and open portals, pits, and vertical openings. Some sites may involve multiple categories of hazards.

3.2.14.5 Probability of Future Events:

Currently, subsidence in the Picher area presents minimal danger to the public due to remediation efforts under the EPA Tar Creek Superfund Project that resulted in the relocation of most of the population and ultimately, the dissolution of the town itself.

Coal mine-related subsidence is still problematic to the former coal mining regions of eastern Oklahoma.

To date, the Oklahoma AML Program has completed a total of 114 emergency projects. All emergency projects are considered to be Priority #1 by the State of Oklahoma.

The AML program has been analyzing maps of coal mines and geological reports from the period 1910 through 1955, to determine the potential location and severity for geologic hazard above abandoned coal mines in the state. In addition to providing funding and technical guidance on abating mine hazards, the AML Program of the Oklahoma Conservation Commission has been assisting the public in providing access to maps and records of abandoned mining operations.

Today, all mining operations are required to be permitted by the Oklahoma Department of Mines (ODM). As part of the permitting process, all mine operators must post an adequate bond to cover reclamation costs, should it be necessary for third party to complete the reclamation process. Mine operators must adhere to all state and federal environmental laws, and mining operations are monitored by state and federal inspectors.

Due to the previously mentioned "Emergency Project" events by AML, the 16 counties in eastern Oklahoma identified as AML coal regions are **Likely** to experience a subsidence event.

Calculated Priority Risk Index (CPRI)

Subsidence = 2.65

<table>
<tr><td colspan="3">Probability</td><td colspan="2">3 Likely</td></tr>
<tr><td colspan="3">Magnitude/Severity</td><td colspan="2">2 Limited</td></tr>
<tr><td colspan="3">Warning Time</td><td colspan="2">2 Less than 6 Hours</td></tr>
<tr><td colspan="3">Duration</td><td colspan="2">4 Greater than one week</td></tr>
<tr><td colspan="5">The CPRI for the Mine Subsidence hazard for the State of Oklahoma is:</td></tr>
<tr><td>Probability</td><td>+Magnitude/Severity</td><td>+ Warning Time</td><td>+ Duration</td><td>= CPRI</td></tr>
<tr><td>(3 x .45)</td><td>+ (2 x .30)</td><td>+ (2 x .15)</td><td>+ (4 x .10)</td><td>= 2.65</td></tr>
</table>

3.2.14.6 Vulnerability and Impact:

During the late 1800's and early 1900's coal mining was a major industry in Eastern Oklahoma. Since that time, most mining operations have been abandoned and homes and businesses have been built over the area. Over time, underground mine chambers may become flooded, and wooden mine supports may become weak and unstable. Small earthquakes can trigger a collapse of the abandoned mine roofs, causing a hole to open to the surface.

3.2.14.7 Vulnerable Populations:

Citizens could be negatively impacted if the opening occurred on developed property, or involved a roadway. The resulting effects could include injuries, loss of the structure, unemployment, loss of accessibility to normal transportation routes, as well as fear that another event might occur. Economic impact to property owners could be substantial since insurance policies in Oklahoma do not typically insure against events involving earth movement, which would include subsidence events.

The probability of future mining subsistence events occurring in Eastern Oklahoma is LIKELY due to previous incidents. The greatest risk is for the Wilburton area due to the concentration of numerous old mines below the surface of the town which increases the threat of subsidence as the mine pillars and wood timber supports deteriorate.

3.2.14.8 Conclusion:

The threat in Latimer County of additional Subsidence events occurring is considered "Likely" due to previous incidents. The populated area of Wilburton is above numerous old mines that increase the threat of additional Subsidence Events due to the rotting timbers in those mines such as those shown above. As time passes more timbers will rot and fail.

3.3.15 Landslides

Hazard Priority # 15

3.2.15.1 Description:

Landslides and smaller slumps are a common highway construction problem in parts of Oklahoma. Most landslides occur in the eastern third of the State, probably due to its wetter climate and the steeper slopes associated with more mountainous terrain. The map shows the general areas in the U.S. most susceptible to landslides. Generally, the threat of landslides is high where natural slopes exceed a gradient of 2:1. "Rotational slump" is the most common type of landslide that occurs in Oklahoma. Rotational slumps can occur on either excavated slopes or embankments. In Oklahoma, highway engineers use a process called benching to minimize the possibility of landslides. A bulldozer is used to make several benches or platforms parallel to the roadway alignment. The embankment is then built upon the benches.

Some slopes are susceptible to landslides whereas others are more stable. Many factors contribute to the instability of slopes, but the controlling factors are the nature of the underlying bedrock and soil, the configuration of the slope, the geometry of the slope, and ground-water conditions.

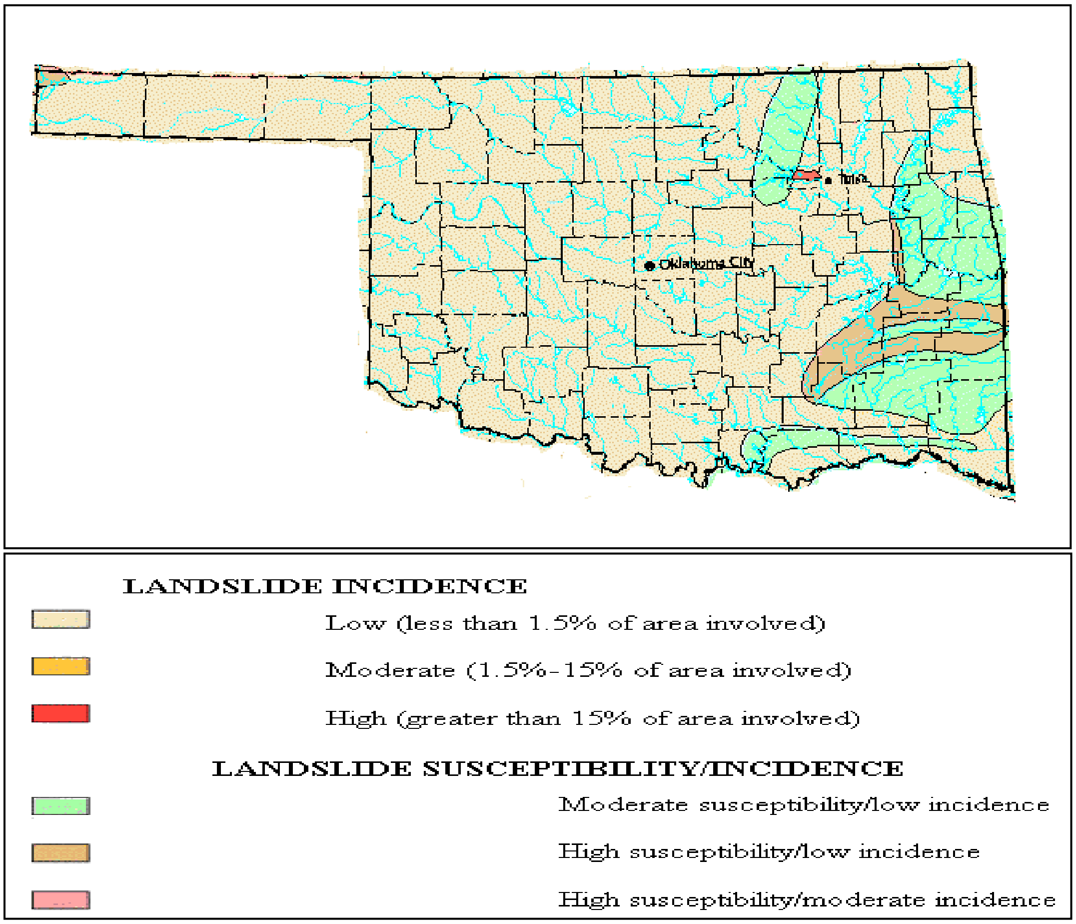
Three distinct physical events occur during a landslide: the initial slope failure, the subsequent transport, and the final deposition of the slide materials. Landslides can be triggered by gradual processes such as weathering, or by external mechanisms including:

- Undercutting of a slope by stream erosion, wave action, glaciers, or human activity such as road building;
- Intense or prolonged rainfall, rapid snowmelt, or sharp fluctuations in ground-water levels;
- Shocks or vibrations caused by earthquake or construction activity;
- Loading on upper slopes; or
- A combination of these and other factors

Once a landslide is triggered, material is transported by various mechanisms including sliding, flowing and falling. Landslides often occur along planes of weakness that may parallel the hill slope. In bedrock, planes of weakness are usually beds, joints or fractures. Soils such as silt and clay are weaker than rock and commonly have complexes or multiple planes of weakness.

3.2.15.2 Location:

Landslides may occur anywhere in Oklahoma but generally east of I-35. Most of the area west of I-35 is flat land where landslides are not an issue. Few counties in Oklahoma consider landslides to be a common occurrence.



3.2.15.3 Extent:

The State of Oklahoma considers any landslide that blocks roads or highways, or causes human injury to be a major severity.

3.2.15.4 Previous Occurrences:

No damage amounts are available for this hazard, primarily because the state has no reported history of events, damages or loss. A mitigation action is in this plan to gather data. According to NCDC, 0 events were reported between 01/01/1996 and 02/28/2013 (6269 days).

3.2.15.5 Probability of Future Events:

The potential for serious landslide hazards in Oklahoma is **unlikely** but feasible.

Calculated Priority Risk Index (CPRI)

Landslide = 1.45

Probability			1 Unlikely	
Magnitude/Severity			1 Negligible	
Warning Time			4 Less than 6 Hours	
Duration			1 Less than 6 hours	
The CPRI for the Landslide hazard for the State of Oklahoma is:				
Probability	+Magnitude/Severity	+ Warning Time	+ Duration	= CPRI
(1 x .45)	+ (1 x .30)	+ (4 x .15)	+ (1 x .10)	= 1.45

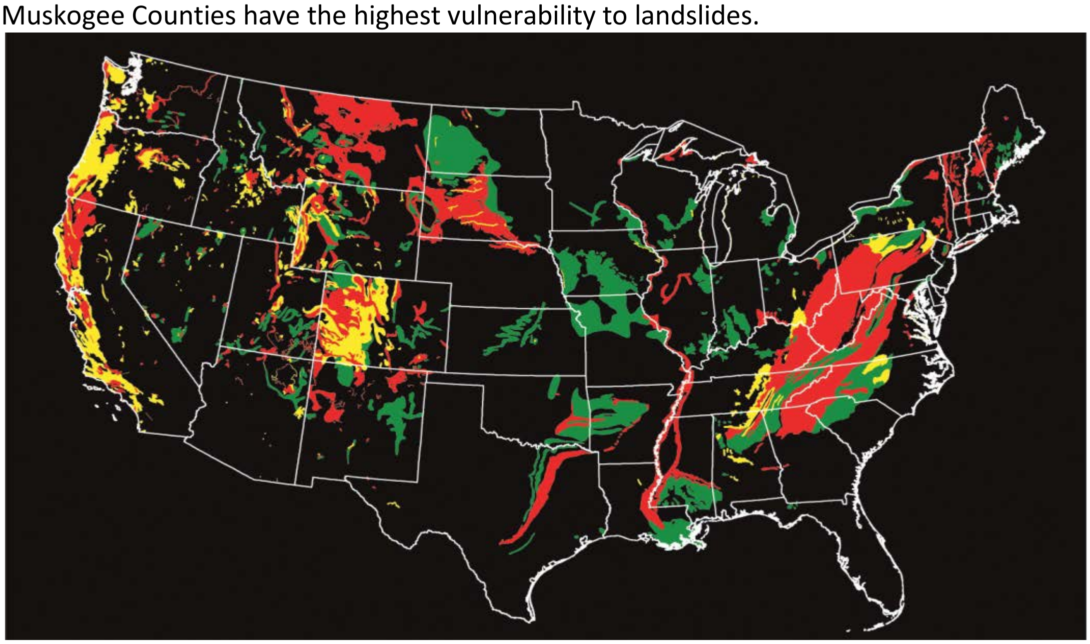
Resources: Oklahoma Department of Transportation; United States Geological Survey (USGS)

3.2.15.6 Vulnerability and Impact:

In Oklahoma, landslides are an uncommon event and are limited to selected areas in the eastern part of the state. Most of the threat is in relatively unpopulated areas along roadways and railways. However, as the population grows and spreads out, homes and businesses could become vulnerable to landslides. The potential for accident and injury exists when debris falls without warning into roadways. Should a landslide event happen, homes and businesses could be severely damaged or destroyed. Roadways blocked for more than a few hours can adversely affect economical factors in the area. Government infrastructure could also be affected through damage to roads, underground utilities and power supplies.

3.2.15.7 Vulnerable Populations:

The Oklahoma Department of Transportation recognizes that landslides could be a potential hazard to the traveling public in some areas and has conducted a landslide recognition and stabilization program as it relates to highway construction. Maps have been prepared for Oklahoma and are updated as new data becomes available. In Oklahoma, Le Flore, Haskell, Latimer, Pittsburg, Coal, Atoka, McIntosh, and Muskogee Counties have the highest vulnerability to landslides.



Red -Very high potential; Yellow - High potential; Green – Moderate potential

Primarily, the vulnerable population is vehicular traffic on roadways that are affected as well as railroads. Structures can be affected especially if they are on the side of a rocky bluff or slope that becomes unstable.

Landslides are usually in the mountainous areas. The potential for accident and injury exists when debris falls without warning into roadways. The State Department of Transportation is responsible for the initial response to divert traffic and remove the debris. Preventive measures are evaluated to reduce or eliminate a recurrence, often by altering the slope of the incline in those areas that may be prone to slides.

3.2.15.8 Conclusions:

The Oklahoma Department of Transportation recognizes landslides as a potential hazard in some areas of the state but little historical data is available. ODOT has a landslide recognition and landslide stabilization program as it relates to highway construction. This assessment is on-going and no damage amounts are available for this hazard because the State has no reported history of damages or loss. Most state buildings are not located in landslide potential areas. When events occur, they are handled as general maintenance and cleaned up as traffic hazards.

Most of the east and virtually the entire southeast quadrant of the state are susceptible to landslides. There may be other isolated areas in the state that could also have occasional problems but not serious ones.

3.3 Risk Assessment: Conclusions

The 2010 US Census Bureau data indicates the State of Oklahoma's population numbered 3,751,351. Oklahoma is ranked 28th in total population among the 50 states.

Oklahoma has seen a 0.91% (less than 1 percent) growth rate since the previous census taken in 2000.

Many jurisdictions in Oklahoma have experienced growth, some faster than others. The large jurisdictions of Oklahoma and Tulsa counties have experienced the largest growth especially on the outskirts where the existing communities are entering into what had been pasture or woodlands. Expansion into these areas often increases the risks faced by Oklahomans and the destruction of property or loss of life potential. Most new construction in Oklahoma consists of brick homes. Some mobile homes are still being placed in communities where restrictions don't prevent them. More buildings and infrastructure means more exposure to natural events.

The massive destruction and loss of life from the May 2013 tornadoes raised awareness of the need for safe rooms in public schools. This awareness has fostered initiatives from both the public and private sector to mandate the construction of school shelters in both existing and new school facilities.

Development into the wild land urban interface puts more people and property at risk. At this time, no state facilities have been constructed in recently developed areas. Local leaders must be cognizant of the new risks, and work toward implementing zoning and building codes to reduce the exposure. Both Oklahoma and Tulsa Counties have floodplain ordinances to prevent development in the SFHA. The addition of new areas of development puts more of a strain on utilities. Without improvements, utilities are more apt to fail and leave people without gas, power, and communications during and after a hazard event. The floodplain ordinances and better building practices cut down the amount of damage from natural hazard disasters. As Severe Repetitive Loss properties are purchased or removed from the floodplain, the damage from flooding is reduced even further.

Roadways are more heavily traveled and have a higher chance of being crowded during and after a hazard event. This also exposes motorists to the hazard more openly and creates delays for emergency response personnel.

The State of Oklahoma owns buildings throughout Oklahoma. A list of those buildings, the Area[1] and county they are in and specific data concerning each structure is provided in Appendix G of this plan. As with the local jurisdictions, the security of these facilities is imperative to ensure public health and safety in the aftermath of a hazard event. Although the State facilities are shown in the Appendix, it is critical that this Appendix remain out of public view. This Appendix contains information for some State agencies that are critical to the health, safety and security of the public in Oklahoma. Due to this, **Appendix G is to be withheld from public disclosure. For information regarding release of this data please contact the State Hazard Mitigation Officer at (405) 521-2481.**

State-owned buildings, the majority of which are accessible to the public, are generally built to more stringent building codes than are private residences and businesses. Although values of the buildings and their contents are shown in **Appendix G (not available for public viewing**) potential dollar losses

[1] The State is divided into 5 Preparedness Areas of Assignment. See Appendix G for a profile listing of the State's Critical Facilities and a detailed listing of state owned facilities grouped by Area and County to represent their jurisdictional vulnerability.

would depend on the amount of damage done to the facility by the "hazard event". In the case of total destruction of the property the loss would obviously be determined by the total value of the building and its contents. Lesser damage would be determined by repair costs.

This hazard analysis and risk assessment is based on the best and most up-to-date data available. It presents a reasonable range of hazards that have affected the State in the past and could, of course, affect it in the future. Hazard Mitigation Plans from local jurisdictions throughout the State of Oklahoma's five Preparedness Areas were reviewed by the HM staff and were found to have hazard profiles, goals, and mitigation strategies much in line with those as presented in the State Hazard Mitigation Plan. It is important to note that although some hazards are classified as only possible or unlikely in probability of occurrence, it does not mean that they cannot affect Oklahoma in a significant way, but only that such an occurrence is relatively less likely.

State Critical Facilities and State owned properties are not identified in the local plans. Therefore the State's critical facilities and State owned properties were assessed for vulnerability by hazard in the list provided in Appendix G.

3.3.1 Local Assessments Summarized within Preparedness Area:

CENTRAL AREA (Oklahoma County)

The state of Oklahoma is divided into five preparedness areas: Northwest, Northeast, Southwest, Southeast and Central. The boundaries are along I-35 dividing the state from east to west and I-40 dividing the state from north to south. These two interstate highways cross in Oklahoma City, Oklahoma County which is the **Central** preparedness area.

Flooding:
Flooding is the most common and widespread of all natural disasters to which the region is susceptible, and virtually every citizen and structure is at risk during a flood event. To assess this region's vulnerability, potential losses were calculated for riverine flooding for 100-year and 500-year MRP events. HAZUS information follows:

Estimated Oklahoma County Population Vulnerable to the 100-Year and 500-Year MRP Flood Hazard

Municipality	Population in 100-Year Flood Boundary	Population in 500-Year Flood Boundary
Arcadia (T)	7	20
Bethany (C)	142	142
Choctaw (C)	984	993
Del City (C)	2,167	3,135
Edmond (C)	2,687	2,866
Forest Park (T)	0	0
Harrah (C)	329	331
Jones (T)	320	320
Luther (T)	125	129
Midwest City (C)	1,844	2,209
Nichols Hills (C)	0	0
Nicoma Park (C)	148	231
Spencer (C)	77	88
The Village	89	165
Unincorporated County	1,419	1,426
Valley Brook (T)	0	0
Warr Acres (C)	16	16
Total	**10,354** **10,034**	**12,071** **11,751**

Estimated Oklahoma County Population Displaced or Seeking Short-Term Shelter from the 100-Year and 500-Year MRP Events

Municipality	100 Year				500 Year			
	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter
Arcadia (T)	23	8.2	5	1.8	33	11.8	8	2.9
Bethany (C)	1,384	6.9	1,101	5.5	1,598	7.9	1,332	6.6
Choctaw (C)	517	5.5	184	2.0	607	6.4	263	2.8
Del City (C)	2,805	12.7	2,472	11.2	3,438	15.5	3,123	14.1
Edmond (C)	2,211	3.2	1,713	2.5	2,351	3.4	1,831	2.7
Forest Park (T)	2	0.2	0	0.0	2	0.2	0	0.0
Harrah (C)	171	3.7	43	0.9	277	6.0	123	2.7
Jones (T)	328	13.0	182	7.2	369	14.7	212	8.4
Luther (T)	57	5.9	12	1.3	72	7.5	23	2.4
Midwest City (C)	2,628	4.9	2,315	4.3	2,864	5.3	2,584	4.8
Nichols Hills (C)	67	1.7	33	0.8	91	2.2	57	1.4
Nicoma Park (C)	103	4.3	23	1.0	133	5.5	36	1.5
Spencer (C)	126	3.4	35	0.9	143	3.8	48	1.3
The Village	439	4.3	366	3.6	548	5.4	457	4.5
Unincorporated County	895	6.8	289	2.2	1,164	8.9	457	3.5
Valley Brook (T)	74	8.9	74	8.9	81	9.8	81	9.8
Warr Acres (C)	662	6.0	570	5.2	762	6.9	680	6.2
Total	**12,492** **12,164**	**5.5** **5.4**	**9,417** **9,235**	**4.1** **3.3**	**14,533** **14,164**	**6.4** **6.7**	**11,315** **11,103**	**4.9** **4.2**

NFIP Policies, Claims and Repetitive Loss Statistics for Oklahoma County, 2011

Municipality	# Policies	# Claims (Losses)	Total Loss Payments	# Rep. Loss Prop.	# Severe Rep. Loss Prop.	Type of Rep. Loss Structure
Arcadia (T)	7	5	$169,600	0	0	N/A
Bethany (C)	18	9	$19,455	1	0	Residential
Choctaw (C)	69	9	$2,182	0	0	N/A
Del City (C)	384	45	$179,532	1 2	0	Residential
Edmond (C)	314	96	$1,426,809	2	0	Residential
Forest Park (T)	3	0	$0	0	0	N/A
Harrah (C)	23	0	$0	0	0	N/A
Jones (T)	33	15	$369,154	4	1	
Luther (T)	5	1	$0	0	0	N/A
Midwest City (C)	265	35	$281,297	1 0	0	N/A
Nichols Hills (C)	16	16	$59,602	2	0	Residential
Nicoma Park (C)	8	3	$7,694	1	0	Commercial
Spencer (C)	24	6	$35,792	0 3	0	Residential
The Village (C)	41	1	$0	0	0	N/A
Unincorporated County	102	47	$429,831	4 3	0	Residential
Valley Brook (T)	1	1	$3,171	0	0	N/A
Warr Acres (C)	15	6	$6,133	0	0	N/A
Total	1,328 1,295	295 280	$2,990,252 $2,621,098	16 14	1 0	13-Residential; 1-Commercial

(1) Data provided by FEMA in October 2011. Statistics are totals using the “Community Name” field.

(2) C = City; Prop. = Property; T = Town

Oklahoma County has implemented numerous flood mitigation projects in recent years but the probability of future flooding events remains *highly likely.*

Tornadoes:

Oklahoma County’s plan profiled Tornadoes and High Winds as a single hazard, while the State of Oklahoma recognizes these as two separate hazards. Oklahoma County has sustained several catastrophic tornado and wind events resulting in the loss of life and property. Both hazards have caused widespread power outages, disruption to transportation corridors, and the loss of homes, schools, and workplaces.

Winter Storms:

Severe winter storms are a concern to Oklahoma County due to the direct and indirect costs associated with these events including storm-related delays, the impacts on people and facilities related to snow and ice removal, and cascade effects such as power outages, traffic accidents, and increased demand on limited community resources. Heavy snow loads can weaken roofs and collapse buildings. In rural areas of the county, citizens may be stranded for long periods of time.

Estimated losses from Winter Storm Events for Oklahoma County:

Municipality	Total (All Occupancies) RV	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Arcadia (T)	$26,418,000	$264,180	$1,320,900	$2,641,800
Bethany (C)	$1,427,258,000	$14,272,580	$71,362,900	$142,725,800
Choctaw (C)	$640,085,000	$6,400,850	$32,004,250	$64,008,500
Del City (C)	$1,459,942,000	$14,599,420	$72,997,100	$145,994,200
Edmond (C)	$5,820,032,000	$58,200,320	$291,001,600	$582,003,200
Forest Park (T)	$78,305,000	$783,050	$3,915,250	$7,830,500
Harrah (C)	$281,952,000	$2,819,520	$14,097,600	$28,195,200
Jones (T)	$152,124,000	$1,521,240	$7,606,200	$15,212,400
Luther (T)	$56,712,000	$567,120	$2,835,600	$5,671,200
Midwest City (C)	$3,508,200,000	$35,082,000	$175,410,000	$350,820,000
Nichols Hills (C)	$488,990,000	$4,889,900	$24,449,500	$48,899,000
Nicoma Park (C)	$185,950,000	$1,859,500	$9,297,500	$18,595,000
Spencer (C)	$245,687,000	$2,456,870	$12,284,350	$24,568,700
The Village	$833,460,000	$8,334,600	$41,673,000	$83,346,000
Unincorporated County	$827,100,000	$8,271,000	$41,355,000	$82,710,000
Valley Brook (T)	$46,459,000	$464,590	$2,322,950	$4,645,900
Warr Acres (C)	$821,741,000	$8,217,410	$41,087,050	$82,174,100

Drought:

All of Oklahoma County is vulnerable to drought; however, areas at particular risk include agricultural lands, open/forested land vulnerable to wildfires, areas where communities rely on private water supply, and areas where elderly, impoverished or otherwise vulnerable populations are located. Local plans indicate the risk of future droughts within this county to be *likely*.

Hail:
The entire population of Oklahoma County is vulnerable to hail occurrences. Local plans indicate that the county experiences, on average, two to five hail events per year, with Oklahoma County experiencing 315 hail events between 1950 and 2011. Currently, there is no comprehensive estimate of damages caused by hail events in the county. The likelihood of future damaging hail events is *highly likely.*

High Winds:
(See Tornadoes above)

Lightning:
According to local plans, the peak lightning period is April to June, which coincides with tornado season. Direct and indirect losses associated with these events include injury and loss of life, damage to structures and infrastructure, agricultural losses, utility failure (power outages), and stress on community resources. The cost of these lightning-related losses within the county cannot be isolated, but the greater concern is the threat of death and injury. The probability of life-threatening lightning events occurring within Oklahoma County is *highly likely.*

Wildfire
According to local plans, all of Oklahoma County is located within a wildland urban interface (WUI) zone making the entire population and all buildings vulnerable to this hazard. Local plans indicate that fire departments do not maintain comprehensive statistics on wildfire losses within this area. Oklahoma County has large expanses of open areas that are vulnerable to grassfires which, when fueled by brisk winds, can quickly escalate to wildfires within city limits. Local plans indicate that a single urban wildfire in March 2011 consumed 30 homes in Oklahoma City, 29 homes in Harrah, and seven in Choctaw. Later that same year, a wildfire burned 3,000 acres and destroyed 21 homes on the edge of Oklahoma City. Due to current trend of new housing developments within the county's wildland urban interface, the probability of future wildfire events occurring in Oklahoma County is *likely*.

Dam Failure:
According to local plans, there are 22 high hazard dams in Oklahoma County. Canton Lake Dam, owned and operated by the U.S. Army Corps of Engineers (USACE) and located approximately 80 miles northwest of Oklahoma City, is the primary source of water for Oklahoma City. Its inundation zone includes most of Oklahoma City including the downtown and State Capitol complex. The USACE has estimated the population at risk due to a failure of the Canton Dam is between 17,000 and 60,000 people, with economic losses estimated between $1.75 and $2.64 billion. Canton Lake dam is currently undergoing an extensive rehabilitation effort due to be completed in 2016 which will greatly reduce the risk factor for this structure.

Local plans conclude that while dam failures are rare, any dam breach could lead to catastrophic events. For this reason, owners of high hazard dams are required to have EAPs in place. Despite the high number of high hazard dams within the county, the potential for dam failure is *unlikely*.

Extreme Heat:

Extreme temperatures generally occur within Oklahoma County for a short period of time. Prolonged periods of high temperatures can lead to life threatening conditions, particularly to vulnerable populations that may not have access to adequate cooling or heating. Statistics within local plans refer to agricultural losses as a result of periods of extreme heat. Based on past history, the probability of the county experiencing prolonged periods of extreme heat is *likely.*

Expansive Soils:

Expansive soil hazards are slow to develop but can cause a range of structural impacts to the built environment. Damage to residential homes, commercial buildings, highways and streets can cause a financial drain on the local and regional economy. At the time of this HMP, insufficient data is available to model long-term potential impacts of expansive soils for Oklahoma County. Over time, additional data will be collected to allow better analysis for this hazard, but best information at this time indicates that the probability of expansive soil causing damage within the county is likely.

Earthquakes:

Local plans indicate an increasing number of "felt" earthquakes within this county in recent years, however all have been considered of minor severity. In the event of an earthquake occurrence of sufficient magnitude to cause damage to homes within this region, most displaced residents would use hotels or stay with family or friends. The following tables summarize the population HAZUS-MH 2.0 estimates will be displaced or will require short-term sheltering as a result of the 100-, 500- and 2,500-year MRP and historic 1952 earthquake events. However, Local plans predict a *negligible* chance that the county will experience a damaging earthquake.

Estimated Number of Injuries and Casualties from the 500-Year MRP Earthquake Event

	Time of Day		
Level of Severity	2:00 AM	2:00 PM	5:00 PM
Injuries	90	88	77
Hospitalization	14	13	12
Casualties	2	2	2

Estimated Number of Injuries and Casualties from the 2,500-Year MRP Earthquake Event

	Time of Day		
Level of Severity	2:00 AM	2:00 PM	5:00 PM
Injuries	1,040	1,189	994
Hospitalization	236	269	233
Casualties	51	56	48

Estimated Number of Injuries and Casualties from the Historic El Reno 1952 Earthquake Event

Level of Severity	Time of Day		
	2:00 AM	2:00 PM	5:00 PM
Injuries	71	65	58
Hospitalization	11	10	9
Casualties	2	2	1

Summary of Estimated Earthquake General Building Stock Losses for Oklahoma County

Scenario	Total * (Buildings + Contents)	Residential (Buildings + Contents)	Commercial (Buildings + Contents)
100-Year MRP Probabilistic	$0	$0	$0
500-Year MRP Probabilistic	$63,632,940	$48,122,068	$1,203,479
2,500-Year MRP Probabilistic	$883,830,446	$649,498,205	$161,529,453
El Reno 1952 **	$119,659,391	$60,780,710	$13,168,224
Annualized Loss	$970,642	$689,043	$194,507

Estimated Impacts to Transportation Features in the Oklahoma County from the 500-year MRP Earthquake Event

Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality	
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Wiley Post Airport - OKC	Bethany (C)	Airport	97.2	2.2	0.5	0	0	99.6	99.9
Downtown Airpark	Oklahoma County	Airport	97.2	2.2	0.5	0	0	99.6	99.9
Wiley Post Airpark	Oklahoma County	Airport	97.3	2.2	0.5	0	0	99.6	99.9
Will Rogers World Airport	Oklahoma County	Airport	97.1	2.3	0.6	0	0	99.6	99.9

Estimated Impacts to Transportation Features in the Oklahoma County from the 2,500-year MRP Earthquake Event

Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality	
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7
Wiley Post Airport - OKC	Bethany (C)	Airport	62.7	18	16.9	2	0.4	87.2	97.9
Downtown Airpark	Oklahoma County	Airport	62.7	18	16.9	2	0.4	87.2	97.9
Wiley Post Airpark	Oklahoma County	Airport	63.5	17.8	16.4	1.9	0.4	87.6	98
Will Rogers World Airport	Oklahoma County	Airport	62.1	18.1	17.3	2.1	0.4	86.9	97.8

Estimated Debris Generated by the 500- and 2,500-year MRP Earthquake Events

	500-Year		2,500-Year		1952 El Reno	
County	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Oklahoma	49,146	14,484	335,984	207,858	33,096	8,968

NORTHWEST AREA

The state of Oklahoma is divided into five preparedness areas: Northwest, Northeast, Southwest, Southeast and Central. The boundaries are along I-35 dividing the state from east to west and I-40 dividing the state from north to south. This section concerns the **Northwest** preparedness area.

Flooding:
This region is less prone to flooding than other regions of the state. Currently, nine of the 17 counties are NFIP participants. Major County's plan included its intention to become HNIP compliant.

Tornadoes:
Ellis County created a model to simulate the damage of an F5 tornado. In the scenario, the tornado would move across the county striking the towns of Arnett, Gage and Shattuck. The model estimated that approximately 70% of the structures and population in the county would be affected. Of the remaining structures in the tornado's path, 25% would sustain 50% damage, and the other 25% would have 25% damage. The following table shows the estimated damages:

Estimated Losses – Major F-5 Tornado Affecting 70% of Structures & Population of Ellis County							
Type of Structures	**Total #**	**Hazard Area # (70%)**	**Hazard Area $**	**50% of Structures Destroyed**	**25% of Structures Received 50% Damage**	**25 % of Structures Received 25% Damage**	**Total Damages**
Residential	2,138	1,497	$50,884,400	$25,442,200	$6,360,550	$3,180,275	$34.983,025
Commercial/Industrial	362	253	$118,440,427	$59,220,214	$14,805,053	$7,402,527	$81,427,794
Government	29	20	$1,296,967	$648,484	$162,121	$81,060	$891,665
Schools / Education	49	34	$14,743,238	$7,371,619	$1,842,905	$921,452	$10,135,976
Total # of Structures	2,578						
Structures Damaged	1,804						
All Property In County	$264,807,188						
Damages (Hazard Area)	127,438,460						
Total County Population	4,075						
Population Hazard Area	2,853						

A large damaging tornado in Ellis County has the potential to do a minimum of $127,438,460 dollars in damage and affect 2,853 citizens.

The town of Fairview in Major County also prepared a tornado scenario. Its results are as follows:

Estimated dollar loss in a scenario involving an EF5 tornado in Fairview

Structure	**Estimated Replacement Value of Structure**

Major County Courthouse	$ 3,500,000
Fairview City Complex (includes Police and Fire Depts.)	$ 3,279,170
Fairview Fellowship Nursing Home	$ 17,000,000
Fairview Hospital	$ 25,000,000
Fairview High School	$ 6,637,125
Cornelsen Elementary and Chamberlain Middle Schools	$ 13,498,228
District 2 County Barn	$ 125,000
1,451 Residential structures	$ 75,306,900
Total estimated dollar loss for scenario	**$ 144,346,423**

Roger Mills County provided information that in the past 13 years, 15 tornadoes had occurred there. As confirmed in local plans, the likelihood of future tornado occurrences for the entire Northwest Area is *highly likely.*

Winter Storms:
According to NCDC, there were 58 snow and ice events with damages totaling over $452 million for several counties in north central and northwestern Oklahoma since 1993, including the 2002 storm which was considered one of the worst storms in the state's history. Major County's plan stated that while the primary concern of communities is the safety of citizens, preserving crops and livestock is also a high priority since the majority of the county is agricultural.

Drought:
Agriculture is the primary industry within the Northwest Area, and drought is a continuous threat to the livelihood of this Area. Drought conditions result in lack of vegetation for grazing and hay production which can force farmers to prematurely sell their herds. Adding to the ranchers' misery is the fact that brittle grass, brush, and undergrowth become fuel for wildfires.

Local plans indicate that this region has experienced ten major drought events within the past 80 years. Drought conditions also lead to the erosion of topsoil. Drought conditions of 1995-65 damaged 700,000 acres in 30 Oklahoma counties, which included most of the Northwest Area. Alfalfa County's plan summarized drought damages as difficult to calculate due to the complexity of the hazard, but concluded that the direct impact of drought is economic rather than loss of life and immediate destruction of property.

Hail:
The following table contains a scenario in which damaging hail stones, ranging in size from 1.0 inch in diameter to 3.0 inches, strikes Ellis County. As shown in the table, 50% of the structures sustain 30% damage which is primarily roofs with some siding damage and window damage. The other 50% of the structures sustain roof damage and only minimal window or other damage, which is shown as 20% of the structure's value. As shown below, a storm of this magnitude could easily cause an estimated $66,201,798 dollars in damage.

Ellis County – Hailstorm Scenario							
	Total #	Hazard Area #	Hazard Area $	50% of Structures Receive 30% Damage	50% of Structures Receive 20% Damage	Total Damages	
Residential	2,138	2,138	$72,692,000	$10,903,800	$7,269,200	$18,173,000	
Commercial/Industrial	362	362	$169,200,610	$25,380,092	$16,920,061	$42,300,153	
Government	29	29	$1,852,810	$277,922	$185,281	$463,203	
Schools / Education	49	49	$21,061,768	$3,159,265	$2,106,177	$5,265,442	
Structures Damaged	2,578						
Value of Damages	$66,201,798						
Hazard Area Pop.	4,075						

High Winds:
Sustained winds in excess of 40 MPH are not uncommon in the Northwest Area of the state since much of this region consists of high, open plains. With the prevalence of Mesonet reporting sites, wind speed and duration of gusts is constantly being documented. The Roger Mills County plan indicated that the Mesonet station at Cheyenne measured a series of non-thunderstorm wind gusts of 58 through 71 MPH on April 15, 2011. The probability of future high wind events in this Area is *highly likely*.

Lightning:
The entire Northwest Area is susceptible to lightning strikes due to the sporadic, erratic nature of lightning. Much of this region is rural, undeveloped land and routine lighting strikes are not problematic, but local jurisdictions identified lightning as a hazard when it occurs in the vicinity of buildings and schools.

Wildfires:
The Northwest Area is extremely susceptible to wildfires due to the combination of dry burnable ground cover, high winds, and frequent lightning storms. The towns of Cheyenne, Hammon, Reydon, Strong City and Sweetbrier in Roger Mills County have abundant sources of native grass, crops, and CRP grass which are prime fuel for wildfires. Local plans warn that this fuel is a potential tinderbox for ignition and that communities much be vigilant in keeping people and structures safe from wildfires.

Local plans stress that continuing drought conditions have severely limited available water sources for fire fighting. Farm ponds are frequently devoid of water. It is not uncommon for fires in rural areas of this region to grow into infernos consuming thousands of acres before they are brought under control. Roger Mills County provided the following summary of wildfire events and losses:

Fire Department	Year	Runs	Acres Burned	Loss
Cheyenne	2008	9	24	$500
Cheyenne	2009	0	0	0
Cheyenne	2010	18	1535	$36,800
Cheyenne	2011	91	1200	$15,000
Hammon	2008	4	67	$6,700
Hammon	2009	21	743	$77,300
Hammon	2010	13	188	$18,800
Hammon	2011	0	0	0
Reydon	2008	21	81	$9,000
Reydon	2009	19	30,293	$3,032,700
Reydon	2010	7	350	$7,000
Reydon	2011	0	0	0
Strong City	2008	1	20	$100
Strong City	2009	3	1200	$36,000
Strong City	2010	1	1	$50
Strong City	2011	0	0	0

Due to periods of drought, dry conditions, high temperatures, wind and low humidity, the threat of wildfires for the Northwest Area is *highly likely.*

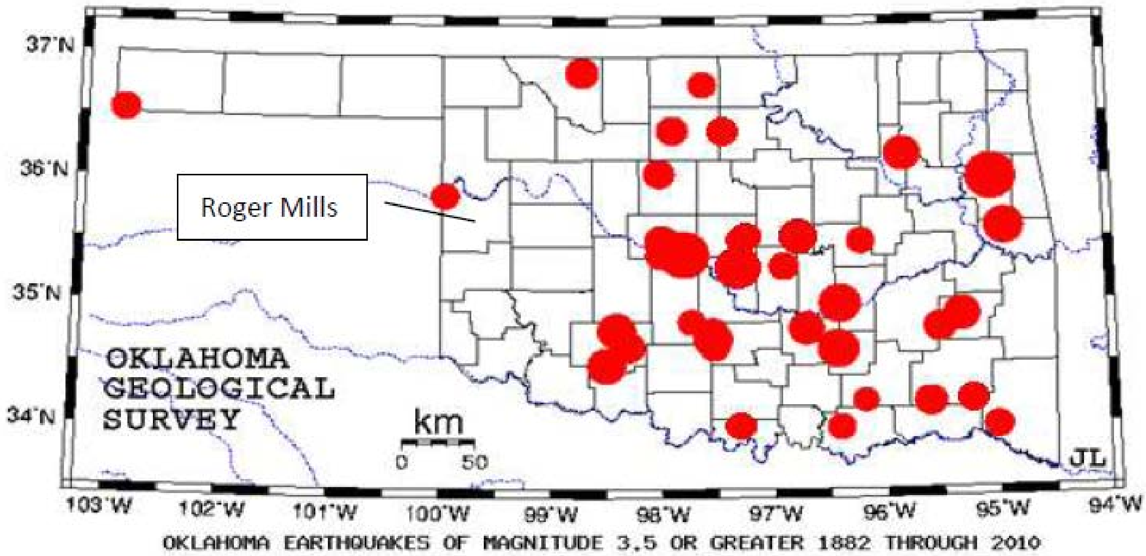
Dam Failure:
There are 27 High Hazard dams located within the Northwest Area, which is relatively low in comparison to other regions. There have been no recorded events of dam failure in this region within the period 1950 – 2012. The U.S Army Corps of Engineers owns and operates the Great Salt Plains Reservoir Dam in Alfalfa County, which is classified as a low-hazard dam due to the existence of little to no population or improved properties within its inundation zone, according to local plans. The risk of dam failure in this Area is therefore *unlikely.*

Extreme Heat:
Based on historical data, this Area of the state has experienced prolonged periods of high heat. Local plans indicate that periods of extreme heat have the potential to affect the economic stability of the region due to the loss of crops and livestock. The likelihood of future occurrences of prolonged extreme heat events is *likely.*

Expansive Soils:

Winter Storms:
The Northwest Area is predominantly rural but winter storms can have devastating effects

Earthquakes:
The Northwest Area has had the fewest number of "felt" quakes in the state. The following map, provided by the Oklahoma Geological Survey, and included in the Roger Mills County plan, confirms this observation:



The Oklahoma Geological Survey Observatory located within Alfalfa County recorded the following earthquakes:

OKLAHOMA GEOLOGICAL SURVEY OBSERVATORY								
OKLAHOMA EARTHQUAKE CATALOG								
ALFALFA COUNTY								
DATE			*MAGNITUDES*			*LATITUDE*	*LONGITUDE*	*DEPTH*
YYYY	*MMM*	*DD*	*3Hz*	*bLg*	*DUR*	*deg (N)*	*deg (W)*	*km*
1979	JAN	8	2.0	2.1	1.9	36.5790	-98.1460	4.70
1979	MAR	16	2.0	1.9	2.0	36.5170	-98.1230	5.00R
1980	NOV	22	2.3	1.8	2.1	36.5270	-98.1460	10.10
1982	MAR	15	2.4		2.0	36.9080	-98.2260	5.00R
1984	NOV	30	2.1		2.2	36.5800	-98.4660	5.00R
1988	MAY	26	2.1		2.2	36.5990	-98.4780	5.00R
1988	OCT	21			1.7	36.9070	-98.2140	5.00R
1993	JAN	14	3.2	3.1		35.5950	-98.2750	5.00R
1993	OCT	19	3.1	2.8	2.5	36.5460	-98.1730	5.00R

The likelihood, however, of future damaging earthquakes remains *possible* for this Area.

SOUTHEAST AREA

Flooding:

Twelve of the 21 counties in the Southeast Area are NFIP participants. The Southwest Area is not as flood-prone as other parts of the state. Local plans indicate that the impact of flooding events to structures is minimal since few structures exist within flood plains. Pontotoc County recognizes a SFHA (Special Flood Hazard Area) due to the presence of multiple rivers and creeks, but the city of Ada in that county is committed to flood zoning guidelines. Despite mitigation efforts to reduce flooding damages to improved property, local plans indicate that flash flooding still presents a *highly likely* hazard in the future of the Area.

Tornadoes:

The area within the Midwestern United States known as "Tornado Alley" encompasses most of the state of Oklahoma. The entire Southeast Area is at-risk for tornadoes due to the random nature of occurrences. The scenario for an F4 or F5 tornado striking any town would be the immediate catastrophic destruction of property and loss of life and injuries caused by tornados, the loss of power and subsequent failure of water and sewage systems present secondary problems to the population, and long-lasting social implications. Local plans project a near-total loss of critical facilities and infrastructure in their models. As an example, the estimated loss of infrastructure and 40% of homes to the relatively small town of Madill, county seat of Marshall County, would exceed $30 million dollars. Based on information presented in Southeast Area local plans, the likelihood of future tornado occurrences is *highly likely*.

Winter Storms:

Winter storms have had devastating effects on all region of the state due to loss of power, travelers- at-risk, fallen debris, frozen pipes, increased fire hazards, and slow-downs or reductions of emergency services. Local plans indicate that significant icing events occur with nearly the same frequency as heavy snow events in this Area. Icing events occur rapidly and can lead to the loss of power as the weight of ice pulls down electric conductor lines and collapses electrical sub-stations. Based on local plans within this Area, the risk for future severe winter storms in the Southeast Area is *likely*.

Drought:

There is much debate as to the definition of what constitutes drought or a drought event, Pontotoc County, located within the Southeast Area has documented seven drought events in the past seven years; Pontotoc County reports that droughts occur on 10-15 year cycles; and Atoka County reports 18 drought events since 2000. The Southeast Area has several aquifers which are a vital natural resource now and in the future. The Arbuckle-Simpson Aquifer serves as the sole water supply for 150,000 Oklahomans in this Area and the OWRB regulates the amount of water cities can draw from it to avoid overuse during periods of drought. This Area is not as severely impacted as other Areas of the state, and overall monetary losses are difficult to ascertain since most figures reflect only agricultural losses, but the probability of future drought episodes, based on local plans, ranges from *possible* to *likely*.

Hailstorms:

With exception of Pittsburg and LeFlore Counties, the Southeast Area has had the lowest historical occurrence of hailstorms in the state. Most of the monetary damage is to field crops, followed by damage to structures and vehicles. Local plans rarely attribute specific monetary losses per event since there is no required reporting of hail damages by any state agency; however, the City of Eufaula plan includes a 2008 hail event that resulted in over $100,000 in damages to homes and automobiles. Local plans indicate that the possibility of future damaging hail events occurring in the Area is *highly likely*.

High Winds:

The Southeast Area is at risk for both intense updrafts and straight-line winds in excess of 40 MPH regardless of the presence of thunderstorms. Local plans state that high winds routinely damage roofs, out buildings, fences, siding and windows but provide little data regarding monetary damages. Mobile homes and deteriorating older structures are often referred to in local plans as being at higher risk for wind damages. Based on local plans, the probability of damaging high winds occurring within this Area is *highly likely*.

Lightning:

This entire Southeast Area is prone to lightning damage due to the sporadic, erratic nature of lightning, but outdoor events present the most opportunity for injury to the population. Any potential lightning strike has the capability of causing property damage or injury. Due to the random nature and lack of warning prior to lightning events, local plans indicate the likelihood of damaging lighting strikes occurring within this Area is *highly likely.*

Wildfires:

The Southeast Area is predominantly rural and agricultural therefore vulnerable to wildfires. Continuing spread of eastern red cedar trees contributes to the risk. Compounded by drought and high winds, wildfires will continue to be a serious and growing threat. March 2006 was a particularly severe period for wildfires with damages totaling $15 million across the state, which resulted in FEMA declaration 1623. Local fire department logs typically include the number of acres and structures burned, but not monetary losses. The current trend of suburban growth is a contributing factor to the increased probability of wildfires making the likelihood of future wildfires in this Area, as determined by local plans, as *likely*.

Dam Failure:

Within the Southeast Area are 82 “high hazard” dams, as determined by OWRB. Most of these dams are owned by towns or individuals but all are inspected annually by OWRB, and dam owners are required by law to have an emergency action plan (EAP) in place in the event of damage to the dam structure. Additionally, the U.S. Army Corps of Engineers operates and regulates 10 dams within the region. A key mission of both regulating agencies is to make sure that dams do not present unacceptable risks to the public, as any breach could lead to loss of cropland, livestock, infrastructure and improved property, transportation routes, and ultimately human life. Local plans indicate that most of the hazard dams are located within rural areas where dam breaches would only affect farm lands. Further, local plans indicate that dam breaches are rare events and the probability of dam failure in the Southeast Area is therefore unlikely.

Extreme Heat:

The Southeast Area of state has historically endured the fewest extreme heat events, although NOAA warns that high heat events may be more frequent, longer lasting, and more intense throughout the entire state. Local plans identify special populations that are most vulnerable to extreme heat. Based on local plans, the likelihood of future occurrence of prolonged extreme events is determined to be *likely.*

Expansive Soils:

Expansive soils a problematic for some communities within the Southeast Area. Local plans identify the counties of McCurtain, Choctaw, Pushmataha, Bryan, Atoka, Marshall, Johnston, Love and Carter as having expansive soils based on U.S. Geological Survey soil maps; however, there is little hard data regarding resultant monetary damage. The city of Ada was able to document the number of breaks that occurred in the city water mains a period of prolonged drought but no cost data was provided. Local plans agree that the potential for expansive soil events within this Area is *likely.*

Oklahoma Expansive Soil High Risk Counties

U.S. Geological Survey
Swelling Clays Map Of The Conterminous U.S.
Soil Map of Oklahoma

MAP LEGEND

- Unit contains abundant clay having high swelling potential
- Part of unit (generally less than 50%) consists of clay having high swelling potential
- Unit contains abundant clay having slight to moderate swelling potential
- Part of unit (generally less than 50%) consists of clay having slight to moderate swelling potential
- Unit contains little or no swelling clay
- Data insufficient to indicate clay content of unit and/or swelling potential of clay (Shown in westermost states only)

The map above was sourced from the U.S. Geological Survey publication "Swelling Clays Map Of The Conterminous United States" by W.W. Olive,| A.F. Chleborad, C.W. Frahme, Julius Schlocker, R.R. Schneider, and R.L Shuster; 1989

Earthquakes:

The Southeast Area includes a relatively active seismic zone. The Ouachita Frontal Fault and the Arbuckle Mountain Uplift are two tectonic features within this region that are known to contribute movement. HAZUS simulations projected that a 5.7 earthquake in Pontotoc County would result in nearly $2 billion in damage. The likelihood that a quake of a 5.7 magnitude is *possible* based on the minimum severity of recorded quakes in the Area.

SOUTHWEST AREA

The state of Oklahoma is divided into five preparedness areas: Northwest, Northeast, Southwest, Southeast and Central. The boundaries are along I-35 dividing the state from east to west, and I-40 dividing the state from north to south. The following profile summarizes the Southwest Area.

Flooding:

Flooding is the most common and widespread of all natural disasters to which the region is susceptible, and virtually every citizen and structure is at risk during a flooding event. 13 of the region's 16 counties are NFIP participants. McClain County, consistent with the region in having many creeks and rivers, reported 13 flood events totaling $1.43 million in its local plan:

FLOOD events in **McClain County, Oklahoma** between 1993 and 2008

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Countywide	05/08/1993	1430	Flash Flood	N/A	0	0	50K	0
2 Purcell	05/23/1993	0815	Flash Flood	N/A	0	0	0	0
3 Northern McClain	05/26/1995	0600	Flash Flood	N/A	0	0	0	0
4 Countywide	04/23/1999	11:00 PM	Flood	N/A	0	0	932K	0
5 Newcastle	10/22/2000	08:30 PM	Flash Flood	N/A	0	0	30K	0
6 Newcastle	10/22/2000	10:55 PM	Flash Flood	N/A	0	0	0	0
7 Blanchard	09/11/2003	04:00 AM	Flash Flood	N/A	0	0	0	0
8 Newcastle	05/07/2007	06:30 AM	Flash Flood	N/A	0	0	5K	0
9 Newcastle	07/10/2007	03:00 AM	Flash Flood	N/A	0	0	10K	0
10 Cole	07/10/2007	04:00 AM	Flash Flood	N/A	0	0	0K	0
11 Purcell	07/10/2007	04:00 AM	Flash Flood	N/A	0	0	400K	0
12 Purcell	08/19/2007	03:00 AM	Flash Flood	N/A	0	0	5K	0
13 Newcastle	04/10/2008	00:00 AM	Flash Flood	N/A	0	0	5K	0
TOTALS:					0	0	1.437M	0

Canadian County compared its 30 flooding events and resultant damages for the period 1995-2009 to the State's total damages for the same period:

Table 4–9: Floods in Oklahoma and Canadian County from 1995-2009

Location	Events	Deaths	Injuries	Damage Events	Property Damage
Canadian County	30	0	3	9	$3,042,000
Oklahoma	1,971	25	25	355	$79,668,000

From NOAA National Climatic Data Center

Based on NCDC, the likelihood of future flooding events occurring within the Southwest Area is *highly likely.*

Tornadoes:

The entire Southwest Area lies within "Tornado Alley." All counties within this region have experienced damaging tornadoes; however, the severity of tornado events varies widely through the region. Beckham County's plan reported that the county has experienced 69 tornadoes since 1950 during which there were four injuries and $8.8 million dollars in damages. This is a dramatic contrast to McClain County, located within the same region, whose total damages for a single day exceeded Beckham County's 60-year history. McClain County's plan documents the event:

May 3, 1999 - Tornado A9 (McClain County). A record outbreak of tornadoes struck Oklahoma from late afternoon of May 3, 1999, through early morning of May 4. A total of 58 tornadoes were recorded across portions of western and central Oklahoma. The 9th tornado, A9, was a violent and long-tracked tornado, and eventually produced F5 damage in Bridge Creek, Newcastle, Oklahoma City, and Moore. This tornado developed in Grady County about two miles south-southwest of Amber, and quickly intensified. The tornado maintained a nearly straight path to the northeast paralleling Interstate 44, as it entered McClain County, except when it made a slight jog to the right and moved directly over the 16th Street overpass in Newcastle where a woman was killed when she was blown out from under the overpass. The tornado continued into northern sections of rural Newcastle and crossed the interstate again just north of the US 62 Newcastle interchange. While this tornado was moving through the northern portion of Newcastle, a satellite tornado (A10) touched down in a field in rural north Newcastle, and caused no damage (F0). Two areas of F4 damage were observed in McClain County, all associated with tornado A9. The first area overlapped the Grady/McClain County line and extended to about three miles northwest of Newcastle, ending just west of the 16th St. overpass on Interstate 44, while the other area was observed two miles northwest of Newcastle. Thirty-eight homes and two businesses were destroyed in McClain County, and 40 homes were damaged. Damage was estimated at $6,000,000.

The City of Lawton's plan indicates the greatest financial losses within a 60-year history were due to tornado damage:

Hazard	Period of Record	Annualized Events	Annualized Property Damages	Annualized Crop Damages	Total Annualized Damages
High Wind / Thunderstorm Wind	1955-2011	2.09	$378,872	-	$378,872
Tornado	1950-2011	0.24	$456,175	-	$456,175
Hail	1955-2011	2.68	$0	-	-
Flooding	1993-2011	0.42	$16,579	-	$16,579

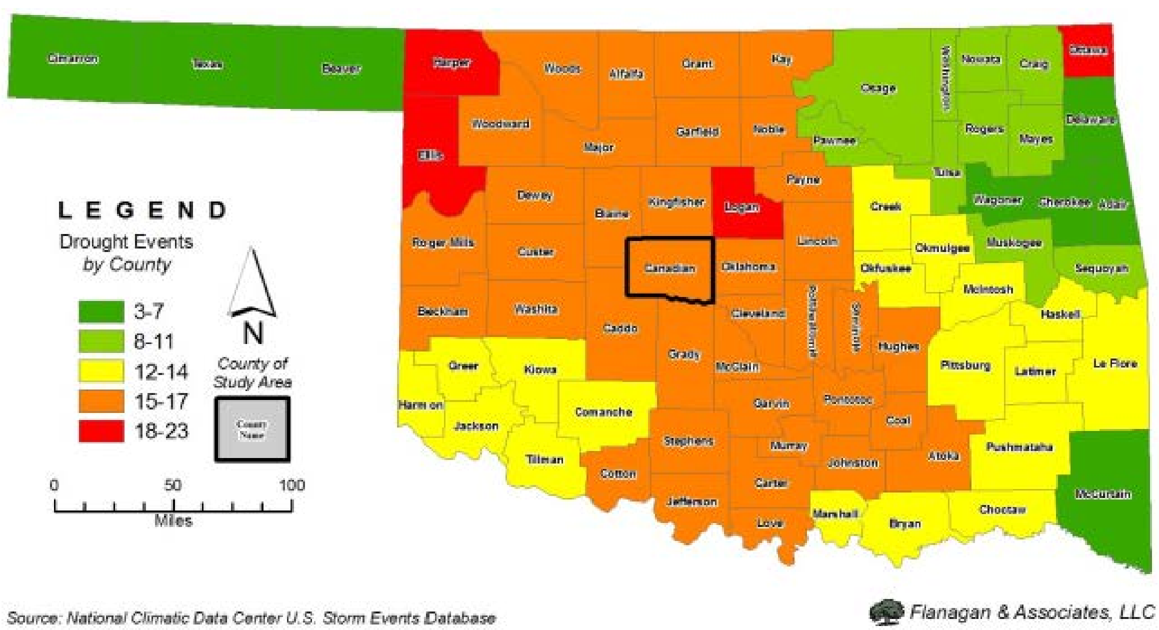
Given the unpredictable size, path, and duration of tornadoes, the entire Southwestern Area of Oklahoma is at risk, and the probability of future tornado occurrences is *highly likely.*

Winter Storms:

Winter storms have had devastating effects on all regions of the state due to loss of power, travelers-at-risk, fallen debris, frozen pipes, increased fire hazards, and slow-downs or reductions of emergency services. Local plans for this region indicate that communities are not well-equipped to deal with prolonged winter storms that close schools, roadways, airports, shopping districts and places of employment. Loss of power due to downed electrical lines is particularly devastating to communities due to the loss of heat and water. Local plans state that winter storms in recent have become more severe, causing the City of Lawton's 2012 planning committee to upgrade the hazard status of winter storms from *Medium* to *High*, which coincides with the Southwest Area's overall *likely* determination for future severe winter storms occurring.

Drought:

Drought may be widespread or localized, depending on how it is defined. Canadian County's plan includes a graphic of Oklahoma's drought events from 1989-2009:



In 2000, portions of Oklahoma were declared a Federal drought disaster by the U.S. Department of Agriculture. Southwestern counties named in this declaration included Comanche, Cotton, and Jefferson which shared the State's total agricultural losses estimated between $600 million and $1 billion. It was during this period that reservoir water levels across southwest and south central Oklahoma fell to 50% below normal range.

Lawton's local plan indicates that based on a 2012 water use study there will be a 27% increase in local water demand by 2060, with no new water sources identified to meet the upcoming need. Historical records for the Southwest Area indicate that at least one drought event will occur annually making the future likelihood of drought *likely.*

Hailstorms:

Several local plans within the Southwest Area note that annualized losses for hail damage are drastically underestimated, in comparison to damages caused by other hazards. This is due to the fact that there is no required reporting of hail damages by any state agency. This differential is exemplified in the City of Lawton's plan:

Hazard	Hazard Rank	Years of Record	Number of Events	Annualized Events	Number of Deaths	Number of Injuries	Total Property Damages	Total Crop Damages	Annualized Damages	Data Source
High Winds	High	57	338	5.93	1	12	$32,358,579	-	$567,694	NCDC
Tornadoes	High	62	50	0.81	3	111	$31,955,430	-	$515,410	NCDC
Winter Storms / Freezing Rain	High	19	37	1.95	2	-	$12,977,500	-	$683,026	NCDC
Wildfires	High	12	911	75.92	-	-	$42,725	-	$3,560	City of Lawton/Comanche County E-911 Dispatch Logs & Lawton Fire Department Incident Reports
Hail	Medium	57	474	8.32	-	-	$5,000	-	$88	NCDC
Flooding	Medium	19 (NCDC) 34 (NFIP)	32 (NCDC) 379 (NFIP)	1.68 (NCDC) 11.15 (NFIP)	1	-	$350,000 (NCDC) $2,576,615 (NFIP)	-	$18,421 (NCDC) $75,783 (NFIP) $275,156 (GIS Analysis)	NCDC, Historical NFIP Claims, & Building Footprint GIS Analysis
Extreme Heat	Medium	19	7	0.37	26	103	$208	-	$11	NCDC
Expansive	Medium	No Loss Estimates Available								

Hazard	Hazard Rank	Years of Record	Number of Events	Annualized Events	Number of Deaths	Number of Injuries	Total Property Damages	Total Crop Damages	Annualized Damages	Data Source
Soils										
Drought	Medium	5	19	0.26	-	4	$799,723	$11,654,533	$655,487	NCDC
Lightning	Medium	19	29	1.53	-	32	$920,000		$48,421	NCDC
Hazardous Material Incidents	Low	19	4	0.21	-	-	$239,149	-	$$12,587	OHMS
Dam Failure	Low	No Loss Estimates Available								
Earthquakes	Low	115	11	0.10	N/A	N/A	N/A	N/A	$489,633	HAZUS-MH 2.0 Oklahoma Geological Survey
Sinkholes/ Subsidence*	Insignificant	No Loss Estimates Available								
Landslides*	Insignificant	No Loss Estimates Available								

*Analysis determined insignificant risk. No vulnerabilities or impacts.

Based on historical data, the likelihood of future hail events occurring within the Southwest Area is *highly likely.*

High Winds:

Local plans for this region indicate that in addition to high winds causing damage to houses and urban structures, winds can cause erosion of exposed topsoil which can lead to crop losses and long-term soil damage. Based on historical data, the probability of damaging winds occurring within the Southwest Area is *highly likely.*

Lightning:

The entire Southwest Area is prone to lighting events. Canadian County's plan mentions nine lightning events between 1995 and 2009 that resulted in $181,000 in damage, but the plan noted that this figure only reflected *reported* damages, while Greer County reported $140,000 in lightning damages within a 6-year time period. All jurisdictions within the Southwest Area agreed that that while lightning damages are difficult to calculate, the potential for future damaging lightning events is *highly likely.*

Wildfires:

The Southwestern Area of Oklahoma includes a wide variety of urban areas, prairies, forestlands, canyons, mountainous areas, and farming and ranchlands, all of which are vulnerable to wildfires. Local fire department logs typically include the number of acres and structures burned, but not monetary losses. During drought conditions, wildfires are more frequent and severe. Local plans indicate that the likelihood of large wildfires occurring within the Southwest Area is *likely.*

Dam Failure:

Within the Southwest Area are 101 “high hazard” dams,” as determined by OWRB. Most are owned by towns or individuals but all are inspected annually by OWRB, and owners of high hazard dams are required by law to have an emergency action plan (EAP) in place in the event of damage to the dam structure. Local plans indicate that there have been no dam failures within this region of the state therefore the likelihood of future dam failures for the Southwest Area is *unlikely.*

Extreme Heat:

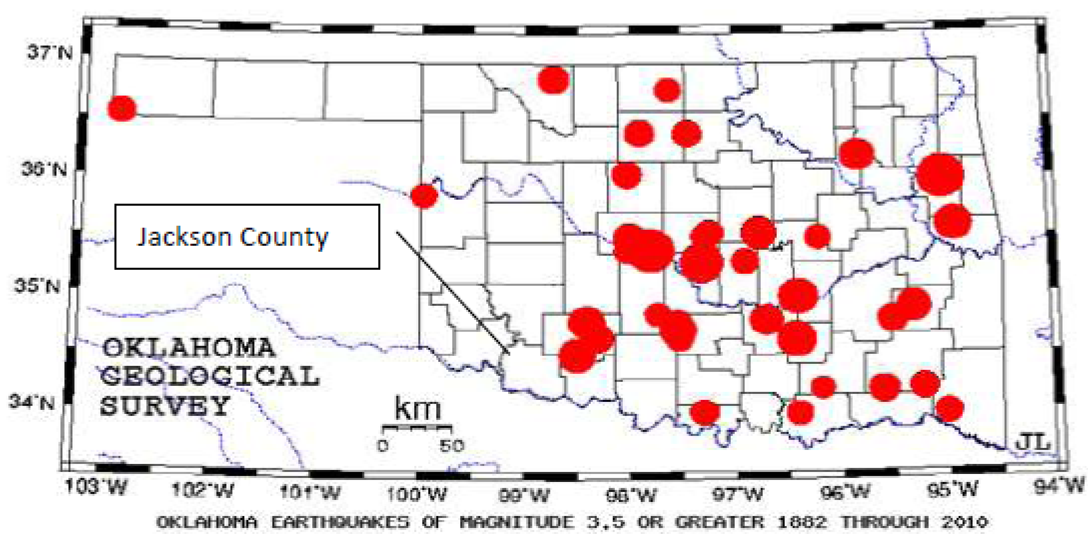
The highest recorded temperature within the state occurred in Tillman County within the Southwest Area. Oklahoma Mesonet recorded a 120 degree reading four miles south of Tipton in 1994. Few jurisdictions were able to assign specific dollar amounts to extreme heat events but all plans agreed that the possibility of future occurrence of extreme heat events in the southwest region is *likely.*

Expansive Soils:

Local plans for the Southwest Area characterized damage from expansive soils as a slow-growing problem that only becomes evident during prolonged dry periods. Some communities chose not to include this as a hazard since the damages were difficult to ascertain and quantify, but due to the variety of soil types within the region, the possibility of future damages resultant of expansive soils is *likely.*

Earthquake:

The Southwest Area has had fewer occurrences of “felt” earthquakes than other areas of the state, as demonstrated in the graphic provided with the Jackson County plan:



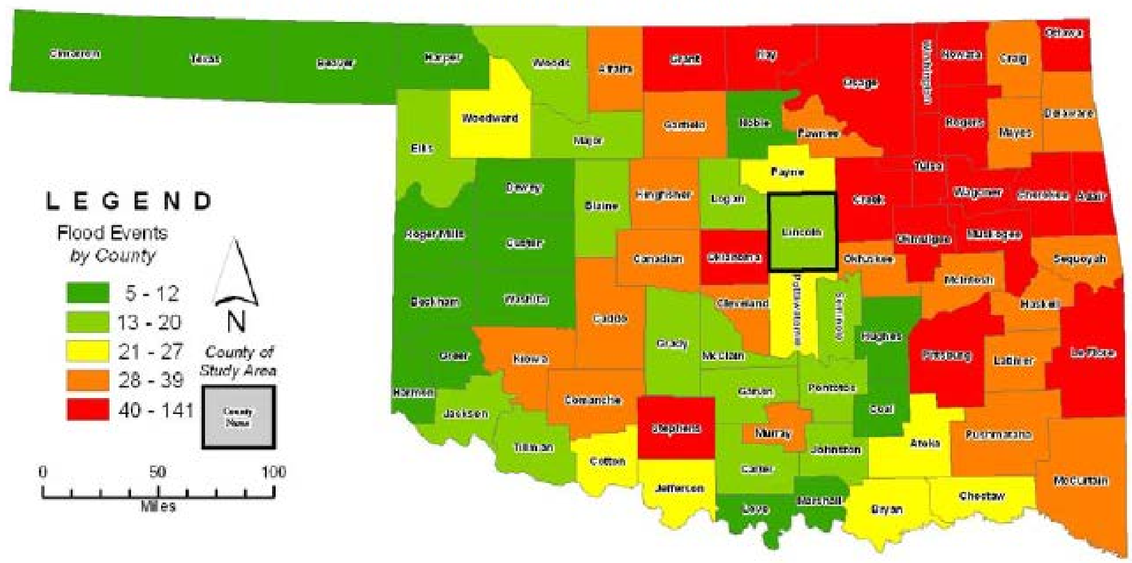
Stephens County chose not to profile earthquakes in its plan due to the lack of occurrences. Based on historic events, the likelihood of a serious earthquake occurring within this region is *possible*.

NORTHEAST AREA

The State of Oklahoma is divided into five preparedness areas: Northwest, Northeast, Southwest, Southeast, and Central. The boundaries are I-35 dividing the state from east to west, and I-40 which divides the state from north to south. This section summarizes hazards within the **Northeast** Preparedness Area.

Flooding:
History has shown that the Northeast Area has experienced the most flooding events in the state, as evidenced in the map below, provided in the Lincoln County plan:

Figure 4–24: Oklahoma Flooding Events by County 1990-2010



Source: National Climatic Data Center U.S. Storm Events Database

Flanagan & Associates, LLC

Tulsa County's hazard mitigation plan states that between 1997 and 2007, the county experienced the most number of floods of any county in Oklahoma. Tulsa County currently has 1,033 structures located in the 100-year floodplain. Tulsa County's HAZUS-MH scenario indicated that during a 100-year flood event 1,023 buildings would be lost resulting in $160 million in damages. Tulsa County's analysis follows:

Table 4–10: Tulsa County HAZUS-MH Flood Analysis Chart

Occupancy Type	North	South	West	Total
At Risk				
Population	14,106	7,713	14,209	36,028
# of Buildings	6,586	3,451	6,598	16,635
Percent of Residential Buildings	93.2%	94.4%	93.0%	93.0
Replacement Value (2006 dollars)	$875 Million	$512 Million	$854 Million	$2.2 Billion
Schools	23	12	22	57
Fire Stations	7	8	3	18
Police Stations	4	3	3	10
HAZUS-MH Scenario				
Buildings w/ Moderate Damage	320	107	596	1,023
Buildings Destroyed	56	11	53	120
Building-Related Loss	$61.63 Million	$28.97 Million	$69.88 Million	$160 Million
Schools (Moderate Damage)	0	1	3	4
Fire Stations (Moderate Damage)	0	0	1	1
Police Stations (Moderate Damage)	0	1	0	1

The City of Bartlesville, located in Washington County, included a flood simulation event in its plan. Based on HAZUS modeling, 332 buildings would be moderately damaged and nine buildings would be entirely destroyed, which together represents approximately half of the city's buildings.

Similarly, the City of Stillwater identified 477 structures located within the 100-year floodplains, with 782 households that would be displaced in the event of severe flooding, with building losses estimated to be $72 million, and economic losses exceeding $47 million, per HAZUS models.

Within the Northeast Area, 19 of the 22 counties currently participate in NFIP. These counties have greatly reduced their flooding risks by implementing NFIP standards. But despite prudent floodplain management, the probability of future flooding in this region will remain *highly likely.*

Tornadoes:

The area within the Midwestern United States known as "Tornado Alley," the most tornado-prone area of the United States, encompasses most of the state of Oklahoma, and all of the Northeast Area of the state. Many local communities have included tornado simulations in their hazard mitigation plans. Tulsa County estimated that if a tornado were to occur within the unincorporated areas of the county, it would affect 952 improved properties for a total of $51 million in damages.

The City of Tulsa's plan included a simulated tornado striking the downtown area and traversing densely populated areas and impacting many critical facilities. Estimated damages for the City of Tulsa's 2009 model would exceed $1 billion today.

Mayes County also incorporated projected tornado damages into its plan:

Table 4–19: Mayes County Tornado Scenario Estimated Damages

F-Scale	Market Value	Damage Factor	Structure Damage	Contents Value	Contents Damage	Total Damage	Pop	Residential Structures	Critical Facilities
1	$8,282,375	0.1	$828,237.50	$4,141,187.50	$414,118.75	$1,242,356.25	102	50	1
2	$2,899,683	0.4	$1,159,873.33	$1,449,841.67	$579,936.67	$1,739,810.00	149	55	0
3	$5,377,008	0.8	$4,301,606.67	$2,688,504.17	$2,150,803.33	$6,452,410.00	225	99	1
4	$821,567	1	$821,566.67	$410,783.33	$410,783.33	$1,232,350.00	40	14	0
5	$0	1	$0.00	$0.00	$0.00	$0.00	1	1	0
Totals	$17,380,633.33		$7,111,284.17	$8,690,316.67	$3,555,642.08	$10,666,926.25	517	219	2

Source: Mayes County Assessor Data

Based on information presented in local plans, the likelihood of future tornado occurrences within the Northeast Area is *highly likely*.

Winter Storms:

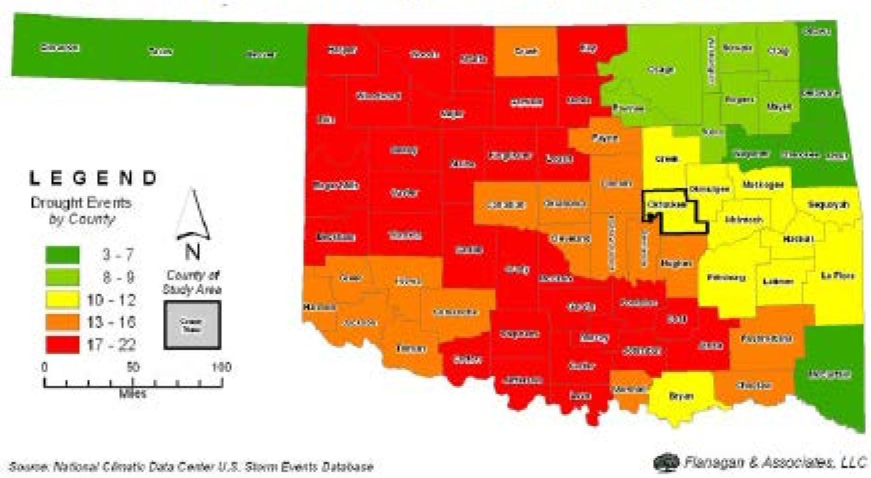
Winter storms have had devastating effects on the Northeast Area of the state. Few communities have the capability or capacity to deal with prolonged periods of winter storms, especially when there is loss of electricity. During the December 2007 ice storm, 15 of the area's 22 counties were included in the federal disaster declaration for DR-1735. Two years later, 21 of the area's 22 counties were included in another winter storm declaration, DR-1876. Only Adair County (undeclared during both events) indicated that it is not as prone as other counties to snow-related events.

The impact of severe winter storms is different for densely populated areas than it is for rural areas. The City of Tulsa plan indicated the need for providing refuge for its homeless population during periods of prolonged winter storm events, while Okmulgee County, predominantly an agricultural community, included its concern for the risk to farmers and ranchers during winter storm events. The Wyandotte Nation, located in Ottawa County, indicated that in addition to being at risk for health and property-related damages, the Nation is at risk for unique and substantial financial damages due to lost revenue from its gaming facilities when roads are impassible. Based on local plans, the risk for future severe winter storms in the Northeast Area is *likely.*

Drought:

Historically, the Northeast Area has been less prone to drought conditions as other parts of the state, as indicated by the following graphic:

Figure 4–18: Oklahoma Drought Events by County 1990-2010



Historically, the Northwest Area has not had as many drought events as other areas of the state. Local plans indicate the secondary effects of drought include increased risk of wildfires and, according to Craig County's plan, the potential for the growth of deadly bacteria within bodies of water when water levels are low. Local plans indicate the likelihood of future drought events is *likely.*

Hail:

Local plans echo the sentiment that hail poses a threat because each time a thunderstorm approaches, hail is a possibility. For this reason, the possibility of future damaging hailstorms within the Northwest Area is *highly likely.*

High Winds:

The Northeast Area is susceptible to high wind events regardless of the presence of thunderstorms. Local plans document non-tornadic wind events sufficient to break trees and utility poles, topple mobile homes, and interrupt airport operations in the region. Based on historical data, the likelihood for future high wind events within the Northeast Area is *highly likely.*

Lightning:

The entire Northeast Area is at risk for lightning strikes, but Tulsa County indicates the highest count for the region. Local plans offer evidence of lightning damage including a June 2006 incident in Glenpool in Tulsa County in which lightning struck a tank containing 5 million gallons of fuel which ignited. Emergency responders evacuated the surrounding area and there were no injuries, but damages were estimated at $2 million. Sapulpa's plan calls for a heightened need for lightning awareness due to frequent, large gatherings at sports events that are common to the community. The likelihood of future lightning strikes within this region is *highly likely.*

Wildfires:

Due to the continuing and alarming spread of Eastern Red Cedar trees in this region of the state, and abundant fuel, the threat of wildfires will continue to exist. Further, tree limbs broken away during ice storms add to the risk. The growing trend of suburban growth into previously undeveloped but forested areas increases the likelihood of future wildfires in this region. Based on local plans, the likelihood of future wildfires within the Northeast Area is *likely.*

Dam Failure:
Within the Northeast Area are 101 “high hazard” dams, as determined by OWRB. Most of these are owned by towns or individuals but all are inspected annually by OWRB, and owners of high hazard dams are required by law to have an emergency action plan (EAP) in place in the event of damage to the dam structure. Additionally, the U.S Army Corps of Engineers operates numerous dams within this area including the Grand River Dam in Craig County.

Local plans indicate that dam breaches are rare events. The city of Tulsa’s plan indicated a 1986 episode involving Keystone Dam, operated by the U.S Army Corps of Engineers, where a release of water resulted in “significant” downstream damages. The same plan indicates that a failure of the Keystone Dam could result in approximately $2 billion in damages due to the density of development, population, and critical facilities within the inundation zone, although the condition of the dam at this time is not substandard. A failure of the Pensacola Dam could affect Mayes and Craig Counties, according to local plans, and Sequoyah County’s plan specifically mentions that Lake Tenkiller Dam poses concerns for the town of Gore in the event of failure or overtopping; however, the probability of future failures for all dams within the Northeast Area is *unlikely.*

Extreme Heat:
The Northeast Area is not immune to the hazard associated with periods of prolonged high heat. Local plans include mitigation plans to identify and protect the most vulnerable populations. The likelihood of future occurrences of extreme heat events for this region is *likely.*

Expansive Soils:
The effect of expansive soils is rarely noticed until periods of prolonged drought and heat that result in water main breaks due to clay soils that have a high degree of shrinkage. Local plans indicate that the towns of Okmulgee, Muskogee, and Tulsa, among others, had an unusually high number of water line breaks during the exceptionally dry summer of 2011. Local plans agree that the potential for expansive soil events, such as buckling roads within the Northeast Area and underground pipe failures is *likely.*

Earthquake:
The Northeast Area is part of an active seismic zone where “felt” earthquakes are becoming more frequent. Lincoln County’s plan documented 361 minor quakes within its update period. The State’s strongest quake occurred November 2011 in the vicinity of Shawnee (within the Southeast Response Area) but was felt statewide. Local plans indicate that the increased frequency of minor earthquakes warrants further research, and the likelihood of future earthquakes within the Northeast Area is *likely.*

Conclusion Summary:

Based on the review of the 5 Areas of Preparedness and their 134 approved local jurisdictional plans risk assessments, and the State's assessment of hazard vulnerability for its Critical Facilities and State Owned Properties for the same 5 Areas, the following conclusions have been determined.

- State-owned and critical facilities are no more exposed to natural hazards than are other structures in the same general vicinity.
- Critical facilities deserve additional mitigation attention because of the higher potential for life and property loss or environmental harm in the unlikely event that they suffer significant damage.
- Oklahoma County (718,633), Tulsa County (603,403), Cleveland County (255,755) and Comanche County (124,098) have the highest populations in Oklahoma (2010 US Census Bureau) and are therefore more vulnerable to natural hazards.
- Oklahoma and Tulsa Counties have the highest vulnerability in terms of transportation infrastructure, respectfully.
- Northeast, Southeast, and Southwest Areas have the highest vulnerability in terms of the number of state-owned facilities.
- Northeast, Southwest, and Central Areas have the highest vulnerability in terms of the total dollar exposure to state owned facilities.

Chapter Four: Goals and Objectives

Requirement 44 CFR §201.4(c)(3)(i) [*To be effective the plan must include the following elements]:* ***A description of state goals to guide the selection of activities to mitigate and reduce potential losses. (d) The plan must be reviewed and revised to reflect changed in development, progress in statewide mitigation efforts, and changes in priorities… and resubmitted for approval to the appropriate Regional Administrator every three years.***

Each section of this Plan Update from the period of prior approval through September 30, 2013 was analyzed and reviewed by the planning team and revisions were recommended.

Changes to this chapter include:

-Updating of historical events
-Realignment of technical data
-Recognition of additional hazard events
-Inclusion of mitigation efforts that have been successfully implemented

INTRODUCTION

Chapter Four addresses the State's Hazard Mitigation **goals**, **objectives**, and **actions**. Local governments are encouraged to utilize this plan as a resource in the development and update of their local plans, and to use the State's goals and objectives to identify mitigation opportunities for which local **actions** can be formulated and carried out.

4.1 Formulation of goals

In 2003, Oklahoma Governor Brad Henry recognized the resilience of Oklahomans when he stated: ***"Our fellow citizens deserve opportunity, safety and security -- no matter where they reside within the borders of our state. We Oklahomans are known for our ability to weather any storm. The pioneers who settled this land were strong in spirit and determination. We are rightly renowned around the world for our compassion and the way in which we band together in the face of challenges. Tragedy brings out the best of the Oklahoma character. We know all too well the potential dangers of springtime and tornado season. Oklahomans came to the aid of their friends and neighbors hit hard by the May 3, 1999, tornadoes. Nature can be cruel, but Oklahomans are a resilient people, and face crises with strength and resolve."***

Governor Henry's ambitious 2004 initiative included forging ***"Partnerships for a safer future through a process of coordination between the private sector, volunteer organizations, individuals and families, and all levels of government."*** Governor Henry's comments contributed to the formulation of the goals expressed in the 2011 State of Oklahoma Hazard Mitigation Plan which were intended to be applicable over a long period of time. They were:

1. To protect life
2. To protect property
3. To protect the environment
4. To increase public preparedness for disasters

In the decade since Governor Henry's remarks, Oklahoma has faced a series of natural disasters that have tested the State's capacity to mitigate, prepare, respond and recover. The original goals however, as reviewed by the State Hazard Mitigation Team and OEM's HM planning review staff for this update, were determined to be valid, and further support the State's initiative to unite pre-disaster and post-disaster hazard mitigation as a whole, rather than as two separate efforts.

The goals identified in the 2011 plan have been met through a variety of local mitigation projects. The Oklahoma Department of Emergency Management (OEM) does not undertake hazard mitigation projects *per se*, but works through its Hazard Mitigation Team (SHMT) to develop statewide strategies and provide guidance to local governments on sound hazard mitigation planning and project development. OEM does, however, provide WebEOC, a comprehensive network for crisis management communications throughout the State.

The goals were also evaluated taking into account the occurrences of hazards and improvements in technology, but the basic goals of the Plan remain the same. Further detail of the goals follows.

4.1.1 Mitigation Goal #1 – Protect Life

Protecting people from harm is one of the primary responsibilities of state government. Many state laws contain a declaration of purpose that includes protecting public health and safety. The purpose of the *Oklahoma Emergency Management Act* [Oklahoma Statutes, Title 63 §683.8], is "…to protect the public peace, health and safety, and to preserve the lives and property of the people of the state…" from the increasing possibility of the occurrence of disasters of unprecedented size and destructiveness.

The State of Oklahoma Hazard Mitigation planning team has identified fourteen natural hazards and one "Special Event" hazard that threaten life and property (see Chapter Three). The threat each poses to human life varies, depending on factors such as knowledge of the hazard, locations of areas most at risk, frequency of hazard event occurrence, population density within the hazard zone, the availability of warning systems, and whether first responders have necessary training and equipment.

PUBLIC AWARENESS

By increasing the awareness of hazards and risks that could arise from natural or man-made hazards and how they could impact their lives, Oklahomans will be better prepared and take the appropriate actions before a major emergency or disaster strikes. OEM is working to enhance the awareness of natural and man-made hazards through outreach to the media, government officials and local stakeholders, and ultimately to all residents and visitors.

RELIABLE COMMUNICATIONS AND ADVANCED WARNING SYSTEMS

Communication systems which provide urgent information on potential and actual or hazard events to people who live in or near hazard areas and to emergency responders are critical to protecting lives. A variety of warning systems exists in Oklahoma including the system used by the National Weather Service. Reliable communications, advanced warning systems, and public education programs are a life-saving combination.

PUBLIC SCHOOL VULNERABILITY

Many of Oklahoma's public school buildings were constructed before safe room and shelter designs were developed, presenting a substantial risk to students, as well as staff and visitors. While school districts have identified specific areas within buildings for sheltering-in-place, the structural integrity of older buildings is unknown, and an accurate inventory of schools without adequate shelters does not exist. The May 2013 tornadoes raised awareness of the need for safe rooms in public schools. This awareness has fostered initiatives from both the public and private sector to mandate the construction of school shelters. This awareness has also led to the development of non-traditional efforts to fund school shelters to ensure the safety of both urban and rural students. Grassroots effort includes fund raising through social media, and the promise of corporations willing to match citizen donations. State trade associations have offered their services in the way of creative design and engineering expertise.

Since the publication of FEMA's pioneering guides for safe room design and construction (Publications FEMA P-320 and FEMA P-361), knowledge and practical experience in mitigating the risks associated with extreme events have expanded and developed substantially. When constructed to these standards, both in-ground and above-ground safe rooms have demonstrated their effectiveness in providing protection from the strongest tornadoes. OEM has encouraged school district participation in local hazard mitigation to enable the schools to be eligible for HMPG-funded shelters. OEM also promotes the development of school safety plans to ensure the safety of students, employees and visitors to school facilities in the event of both natural disasters and non-storm events that would necessitate evacuations or building lock-downs.

Hazard Mitigation Initiatives to Protect Life						
Strategy	Action	Responsible Agency	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Every public school should have a tornado shelter or designated safe room	Develop an inventory of public schools with safe rooms or shelters, and those that lack any sheltering facilities.	OEM, Oklahoma Department of Education	Ongoing **High Priority**	HMGP, PDM	By identifying schools that lack shelters, efforts can be initiated in communities to raise awareness and funding for shelter construction or retrofitting of existing buildings.	Use of tornado shelters prevents injuries and saves lives.
Provide a reliable state-wide emergency communications method	Plan and implement user training sessions and tests of **WebEOC** simulating various disaster scenarios.	OEM	Ongoing **High Priority**	Existing State and local resources	Communities rely on the **WebEOC** network to coordinate emergency response activities.	**WebEOC** enables real-time information sharing which is vital in the deployment of regional resources during emergencies and disaster events to save lives and property.
Promote increased awareness of, and participation in NFIP	Sponsor and conduct annual NFIP courses for floodplain professionals	OEM, Oklahoma Water Resource Board	Ongoing **High Priority**	CAP-SSSE	Educate community stakeholders on the importance of floodplain management, NFIP regulatory and administrative requirements, and the benefits of NFIP participation.	Education of the public along with local enforcement of NFIP regulations ultimately reduces the risk of exposing residents to flood-prone areas.
Provide site-specific emergency preparedness instruction for school administrators	Continue the all-hazard Emergency Preparedness for Public Education program.	OEM, Oklahoma Department of Education, Oklahoma Department of Homeland Security	Ongoing **Medium Priority**	HMGP, State and local resources	State schools do not have a standard protocol for ensuring safety of students and staff in the event of natural disasters, school violence, or need for campus lock-downs.	Having plans, and conducting drills so that teachers and staff know exactly how to move school building occupants to safety and work with first responders, will reduce injuries and save lives.
Promote enforcement of State and local building codes	Promote enforcement of existing building codes by State and local governments.	Oklahoma Uniform Building Code Commission, State Fire Marshal	Ongoing **Medium Priority**	State and local resources	Oklahoma has adopted stringent building codes, but enforcement is the responsibility of local government.	Conformance to minimum construction standards ensures stronger, safer buildings which, in turn, contribute to the safety of the public.

4.1.2 Mitigation Goal #2 – Protect Property

Mitigation actions designed to protect life often serve to protect property, especially when the actions implement structural elements such as those designed to strengthen buildings from violent storms and tornadoes, high winds, or snow loads. Identification of critical facilities has improved with the advent of Homeland Security, but initiatives to prioritize and protect facilities from the effects of natural hazard events are always encouraged by OEM.

Significant goals of OEM include identifying and building a portfolio of all repetitive loss structures in the State of Oklahoma, and encouraging local jurisdictions to place high importance on reducing or eliminating repetitive loss properties.

Additionally, OEM recognizes the need for backup power supplies and redundant telecommunication systems to support the uninterrupted delivery of vital public services. The focus of the following matrix is protection of property from the impact of hazard events.

Hazard Mitigation Initiatives to Protect Property						
Strategy	Action	Responsible Agency	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Protect critical State-owned assets	Prioritize structural and non-structural retrofits for critical State-owned facilities based on their vulnerability to natural hazards.	OEM , Oklahoma Department of Management and Enterprise Services	3 Years **Medium Priority**	Capital budget funds, HMGP	Prioritizing the facilities will provide direction for timely upgrades pending availability of funding.	Retrofitting facilities will preserve State buildings, as well as protect their contents and occupants from hazard events.
Identify vulnerabilities of transportation infrastructure	Examine the vulnerability of transportation infrastructure and develop contingencies for alternate operations.	OEM , Oklahoma Department of Transportation, Oklahoma Department of Public Safety	3 Years **Medium Priority**	Existing and future State resources.	By studying past events and known vulnerabilities and projecting this data to future events, contingency plans can be developed for overcoming failures in transportation infrastructure.	Identifying potential infrastructure weaknesses enables stakeholders to plan solutions before the failures occur, and to allocate resources proactively.
Identify areas and properties at risk for repetitive flood damage.	Identify and build a portfolio of all repetitive loss structures throughout the State.	OEM, Oklahoma Water Resource Board	2 years **High Priority**	FMA, SRL, RFC, HMGP	Having a comprehensive inventory of repetitive flood damaged properties will expedite buy-out procedures when funding becomes available.	Implementing buy-outs eliminates future flood damage, preserves local financial resources, and allows communities to recover more quickly from flooding disasters.
Establish a goal of reducing repetitive loss structures by 10% per year	Communities would utilize local resources to raze or remediate 10% of at-risk structures without having to acquire the property.	OEM, Department of Commerce	Ongoing **High Priority**	HMGP, PDM, FMA, CDBG	The cost to remediate or raze repetitive loss structures is considerably less than acquiring the property itself, and a local initiative to reduce the at-risk inventory by 10% could lead to further local abatement activity.	Retrofitting, elevating or removing repetitive loss structures from known hazard areas protects property and lives, while preserving local, state and federal financial resources.
Inform citizens of need for flood insurance	Encourage renters, homeowners, and business owners to purchase flood insurance even if their property is not located within high flood risk areas.	OEM, OWRB, Oklahoma Insurance Commission	3 Years **High Priority**	Existing and future State resources.	Many people do not realize that most homeowners and business insurance policies do not cover flood losses; also renters may not realize that they are eligible to purchase flood insurance through NFIP.	While having insurance doesn't mitigate the flooding event, having flood insurance helps deter catastrophic financial losses and reduces the possibility of blighted, abandoned properties which erodes the property value of adjacent areas.

4.1.3 Mitigation Goal #3 – Protect the Environment

Hazard events can wreak havoc on the physical environment, beyond damage to buildings. Floods can ruin critical habitat and foul domestic water sources. Ground shaking of an earthquake can cause spills of hazardous materials into the environment. Tornadoes can carry fuel storage tanks into waterways or environmentally sensitive areas.

The focus of the following matrix details initiatives that exist to protect and preserve the environment from the direct and secondary impacts of hazard events.

Hazard Mitigation Initiatives to Protect the Environment						
Strategy	Action	Responsible Agency	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
De-energize power lines in emergencies	Work with electric utilities to develop policies to allow selective de-energizing of power lines during emergencies.	Oklahoma Corporation Commission (under Oklahoma Emergency Management's EOP ESF #12). GRDA, Oklahoma Municipal Power Authority	Ongoing **Medium Priority**	Existing resources	De-energizing power lines during emergencies can reduce the risk of secondary damages, such as keeping sparking power lines from causing an explosion in the presence of leaking gas lines.	Selective de-energizing of power lines for brief periods of time could prevent secondary damages from explosions and fires. Older electric transformers may contain PCB, a toxic substance, which could leak into the environment in the event of fire or explosion.
Bury electric transmission lines	Work with electric utilities to explore development of underground lines in high-risk areas, including fire interface areas.	Oklahoma Corporation Commission (under Oklahoma Emergency Management's EOP ESF #12). GRDA, Oklahoma Municipal Power Authority	Ongoing **Medium Priority**	Existing resources	Electric transmission lines protected in underground conduits are not susceptible to damage from fire, fallen trees or snow loads.	Buried electric lines can't create sparks that can cause fires, nor are they vulnerable to damage from wildfires.
Control and eradicate Eastern Red Cedar trees	Develop and implement effective strategies to prune, control, and remove hazardous red cedar trees.	Department of Agriculture, Forestry Division, NRCS	Ongoing **Medium Priority**	Existing resources	Eastern Red Cedar is a ladder fuel which provides a path for grass fires to become tree canopy fires. Also, red cedars contain chemical compounds that burn rapidly and at high temperatures.	Controlling Easter Red Cedar trees reduces the risk of grass fires becoming wildfires.
Establish Firewise Communities	Promote establishment of Firewise Communities Program throughout State	Department of Agriculture, Forestry Division	Ongoing **High Priority**	Existing resources	The mission of the Firewise Communities Program is to protect people and property in communities at risk for wildfires.	By educating residents about the hazards of wildfires and how they can make their property fire-resistant, this program has a proven record of success in protecting lives, property, and the environment.

4.1.4 Mitigation Goal #4 – Increase Public Preparedness for Disasters

Preparing for natural hazard disasters can take many forms such as restricting development within hazard areas; providing information to the public regarding hazards, vulnerability and preparedness; and providing training to responders. Activities undertaken by the State of Oklahoma to promote and increase public preparedness include:

- Conducting research to further knowledge about hazards and vulnerability.
- Providing information on hazards and maps of their locations.
- Delivering an annual disaster preparedness campaign to the public.
- Providing grants for structural and non-structural actions to prevent or reduce future hazard-caused damage.

Decisions can only be as good as current hazard information and data networks allow. As scientific knowledge of natural hazards has grown, decisions on land use policy, various planning initiatives, and emergency response has improved resulting in safer communities. For this reason, this Plan includes revisions from the Oklahoma Climatological Survey, and the Oklahoma Geological Survey to provide local governments with the most current research and scientific models available regarding Oklahoma's natural hazards.

Between June 1, 1955 and July 10, 2013, Oklahoma has had 74 Presidentially-declared disasters, 10 State Emergency Declarations and 85 Fire Management Assistance Declarations for a total of 169 disaster events. In each instance, partnerships with State and federal agencies were key in providing timely delivery of response and recovery programs to the affected citizens of Oklahoma.

Equally important to the need for effective response and recovery programs is the need for increased public preparedness. Following epic tornado outbreaks which included the EF-5 tornado of May 3, 1999, many residents, schools, and mobile home parks installed storm shelters. Prior to 1999, FEMA had not allowed federal hazard mitigation funds to be spent on individual safe rooms, but OEM and former Governor Frank Keating requested, and were granted, federal funding for reimbursement of residential safe rooms. The EF-5 tornadoes of May 2013 reinforced the continued importance of this program.

Hazard Mitigation Initiatives to Increase Public Preparedness						
Strategy	Action	Responsible Agency	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Increase stakeholder knowledge of Hazard Mitigation Planning	Encourage local jurisdictions to prepare local Hazard Mitigation plans for FEMA approval.	OEM	Ongoing	Existing resources	Preparing and maintaining local plans leads to increased awareness of Hazard Mitigation issues through public forums and continued dialog.	Improving knowledge of the State's hazards and the risks they pose will lead to development of better policies and improved funding for hazard reduction strategies.
Improve public knowledge of hazards and protective measures so individuals appropriately respond during hazard events	Assess the State's public school education program on emergency preparedness and disaster resistance to determine its effectiveness and establish a baseline for future education efforts.	OEM	2 Years	Existing program resources, State mitigation programs	There is no standardized awareness program to make school officials aware of potential hazards and how to respond to them.	Educating school officials about potential hazards and how to respond before, during, and after events will lead to effective preparedness programs.
Educate the public about the risks of wildfires in urban areas that abut undeveloped areas	Develop and maintain a comprehensive public education program that increases awareness of the wildland interface fire risk and promotes actions that reduce the risk of fire to life and property.	Oklahoma Department of Agriculture Food & Forestry; Oklahoma Fire Center of the Bureau of Indian Affairs; councils of government; local and tribal fire organizations	Ongoing	Existing resources	Development in interface areas is increasing but property developers and residents need to be aware that the risk for wildfires is not limited to undeveloped, rural areas.	Increasing the knowledge of the public, property developers and local planners of the wildland fire risk and mitigating that risk will improve public safety in interface areas.
Improve hazard information including databases and maps	Develop and maintain an inventory of existing geographical databases for natural hazards.	Oklahoma Department of Commerce; Oklahoma GIS Council	2 Years	Existing and additional resources	Many land-use planners and emergency managers do not know where to turn for geographical (GIS) databases for hazards or whether such a database exists.	Maintaining a centralized library of hazard databases will improve their accessibility and expand their use by land-use planners and emergency managers, resulting in better plans and mitigation initiatives.
Create a GIS database of areas within the state that are prone to natural hazards for fast and easy access	Accelerate mapping of natural hazard areas, including floods, and develop GIS-compatible database products for them.	Oklahoma Department of Commerce; Oklahoma Water Resource Board; Oklahoma Department of Environmental Quality	2 Years	Dependent on continued funding	Few GIS databases for natural hazards exist.	Availability of GIS databases for natural hazards would greatly improve mitigation initiatives and consequent land-use planning.

4.2 Mitigation Strategies/Actions

This section identifies specific actions/projects to achieve the goals listed at the beginning of this chapter. HMPT discussed the following when deciding how to prioritize the projects: number of people affected, cost, safety concerns and the uniqueness of the hazard to the State. The State and communities within will communicate closely when executing projects. Some projects will receive assistance from community volunteers for in-kind work. Using the STAPLEE method as a guideline, the team notes the following facts: The priorities shown are reflective of the desires of the State and all participating jurisdictions. The priorities shown are reflective of the desires by the communities and public schools. Committee members found through hazard research (risk assessment) and gathering information from knowledgeable individuals specific to the hazard and the mitigation, that the following actions/projects will reduce long-term losses. Personnel and administrative aspects were also considered, along with maintenance and how long it would take to complete the project. Adequate staff is present to produce the projects in a timely fashion. Obvious political support exists with this State with several elected officials on the planning committee. At the time this Plan was adopted, there was no legal reason for the actions not to be carried out. The order of implementation could ultimately depend upon the amount of funds available and when they become available. Economically, the cost-benefit review of the following actions/projects is on target. The benefits of the listed mitigation far out-weigh the cost of each project. There are local funds available and/or funds to be awarded to communities with the proposed actions. The benefits of reducing loss far out-weigh the cost of each project. Cost was evaluated throughout the action planning process. Although some projects carry a hefty price, the committee felt that long-term benefits for the State, communities and public schools were the important aspect. When State, community and public school leaders are considering other improvements for their areas; they will use this plan in conjunction with the Capital Improvement Plans (CIP), Emergency Operations Plans (EOP) and CLEP Plan to benefit in future development and safety of the State, communities and public schools therein. Each project proposed in this Plan is environmentally sound (concerning land, water, endangered species) for the State. There are no evident legal reasons or no conflicting interest with the projects. The table below summarizes the criteria used for selecting and prioritizing action items.

4.2.1 S.T.A.P.L.E.E. - Prioritization and Review Criteria for State

Evaluation Category	**Sources of Information and Considerations**
Social	Over 30 state, federal, local and non-profit agencies were contacted and had input throughout the planning process. While many were team members, others participated by identifying potentially vulnerable facilities, resources they were able to contribute, and efforts each agency is making to integrate mitigation in their operations. Approved local natural hazard mitigation plans were incorporated wherever possible. The selected mitigation actions/projects were considered to do the most good for the largest amount of people without adversely affecting any significant section of the population.
Technical	The following persons/agencies were consulted as to the technical feasibility of the various projects: FEMA, NWS, US Army Corps of Eng., US Fish & Wildlife, USGS, HUD, BIA, US Bureau of Reclamation, American Red Cross, OKACCO, OK Dept of Ag., OCS, ODOC, OK Cons. Comm., OK Corp. Comm., OEMA, ODEQ, OFMA, OGS, OK Dept. of Health, SHPO, OK Dept. of Human Services, OK Ins Comm., OML, ODOT, OWRB, NFIP Cord., State Dam Safety Cord., OK Dept of Wildlife Conservation. The mitigation actions/projects implemented were also based upon the judgments of these experts and existing literature/studies regarding the hazards and technically feasible mitigation actions for repetitive loss properties. It was felt the selected actions/projects would provide the best long-term solutions and have minimal secondary impacts.
Administrative	Based upon available funding, capability assessment and organizational responsibilities, staffing for implementation of the state plan will rely on existing personnel in OEM and members of the SHMPC.
Political	Representatives from state, federal, local and non-profit agencies attended the SHMPC meetings and were consulted on all aspects of the plan and mitigation actions/projects and provided input.
Legal	The State Natural Hazard Mitigation Plan was made available to all state agencies, governing bodies, and promulgation authorities. In their opinion, no significant legal issues were involved in the state mitigation strategies/actions that were selected.
Economic	Economic issues were discussed by all involved. It was felt that based upon the state's benefit-cost analysis methodology, economic impact assessment, priorities and funding capabilities the mitigation actions/projects selected would do the most good at eliminating or reducing loss of life, repetitive loss properties and other property, help break the cycle of damage, reconstruction, and repeated damage and have the most benefits. Each project is subjected to a cost benefit review.
Environmental	All environmental concerns are addressed through their respective state agencies before any mitigation actions/projects are undertaken at the state or local level. Coordination with state and federal resource agencies during the formation of the plan and before any mitigation actions/projects are implemented insures compliance with all relevant statutes and regulations.

4.3 Coordination of Local Mitigation Policies and Planning

Reducing hazards has long been a priority of the State of Oklahoma. The Hazard Mitigation Division of OEM worked with the State Hazard Mitigation Team and State agencies to evaluate the State regulations, policies and state-funded or administered programs that benefit hazard mitigation activities.

Among the best examples of hazard mitigation in Oklahoma are the FEMA funded, state-administered hazard mitigation programs; however, a myriad of other programs, funding sources, executive orders, and interagency agreements have elements that support or facilitate hazard mitigation. The ***Oklahoma Floodplain Management Act***, passed in 1980, authorizes communities to develop their own floodplain regulations, designate specific flood hazard areas, and establish local management teams. By giving local governments authority to control structures within floodplains, the Act serves to mitigate the effects and cost of flooding disasters.

The ***Robert T Stafford Disaster Relief and Emergency Assistance Act***, signed into law November 23, 1988, provided the country with a new source of funding for recovering from the tragic and costly effects of flood damage. Section 404 of the Stafford Act provides specific grant programs which, over time, have been modified to include hazards other than flooding, but the mission of protecting life and property is unchanged. As found in the State Administrative Plan, (Section II. Responsibilities), the Oklahoma Department of Emergency Management is designated (by the legislature) to administer Section 404 of the Stafford Act. These grant programs are identified as:

- Hazard Mitigation Grant Program (HMGP)
- Flood Mitigation Assistance Program (FMA)
- Repetitive Flood Claims Program (RFC)
- Severe Repetitive Loss Program (SRL)
- Pre-Disaster Mitigation Assistance Program (PDM).

The largest and most comprehensive to manage is the HMGP. Since 2006, OEM, under the auspices of the State Hazard Mitigation Officer, has administered the Section 404 grant program utilizing its reservist cadre to perform all aspects of the Section 404 grant management. Despite having only one full-time Hazard Mitigation employee, OEM has continued to develop new programs and improve its reporting and auditing procedures. In order to be eligible for 404 grant funding, local governments, including tribal entities must develop a *local hazard mitigation plan*, and the plan must be approved by FEMA.

The purpose of the local plan is to identify hazards that are specific to that area, and to identify a prioritized list of hazard mitigation measures, with an action plan for their implementation. For this reason, OEM has a staff of plan reviewers who coordinate plan submissions to FEMA (in compliance with 44 CFR 201.6(d)(1)), and maintain detailed records for tracking, approval, and renewal purposes. Once approved by FEMA, these local plans are then updated, approved, and adopted every five years. The action items within the local plans are reviewed by the SHMO for 404 funding eligibility and State Planning purposes.

For the first two years of OEM's administration of 404 funding, there were only two disasters which resulted in HMGP allocations. Currently, more than 460 local jurisdictions have had their plans approved by FEMA. Additionally, OEM has 22 open disasters and maintains a list of approximately 50 categories of eligible mitigation projects. To date, 404 mitigation grants have funded everything from the purchase of NOAA weather radios by Beaver County, to the acquisition of a large tract of urban land in Tulsa which was transformed from a blighted area of abandoned, flood-ravaged structures to a community greenbelt for recreation.

4.4 Oklahoma Recent Disaster Declarations:

4.4.1 Presidential Disaster Declarations

Number	Date Declared	Presidential Disaster Declarations
4117	5-20-2013	Severe Storms and Tornadoes
4109	4-8-2013	Severe Winter Storm and Snowstorm
4078	8-22-2012	Wildfires
4064	6-14-2012	Severe Storms, Tornadoes, Straight-line Winds, and Flooding
1989	6-6-2011	Severe Storms, Tornadoes, Straight-line Winds, and Flooding
1988	5-27-2011	Severe Storms and Flooding
1985	5-13-2011	Severe Winter Storm and Snowstorm
1970	4-22-2011	Severe Storms, Tornadoes, and Straight-line Winds
1926	7-26-2010	Severe Storms, Tornadoes, Straight-line Winds, and Flooding
1917	5-24-2010	Severe Storms, Tornadoes, and Straight-line Winds
1883	3-5-2010	Severe Winter Storm
1876	2-25-2010	Severe Winter Storm
1846	6-19-2009	Wildfires
1823	2-17-2009	Severe Winter Storm
1820	2-15-2009	Severe Storms and Tornadoes
1803	19-9-2008	Severe Storms, Tornadoes and Flooding
1775	7-9-2008	Severe Storms and Flooding
1756	5-14-2008	Severe Storms, Tornadoes and Flooding
1754	5-9-2008	Severe Storms, Tornadoes and Flooding
1752	5-5-2008	Severe Storms, Tornadoes and Flooding
1735	12-18-2007	Severe Winter Storms
1723	8-31-2007	Severe Storms, Tornadoes and Flooding
1718	8-24-2007	Severe Storms, Tornadoes and Flooding
1712	7-7-2007	Severe Storms, Tornadoes and Flooding
1707	6-7-2007	Severe Storms, Tornadoes and Flooding
1677	2-1-2007	Severe Winter Storm
1678	2-1-2007	Severe Winter Storms
1637	4-13-2006	Severe Storms and Tornadoes
1623	1-10-2006	Severe Wildfire Threat
1465	5-10-2003	Severe Storms and Tornadoes
1452	2-4-2003	Severe Ice Storm
1401	2-1-2002	Ice Storm
1395	10-25-2001	Severe Storms and Flooding
1384	6-29-2001	Severe Storms
1355	1-5-2001	Severe Winter Storm
1349	11-27-2000	Severe Storms and Flooding
1272	5-4-1999	Severe Storms, Tornadoes and Flooding
1066	9-1-1995	Tornado, Flooding
1058	6-26-1995	Severe Storms, Tornado and Flooding
1048	4-26-1995	Explosion at Federal Courthouse in Oklahoma City
1024	4-21-1994	Severe Storms and Flooding
991	5-12-1993	Severe Storms, Tornadoes and Flooding
987	4-26-1993	Severe Storms and Tornadoes

Number	Date Declared	Presidential Disaster Declarations
905	5-8-1991	Severe Storms and Tornado
866	5-18-1990	Severe Storms, Tornado and Flooding
794	7-9-1987	Severe Storms and Flooding
778	10-14-1986	Severe Storms and Flooding
709	5-31-1984	Severe Storms and Flooding
704	5-3-1984	Severe Storms and Flooding
693	10-26-1983	Severe Storms and Flooding
685	6-10-1983	Severe Storms and Flooding
662	6-18-1982	Severe Storms and Flooding
649	11-4-1981	Severe Storms and Flooding
576	4-13-1979	Severe Storms and Flooding
504	6-5-1976	Severe Storms and Flooding
497	4-1-1976	Severe Storms and Flooding
491	12-10-1975	Severe Storms and Flooding
474	7-9-1975	Severe Storms, Tornadoes and Flooding
453	11-26-1974	Severe Storms and Flooding
441	6-10-1974	Severe Storms and Flooding
419	3-22-1974	Heavy Rains and Flooding
409	12-10-1973	Severe Storms and Flooding
404	10-13-1973	Severe Storms and Flooding
392	6-13-1973	Severe Storms, Tornadoes and Flooding
317	1-14-1972	Severe Storms and Flooding
314	9-28-1971	Heavy Rains and Flooding
297	10-14-1970	Severe Storms, Tornadoes and Flooding
241	5-29-1968	Heavy Rains and Flooding
104	7-15-1960	Heavy Rains, Hail, Floods and Tornadoes
95	11-9-1959	Heavy Rains and Flooding
92	7-8-1959	Flooding
74	5-18-1957	Flooding
54	4-7-1956	Tornadoes
35	6-1-1955	Tornadoes and Flooding

4.4.2 Emergency Declarations

Number	Date Declared	Emergency Declarations
3316	2-2-2011	Severe Winter Storm
3308	1-30-2010	Severe Winter Storm
3305	6-23-2009	Snow
3280	12-10-2007	Severe Winter Storms
3272	1-14-2007	Severe Winter Storms and Flooding
3219	9-5-2005	Hurricane Katrina Evacuation
3158	12-28-2000	Snow Storm
3118	2-27-1996	Fire Emergency
3115	4-19-1995	Explosion at Federal Courthouse in Oklahoma City
3020	1-18-1977	Urban Fire

4.4.3 Fire Management Assistance Declarations

Number	Date Declared	Fire Management Assistance Declarations
5003	8-4-2012	Drumright Fire
5002	8-4-2012	Glencoe Fire
5001	8-3-2012	Luther Fire
5000	8-3-2012	Freedom Fire
2999	8-3-2012	Noble Fire
2998	8-3-2012	Geary Fire
2997	7-30-2012	Fire Grounds Fire Complex
2956	9-3-2011	Ferguson Fire
2953	8-31-2011	Twin Lakes Fire Complex
2954	8-31-2011	Westminster Fire
2951	8-30-2011	63rd and Sooner Road Fire
2948	8-8-2011	Cedar Lane Fire
2947	8-7-2011	Cleveland-Mannford Fire Complex
2946	8-5-2011	265th West Fire
2945	8-4-2011	Coffee Creek Fire
2942	8-2-2011	Anderson Road Fire
2943	8-2-2011	Regency Fire
2944	8-2-2011	Turley Fire
2941	8-1-2011	Mustang Road Fire
2940	7-26-2011	Frankoma-81 Fire
2938	7-15-2011	Edmond Fire
2939	7-15-2011	Falls Creek Fire
2932	6-24-2011	Medicine Park Fire
2890	4-15-2011	Goodyear Plant Fire
2887	4-10-2011	Cleveland Fire
2883	4-6-2011	Jones-Spencer Fire
2879	4-3-2011	Guymon Fire
2874	3-24-2011	Osage County Fire Complex
2872	3-12-2011	Shawnee Fire
2871	3-11-2011	Goldsby Fire
2868	3-11-2011	Harrah Fire
2869	3-11-2011	Midwest City Fire Complex
2812	4-10-2009	Velma Fire
2813	4-10-2009	Mulhull Fire
2808	4-10-2009	Midwest Choctaw Fire
2809	4-10-2009	McClain Fire
2811	4-10-2009	Healdton Carter County Fire
2799	3-5-2009	Taloga Fire
2769	6-5-2008	Gotebo Fire
2756	3-21-2008	Quinlan Fire

4.5 Pre- and Post-Disaster Hazard Management Programs

State-funded and State-administered programs, policies, regulations or practices related to hazard mitigation or loss reduction are detailed below:

State Agency	Programs, Plans, Regulations, Funding, or Practice	Source / Description	Current Status of Program
Oklahoma Emergency Management	**EMPG**	This FEMA program provides grants to assist Oklahoma's local governments and tribal entities with all aspects of emergency management preparedness planning including hazard mitigation planning.	ongoing
	HMGP	Following a Federal Declaration, FEMA provides funding for mitigation plans and cost-effective mitigation projects, especially those involving buy-outs of repetitive loss properties.	ongoing
	PDM *(pre-disaster)*	This competitive program funds mitigation plans and cost effective projects that reduce or eliminate the effects of hazards.	As of 2012, funding suspended
	FMA	This FEMA program provides funding for mitigation plans, technical assistance, and construction projects that reduce flood risk to insured, repetitive loss properties.	The Biggert-Waters Act of 2012 combined the FMA, RFC and SRL programs into a single program
	RFC	This FEMA program is designed to reduce or eliminate the long term risk of flood damage to structures insured under the NFIP that have had one or more flood claims for flood damages.	
	SRL	This FEMA program provides funds to eliminate or reduce the long term risk of flood damage to severe repetitive loss residential properties and the associated drain on the NFIP (National Flood Insurance Fund) from such properties.	
	Map Modernization Management Support (MMMS)	This FEMA program provided funding to increase local involvement in developing and updating the inventory of base maps for NFIP.	completed (see below)
	Cooperative Technical Partners (CTP)	In 2011, FEMA transitioned the Oklahoma MMMS program to CTP. OEM is the grantee for this program, but the work is performed by the Oklahoma Water Resources Board (OWRB).	new
	Community Assistance Program (CAP-SSSE)	FEMA provides funds to local NFIP administrators to restrict floodplain development and to ensure ongoing NFIP compliance.	ongoing
	Hazardous Materials Emergency Preparedness (HMEP)	This US DOT-funded program funds planning and training for local emergency response personnel to mitigate events involving the transportation of hazardous materials to protect the public and the environment.	ongoing
	Earthquake Program	This FEMA-funded grant funds coordination and oversight of seismic safety programs,	Ongoing, but as of

State Agency	Programs, Plans, Regulations, Funding, or Practice	Source / Description	Current Status of Program
	(pre-disaster)	public education and mitigation planning, and tools to support seismic hazard reduction.	2012, federal funding was reduced from 100% to 50%
	Mobile Generator Program	Using FEMA HMGP grant funding, OEM purchased 18 mobile commercial generators (8 units are 35 kW, 8 units are 80 kW) for use by publically-owned critical facilities. Maintenance of units is currently funded through EMPG.	Ongoing; as of July 2013, all units are pre-positioned around the state
	School Preparedness Program (EPPE) *(pre-disaster)*	OEM designed and implemented Emergency Preparedness for Public Education (EPPE), a comprehensive all-hazard program, used by over 200 school districts in cooperation with the Oklahoma Department of Education. The program began in 1999 and was completely funded by the State.	completed
Oklahoma Corporation Commission (OCC)	**Brownfields Program**	Using funds from the US EPA, OCC developed and maintains a GIS mapping program to identify industrial sites where pollutants leaked or were spilled to aid in remediation efforts. OCC works with OK DEQ to remediate these sites.	ongoing
Oklahoma Water Resource Board	**National Floodplain Management Program**	OWRB assists communities in meeting the requirements for NFIP participation, as set forth in 44 CFR 60.3.	ongoing
	Dam Safety Program	Integral role in hazard mitigation relative to ensuring the safety of non-Federal dams	ongoing
	Statewide Water Development	Provides loans and grants for the financing and implementation of water treatment facilities. Also available are smaller community emergency grants that are facing infrastructure crises that could threaten life, health or property.	ongoing
US Army Corps of Engineers, Tulsa District	**Feasibility Studies and Projects**	Studies that may result in projects for flood control, navigation, hydropower, water supply, recreation.	ongoing
	Emergency Streambank Protection of Public Facilities	Limited in scope and cost: $500,000. Cost share may be required.	ongoing
	Snagging and Clearing for Flood Control	Limited in scope and cost: $500,000. Cost share may be required. Technical Assistance with debris management specialists	ongoing
	Floodplain	Technical Assistance with Floodplain Mgrs, Emergency Management Personnel for Debris	ongoing

State Agency	Programs, Plans, Regulations, Funding, or Practice	Source / Description	Current Status of Program
	Management Services	Management etc. Provide assistance in evaluating flood hazards to a site, shoot critical infrastructure elevations, develop flood consequence risks identification from USACE projects, floodplain delineation, technical assistance, guidance, and comprehensive floodplain management, establishing.	
	Permit Authority	Section 10 permits to cover construction, excavation, and other related work in or over navigable waterways. Section 404 permits covering the discharge of dredged or fill material in all waters.	ongoing
	Flood Control	Responsible for controlling floodwater releases from all Corps lakes and has agreements with others t Emergency Flood Exercises based on consequence management from USACE projects. Monitor and control flow releases.	ongoing
	Dam Safety	Mandatory annual training for personnel on dam safety. Dams are inspected every four years. Emergency Flood Exercises based on consequence management from USACE projects.	ongoing
Oklahoma Department of Agriculture Food & Forestry	**Oklahoma Forest Regeneration** and **Forest Tree Improvement Programs**	These programs provide technical and educational assistance to landowners, as well as tree seedlings, to achieve successful and enduring, as well as genetic diversity, of reforestation efforts. Current results indicate cost-to-benefit ratio of 5:1.	ongoing
	Oklahoma Forest Water Quality Management program	Technical training and assistance in best management practices-enabling loggers and landowners to harvest timber while maintaining premium water quality.	ongoing
	Oklahoma Forest Stewardship Program	Assists Oklahomans in managing their forestlands and mitigating against natural disasters.	ongoing
	Prescribed Burning Program	The program is aimed at reducing wildfire potential by coordinating controlled burning, under safe weather conditions, to reduce vegetative fuel.	new – initiated 2013
Oklahoma Climatological Survey (OCS)	**Oklahoma Mesonet**	Statewide network of automated weather stations, one station located in each county in the State.	ongoing
	OK-First	Serves Oklahoma Emergency Managers and public safety communities: access and interpret radar and other weather data sources, improve coordination of storm spotter activities with State and Federal officials, and interact with State's meteorology community.	ongoing

State Agency	Programs, Plans, Regulations, Funding, or Practice	Source / Description	Current Status of Program
Oklahoma Department of Commerce	**Capital Improvement Planning (CIP)**	Assisted communities in identifying and updating their inventory of publicly owned and controlled assets.	ongoing
	Community Development Block Grant (CDBG)	Assists communities with an array of publicly owned infrastructure needs. Can be applied to non-federal portion of HMGP and PDM funds.	ongoing
	Community Revitalization Reuse Program	Provides US HUD funds to assist communities with fire and emergency equipment, street overlays, and emergency vehicles.	ongoing
	Rural Economic Action Plan (REAP)	REAP provides funding to assist communities with eligible water development projects which OWRB approves and oversees.	ongoing
	Community Services Block Grant	Contracted to Community Action Agencies for locally determined initiatives in housing, education, nutrition, health, emergency assistance and economic development.	ongoing
	Oklahoma Century Community Program	This program was created to give communities a process in which to conduct a self evaluation of community strengths and weaknesses, community planning, and plan implementation.	completed
Oklahoma Conservation Commission	**319 Cost-share Programs**	Administers USDA funding assistance for soil and water conservation practices to improve water quality and control soil erosion. Non-federal costs are borne by state and local governments.	ongoing
	Small Watershed Program	This historic program provides technical and financial assistance for water control programs that improve public safety and the environment.	ongoing
	Locally-led Conservation Cost-Share Programs	Assist landowners in installing conservation practices to reduce non-point source pollution.	ongoing
	Abandoned Mine Land Reclamation	Projects include elimination of dangerous high walls closure of mine openings, subsidence protection, and reclamation of hazardous water filled strip pits. 100% funded by federal tax on active mine production.	ongoing

State Agency	Programs, Plans, Regulations, Funding, or Practice	Source / Description	Current Status of Program
Oklahoma Department of Environmental Quality (DEQ)	**Environmental Complaints and Local Services (ECLS)**	Provides help for pollution prevention, Small Business Assistance, Risk Communication and Management, and Waste Exchange. Provides advice to property owners following disaster events regarding safe and legal removal of storm debris.	Formerly called *Customer Assistance Program;* ongoing
	State Revolving Fund for Drinking Water Improvements	This agency administers US EPA-funded grants and low-interest loans to local governments for the purpose of enhancing potable water supplies, and mitigating potential interruption and contamination of local water supplies.	Ongoing
Oklahoma Department of Fish and Wildlife	**Natural Resources Program**	Promotes habitat improvement, environmental quality, conservation management, provides information on natural resource concerns to conservation groups and the media to help maintain public awareness.	Ongoing

4.6 Local / State Capability Assessment

For this 2014 update, the Hazard Mitigation in-house planning review staff inventoried existing programs to identify changes that affect the State's mitigation capabilities, including:

- Changes in State funding capabilities;
- Changes in agency staffing;
- Changes in State Statutes;
- Changes in any agency policies, regulations or land use provisions;
- Changes in other State agency capabilities;
- Emergent technology tools from outside sources;
- Any obstacles that might impede hazard mitigation processes.

Within the update period, OEM's funding and staffing capabilities have remained static, and there have been no statutory or regulatory changes that would affect the State's mitigation capabilities. But technological advancements have provided increased capability, most notably in the areas of weather detection and incident preparedness. Since this Plan's last update, Oklahoma Mesonet has exponentially increased its data collection capability. Mesonet data is used by emergency management officials to develop evacuation routes; by agricultural professionals to mitigate the effects of drought and stress to livestock; and by the insurance industry to pinpoint areas at greatest risk for property loss to natural hazard events.

As an agency, OEM's communications capabilities have grown. In the past three years, OEM has documented a substantial increase in the number of registered ***WebEOC*** users statewide thus increasing both response and mitigation capabilities of local jurisdictions. Recently, OEM entered the social media arena with its establishment of FaceBook and Twitter accounts.

Within the update period, the Oklahoma Water Resources Board (OWRB) began upgrading the State's database of dams and inundation zones using LIDAR sensing and digital mapping techniques. This effort will provide immediate, no-cost Internet access to dam records for planning and mitigation professionals.

The increased frequency and severity of ice storms since 2000 led to the private development of the Sperry-Piltz Ice Accumulation Index (SPIA). Using data from the Oklahoma Mesonet, this algorithm-based program anticipates areas where acute icing is most likely to occur. Originally, the information was developed to allow electric utilities to pre-position assets and manpower in advance of storms. In the course of this update, the success of the SPIA as a forecasting tool has led to its use by OEM and FEMA, and many other industries to anticipate and prepare for severe icing events.

During the Plan update period, no new obstacles were identified that would serve to impede the State's hazard mitigation capability efforts.

State and local governments have policies, ordinances, and programs designed to help mitigate the impacts of hazard events within their jurisdictions. The following matrix indicates the planning and regulatory capabilities of the State and local governments, as well as plans and policies that play a role in preventing and reducing the impacts of hazards.

Existing State and Local Policies and Programs			
Policy/ Program	***Description***	***Applicability***	***Effectiveness***
Emergency Operation Plan (EOP)	State Statute (**OS 63 § 683.2**) requires the State to maintain and update a written Emergency Operations Plan (EOP) which assigns responsibilities and actions to be taken any time the State Emergency Operations Center (EOC) is activated. State Statute (**OS 63 § 683.11**) requires all incorporated jurisdictions to *also* have an EOP, or else enter into agreement with their county government to manage their emergencies.	Based on *the National Incident Management System* (NIMS), the State EOP clearly defines the roles of state departments, agencies, commissions, and volunteer organizations. Communities and counties are free to adapt the State EOC as a framework for local EOCs.	The State EOP has proven highly effective any time the EOC has been activated, including 36 Federally declared disasters, 7 state emergency declarations, and 39 FMAGS. All EOPs are reviewed and revised annually. Community and county EOPs are based on ***local*** risk analyses.
Floodplain Management Program	The ***Oklahoma Floodplain Management Act*** (**OS 82 §1601-1620**) allows municipalities, counties, and tribes to adopt FEMA sponsored floodplain regulations. In an NFIP community, developers must comply with all local, state and federal requirements. NFIP communities must also comply with the Storm Water Permit requirements enforced by the **OK Department of Environmental Quality**.	This Act regulates structures in floodplains. A high priority is placed on the elimination of repetitive loss properties through buy outs or elevation projects. The **Oklahoma Water Resources Board** is the coordinating agency for NFIP initiatives in Oklahoma.	Oklahoma currently boasts 396 NFIP member communities, an increase from 381 last reported. NFIP communities are free to enact their own ordinances requiring, for instance, the elevation of new structures, and installation requirements for mobile homes. Enforcement is up to the local floodplain management. Overall, 95% of the State's population has access to Federal flood insurance as a result of participation in the NFIP. Reducing flood loss helps communities develop sound, stable economies.
Community Rating System (CRS)	CRS is a voluntary FEMA-sponsored program for communities that participate in NFIP. It is designed to provide discounted premium costs to communities that	CRS participation can result in a 5% to 45% premium discount. There are 10 CRS ratings: Class 1 provides the greatest premium discount; Class 10 offers no	The benefit to the CRS-rated communities is twofold: elimination of flood-prone structures, and reduced cost of flood insurance policies.

Existing State and Local Policies and Programs			
Policy/ Program	***Description***	***Applicability***	***Effectiveness***
	exceed minimum floodplain management requirements.	discount. FEMA determines the CRS classifications based on the credit points a community has earned through implementation of activities designed to eliminate flooding risks.	In 2011, 13 Oklahoma communities were CRS rated, with an average policy discount of 17.3%. In 2013, the average discount to these communities was increased to 18% due to improved CRS ratings.
State Hazard Mitigation Plan	DMA 2000 (**Public Law 106-200**) encourages and rewards local and State pre-disaster planning and is intended to integrate State and local planning and implementation efforts.	Developing and maintaining a Hazard Mitigation Plan enables the State, and local jurisdictions to articulate specific mitigation needs, resulting in faster allocation of funding for effective risk reduction.	As of June 2013, Oklahoma has 123 FEMA-approved local plans covering a total of 460 jurisdictions. Compared to the May 2010 total of 185 plans for 468 jurisdictions, the number is lower due to some single jurisdictions being absorbed into multi-jurisdiction plans.
StormReady Communities Program	This voluntary program, developed by the **National Weather Service**'s Tulsa forecast office, provides clear-cut advice to communities regarding weather warnings.	In order to achieve *StormReady* status, a community must establish a 24-hour warning point and EOC; have more than one way to receive weather forecasts and warnings and to alert the public; create a system that monitors local weather conditions; promote the importance of public readiness; develop a formal hazardous weather plan to include the training of weather spotters and holding emergency exercises.	As of December 2009, Oklahoma had 24 counties, 44 communities, 2 universities and 1 military base, designated StormReady. As of this update, there are 29 counties, 54 communities, 9 universities and 2 military bases in Oklahoma designated *StormReady*.
Firewise Communities Program	**The Oklahoma Department of Agriculture, Food and Forestry**, in cooperation with the **USDA Forestry Service**, provides cost share funds to communities for the purpose of reducing wildfire risks.	To be eligible for fire grants, applicants must first be *Firewise Community USA Certified*. The focus of the funding is to support new initiatives that would not occur without grant funds.	Currently, there are 50 certified *Firewise Communities* in Oklahoma. Development of Firewise plans results in the implementation of cost-effective fire mitigation initiatives designed to increase human safety, reduce structure wildfire vulnerability, and maximize firefighter agency capabilities.

Existing State and Local Policies and Programs			
Policy/ Program	***Description***	***Applicability***	***Effectiveness***
Continuity of Operations Plans (COOP)	State agencies and local governments should develop an emergency operating plan to be followed in the event of emergency situations, to ensure continued operation of the department or agency.	Due to Oklahoma's risks for extreme weather, it is vital that each state agency have a written plan to assure seamless delivery of services to the public.	State agency COOPS are routinely updated to reflect changes in technology that serve to increase agency capabilities.
Capital Improvements Plans (CIP)	CIPs identify where major public expenditures will be made over the next 5 to 10 years.	CIPs can secure hazard-prone areas for low-risk uses; identify roads or utilities that need strengthening, replacement, or realignment; and prescribe standards for the design and construction of new facilities.	CIPs allow more efficient use of public funds. During this update, there is increased interest statewide to include community tornado shelters and safe rooms in local CIPs.
Local Hazardous Materials Response Program (LEPC)	The ***Oklahoma Emergency Response Act*** (**27A OS §4-2-102**) requires that each community have a local emergency planning committee for the purpose of developing plans to address hazardous material spills.	Oklahoma is the crossroads of the nation's interstate transport industry. Every day, shipments of agricultural products, manufactured goods and bulk industrial materials share the roadways. Accidental release of hazmat cargo can have life-threatening results if not remediated properly. Local emergency planning committees comprised of volunteers such as emergency responders and industry representatives provide guidance for hazmat emergency planning and response to meet the requirements of these unfunded mandates.	All events involving accidental release of chemicals are called in to the **National Response Center** (NRC) where data is compiled and results can be queried on-line. Additionally, the **OK Department of Environmental Quality** licenses all companies that perform clean-up of hazardous materials spills on State highways; and the **OK Corporation Commission** is alerted when incidents involve pipelines.
Local Zoning and Land Use Restrictions	Comprehensive land use planning provides a mechanism to prevent development and specific activities within designated areas.	Enforcement of land use provides benefits to citizens and the environment by limiting the impact of natural hazards and potentially hazardous activities within designated areas.	Land use planning and restrictions are key to mitigation measures, but there is no requirement for local jurisdictions to adopt zoning, planning, or building standards or ordinances.

Existing State and Local Policies and Programs			
Policy/ Program	***Description***	***Applicability***	***Effectiveness***
Community Shelters and Safe Room Programs	Other than SoonerSafe, no State-sponsored programs exist, but this initiative is gaining national attention through private fund-raising efforts, celebrity-sponsored events, and social media.	Currently, the State has no authority to require accountability of funds raised through these programs.	Unknown.
SoonerSafe Residential Safe Room Program	This State-administered program utilizes FEMA funds to rebate homeowners for installation of safe rooms built to FEMA-approved designs.	Homeowners may qualify for up to 75% of their installation costs not to exceed $2000 per safe room.	This program, initiated in 1999, has been renewed as federal funding becomes available. Following the May 2013 tornados, the program received over 6,000 applications. Due to the program's popularity, the State has implemented a random selection process to select rebate recipients. Additionally, since 2002, *all* residential safe room construction costs (for shelters up to 100 square feet) in Oklahoma are tax exempt.
Emergency Management Accreditation Program (EMAP)	**EMAP**, an independent, non-profit organization, offers a standard-based assessment and peer review accreditation process for government programs responsible for coordinating all aspects of disaster management, including hazard mitigation.	**EMAP** is currently the *only* accreditation process for emergency management programs.	Oklahoma Emergency Management was approved for EMAP certification in April 2012. *Hazard Mitigation* is one of the 64 standards that were evaluated as part of the accreditation process. Oklahoma's State *Hazard Mitigation Plan* was found to be effective in meeting the organization's standards.

4.7 State Mitigation Actions and Funding

The State of Oklahoma has been proactive in hazard reduction and management for a long time. In addition to the mitigation actions the State is considering and which are listed in the following section's State Hazard Mitigation Actions Projects/Programs Table, OEM has mounted an aggressive program to encourage planners and local jurisdictions to include zoning ordinances in their local plans as action projects to protect their communities from building in hazard prone areas.

The following is a summary and description of each of these mitigation actions and then a listing of each hazard that they address and mitigate. In an effort to minimize the effects of all disasters and emergencies upon the people of Oklahoma through preparedness, response, recovery and mitigation, each on-going or completed action addresses a specific hazard and was evaluated and determined to be cost-effective, environmentally sound and technically feasible.

All hazard mitigation projects within the state are designed to mitigate the effects of disasters on one or more of the following:

- Life safety of the at-risk population;
- National Flood Insurance Program (NFIP) repetitive loss properties;
- Private structures and properties;
- Government and public infrastructure (through Section 404 HMGP program funds);
- Environmental resources;
- Functionality of critical facilities

The process used to identify cost-effective and technically feasible mitigation projects/actions will be based, primarily, on the source of the mitigation funds.

4.7.1 Disaster Funds

Mitigation funds that are available as a result of a presidentially declared disaster are based on a percentage of the overall estimated federal share of disaster assistance provided as a result of that disaster. Mitigation funds can be used anywhere in the state and on any hazard, however, priority will be given to:

- Mitigation projects related to the hazard that necessitated the disaster declaration
- Those jurisdictions included in the disaster declaration

OEM's Mitigation Division will review proposed mitigation projects for the following criteria:

1. Does the project compliment existing State and local mitigation goals and objectives?
2. Is the project cost-effective, based on applying the submitted project data to FEMA's benefit cost analysis module?
3. Are sufficient mitigation funds available to complete the project?
4. Does the applicant have sufficient funds (if other funds are not available) to meet the local share of the project?

5. Does the project solve a problem?
6. Is the applicant located within the declared areas for the applicable disaster? (This does not prevent a mitigation project from being approved.)

Oklahoma's SHMO will coordinate with FEMA and other governmental agencies to ensure that projects chosen for funding comply with all State and federal laws and regulations. After submitted project applications have passed an initial review by OEM, they are forwarded to FEMA Region VI mitigation staff for final approval prior to commencement of any work.

4.7.2 Other Mitigation Programs:

The availability of mitigation funds associated with other federal/state programs is dependent on the specific program in question. These mitigation funds can only be used in those jurisdictions identified by the applicable program. These funds are generally available based on applications submitted by specific jurisdictions, and only those applying jurisdictions will have access to the funds.

While local jurisdictions are encouraged to submit mitigation projects that reflect current State and local hazard mitigation goals and objectives, their projects must seek to mitigate hazards to which their area is at specific risk.

Since these programs are usually initiated between the jurisdiction and the applicable program staff, OEM Mitigation Division will review local mitigation proposals only upon request and if personnel are available. If that review is requested, OEM Mitigation Division will review the project based on the same criteria used for disaster related mitigation projects. Those criteria are as follows:

1. Does the project compliment existing State and local mitigation goals and objectives?
2. Is the project cost-effective based on applying the submitted project data to FEMA's benefit cost analysis module?
3. Are sufficient mitigation funds available to complete the project?
4. Does the applicant have sufficient funds (if other funds are not available) to meet the local share of the project?
5. Does the project solve a problem?

OEM Mitigation Division will advise the jurisdiction to coordinate with other State and/or federal agencies to ensure that the project complies with all State and/or federal laws and regulations. These requirements include, but are not limited to, the Endangered Species Act, the Historic Preservation Act, Floodplain Management and National Environmental Policy Act requirements. OEM Mitigation Division will forward their comments to the jurisdiction for their final review and determination.

When evaluating mitigation projects that have been submitted for review and possible approval, several factors must be taken into consideration. These factors include, but are not limited to, the following:

1. The specific requirements and/or restrictions placed on the projects by the funding source.
2. There will always be more requests for mitigation funds that there will be available funds.
3. Federal and State funding for mitigation projects will be limited and in some instances may not be available.

4. Whenever possible, local jurisdictions should develop mitigation projects and initiatives that can be funded locally.
5. Local jurisdictions should actively pursue public-private partnerships, where appropriate, to achieve desired mitigation goals.
6. The requested mitigation project should complement the goals and objectives of the State and local mitigation strategy.

4.8 State Hazard Mitigation Action Projects/Programs (Past and Present):

In recent years, the Hazard Mitigation Division of OEM has changed its focus from State-sponsored efforts to the support of local governments in developing site-specific programs and projects. To date, most State-sponsored projects were successfully completed or transitioned to other sponsoring agencies, including the following:

Project #	Description	Associated Hazards	Lead Agency	Schedule / Completion Date
OK 1	**State Facility Mapping** The State is currently using its Emergency Management network to systematically verify each location of State owned and operated facilities.	Dam Failure Earthquake Flooding Tornado Wildfire	Oklahoma Emergency Management (OEM)	Transitioned to Oklahoma Office of Management and Enterprise Services
OK 2	**Local Jurisdiction Hazard Mitigation Projects** Reverse 911, GIS Mapping, 911 Training, School Safe Rooms, Shelter Models, Acquisitions, Natural Hazard Mitigation Plans, etc.	Dam Failure, Drought, Earthquake, Severe Thunderstorms / Hail / Lightning, Expansive Soils, Extreme Temperatures Heat/ Cold, Flooding, High Winds, Landslides, Tornadoes, Wildfires, Winter Storms/ Icy Hazards	OEM (funding source only)	Multiple completion dates ranging from one to three years; Ongoing
OK 3	**Tornado Shelter Seminars** Oklahoma Emergency Management presents free seminars across the State specifically discussing community and school shelters.	Tornadoes High Winds	OEM	April/May Annually
OK 4	**Blaine Gypsum Groundwater Recharge Demonstration Project** Designed to offset seasonal and long-term water level declines in an aquifer heavily pumped for irrigation.	Drought	Oklahoma Water Resource Board (OWRB)	Successfully completed; transitioned to local landowners
OK 5	**McReady Oklahoma** State-wide severe weather preparedness campaign designed to prepare families for emergencies, increase awareness of severe weather threats and build better prepared communities.	Floods Tornadoes Lightning Thunderstorm	OEM	Completed
OK 6	**Emergency Preparedness Public Education Program** Provided to requesting school districts to educate and assist them in development of emergency preparedness plans.	Dam Failure, Drought, Earthquake, Expansive Soils, Extreme Temperatures Heat/Cold, Flooding, High Winds, Landslides, Severe Thunderstorms/ Hail/Lightning, Tornadoes, Wildfires, Winter Storms/Icy Hazards	OEM	Completed
OK 7	**Oklahoma Weather Modification Program**	Drought	Oklahoma	Completed

Project #	Description	Associated Hazards	Lead Agency	Schedule / Completion Date
	Experimental program designed to augment water supplies and prevent future drought.		Bureau of Reclamation	
OK 8	**Hazard Mitigation Planning Workshops** Conducts informational sessions throughout the State explaining the value and need for Local HM Plans, why they are important, and options on how to create them.	Dam Failure, Drought, Earthquake, Expansive Soils, Extreme Temperatures Heat/Cold, Flooding, High Winds, Landslides, Severe Thunderstorms/Hail/ Lightning, Tornadoes, Wildfires, Winter Storms/Icy Hazards	OEM	Ongoing
OK 9	**Individual Safe Room Project #1272** An initiative to promote and support the construction of storm shelters in homes.	Tornadoes High Winds	OEM	Completed, Closed 2010
OK 10	**OK-WARN Project #1355** Created a state-wide system for advance warning of emergency directed to the deaf and hard of hearing population.	Flooding High Winds Tornadoes Thunderstorms Winter Storms	OEM	Completed May 2004
OK 11	**NFIP Compliance Workshops** OWRB and FEMA sponsor workshops throughout the State to update city and county floodplain administrators on NFIP compliance requirements, mitigation and assistance in the development, administration and enforcement of local flood damage prevention ordinances that guide floodplain development.	Flooding Thunderstorms	OWRB	OEM to longer involved
OK 12	**Upstream Flood Control Program** Oklahoma leads the nation in the number of small watershed upstream flood control dams. This program assists communities in design, construction and maintenance of small flood control dams on tributaries upstream from rivers or large streams to mitigate flood damages.	Flooding	OWRB Oklahoma Conservation Commission	OEM no longer involved
OK 13	**Abandoned Mine Land Reclamation Program** The program remediates land damaged by past oil field or mining operations. Some hazards include dangerous high walls, hazardous water bodies, unstable banks, subsidence such as caving, potholes, etc.	Landslides, Flooding Expansive Soils, Man-made hazards	Oklahoma Conservation Commission	OEM no longer involved
OK 14	**Watershed Protection & Flood Prevention Program** Under Public Law 83-566, local sponsors have requested assistance for nearly 1,000 small watershed programs as an effective tool to provide flood control, protect improved property, and provide wildlife and recreational areas.	Flooding, drought	Oklahoma Conservation Commission	OEM no longer involved
OK 15	**March is "Flood Insurance Month**" This annual State campaign spreads the word about the availability of FEMA's affordable NFIP flood insurance.	Flooding	OWRB	Every March

Project #	Description	Associated Hazards	Lead Agency	Schedule / Completion Date
OK 16	**May is "Flood Awareness Month"** This annual State campaign reminds citizens of the dangers of flash flooding.	Flooding	OWRB	Every May
OK 17	**Tar Creek Relocation Project** OK Senate Bill 1490 authorized a voluntary relocation program for families with young children in the most hazardous part of the abandoned mining area in northeastern Oklahoma.	Man-made Hazards	GGEDA	Completed – turned over to COG for final disposition
OK 18	**Landslide/Rockslide Mitigation Policy** Following a lengthy study, ODOT released its policy statement regarding recognition of landslides as a hazard to the traveling public, specifying a hazard rating system and guidelines for rock slope design and maintenance.	Landslides	Oklahoma Department of Transportation	Completed
OK 19	**Individual Safe Room Project #1465** This second initiative to promote and support the construction of storm shelters in homes was completed in 2010.	High Winds Tornadoes	OEM	Completed
OK 20	**Oklahoma Red Flag Fire Alert** This notification program limits the use of outdoor burning during periods of high risk.	Wildfires	Oklahoma Forestry Service	Ongoing
OK21	**Dam Safety Program** This program ensures that the 4,500 dams in the State are inventoried, inspected and properly maintained.	Dam Failure Flooding	OWRB	Ongoing
OK22	**OK-FIRST Program** This communications system has been recognized internationally for its innovative approach in providing instant access to vital weather data for fire, police, and emergency management agencies.	High Winds Thunderstorms Tornadoes Winter Storms	Oklahoma Climatological Survey	Ongoing
OK23	**Bioretention Cells** Educational research project for evaluating experimental techniques of managing storm water runoff. Successfully completed.	Flooding	Oklahoma State University	Completed
OK24	**FMA 031 Tech Grant** This grant-funded program conducted site visits and collected information for 750+ repetitive loss properties in the State.	Flooding	OWRB	Completed August 2010
OK25	**FMA 031 Planning Grant** Gathered and assembled information and created portfolio of 750+ repetitive loss properties in the State for further study.	Flooding	OWRB	Completed
OK26	**Winter Weather Preparedness Day** This annual event serves to educate Oklahomans of the preparedness steps to take in order to mitigate the effects of winter storms that include widespread, lengthy power outages and treacherous travel conditions.	Winter Storms	OEM	Ongoing
OK28	**Resolve data deficiencies** Work with local jurisdictions to assist them in identifying and gathering data that is missing from their plans prior to submission to FEMA.	Tornado, Winter Storms, Sinkholes, Mine Subsidence, Flooding, Wildfires, High Winds,	OEM	Ongoing

Project #	Description	Associated Hazards	Lead Agency	Schedule / Completion Date
		Drought, Hail, Lightning, Extreme Heat, Earthquake, Dam Failure, Landslides, Expansive Soils, Special Events		

4.9 Project Closeout

Upon completion of a hazard mitigation grant project, the SHMO or their designee will conduct a closeout site visit to review all files (or a representative sample) and all documents pertaining to the use of 404 funds and State General Revenue funds. In addition, all procurement files and contracts to third parties will be reviewed. Worksheets have been created to aid in the closeout review.

All reports generated at the closeout site visit are compared with Request for Funds submitted throughout the duration of the program. Any significant findings are reported to the SHMO for final determination in corrective action. Corrective Action notices will be sent to sub-grantees and another site visit will be conducted, if necessary, prior to the release of remaining funds.

Closeout reports will be submitted for each sub-grantee upon expiration of the grant. The closeout report will summarize the following:

- Grant application and approval award
- Procurement
- State Historical Preservation Office
- Use of administrative allowance
- Final list of properties acquired, if a buyout project
- Summary of costs incurred
- Verification of project monitoring and correspondence
- Demolition (open space), if a buyout project
- Certificate of Completion

Closeout reports will be submitted 90 days after notification by quarterly report that a project has been completed, to include demolition (if applicable).

Analyses of the initiation, status and completion of mitigation activities revealed that these methods, schedules and processes are proper, effective and will continue to be appropriate for use in the future.

4.10 Completed Acquisition Projects to Mitigate Repetitive Loss and Severe Repetitive Loss Properties

Jurisdiction/Project	Funding	Project Total
Bixby	SRL 08	$ 120,777
Bixby	DR-1823	$ 736.708
Miami	SRL 08	$ 914,209
Miami	SRL 12	$ 334,858
Ottawa County	SRL 08	$1,272,960
Ottawa County	RFC 09	$5,155,704
Oklahoma County	DR-1623	$1,783,090
Oklahoma County	DR-1678	$1,478,297
Oklahoma County	DR-1735	$ 150,903
Bartlesville	DR-1678	$1,272,960

4.11 Progress Review for Mitigation Goals and Objectives

In order for any program to remain effective, the goals and objectives of that program must be reviewed periodically. The State Hazard Mitigation Officer is responsible for this review on an ongoing basis. That review should address, as a minimum, the following issues:

1. Are the established goals and objectives realistic? Take into consideration available funding, staffing, and State/local capabilities, and the overall State mitigation strategy.
2. Has the State clearly explained the overall mitigation strategy to local governments?
3. Are proposed mitigation projects evaluated based on how they help the State and/or local government meet their overall mitigation goals and objectives?
4. How have approved mitigation projects complemented existing State and/or local government mitigation goals and objectives?
5. Have completed mitigation projects generated the anticipated cost avoidance or other disaster reduction result?

A thorough and realistic evaluation of the benefits of a mitigation project may be delayed until the area of the project is impacted by another disaster. The lack of realized benefits from a completed mitigation project may result in the disapproval or modification of similar projects in the future. At the same time, mitigation projects that have proven their worth may be repeated in other areas of the State.

Based on the results of the review/evaluation mentioned above, the State may need to adjust its goals and objectives to meet the current and future mitigation needs of the State and local governments. A formal mitigation status report will be prepared by the SHMO on an annual basis. This report will be provided to the Oklahoma Emergency Management Director and Deputy Director for review and distribution, as needed. The report will address, as a minimum, the following items:

1. Completed mitigation projects
    a. Affected jurisdiction
    b. Brief description of the project
    c. Source of funding
    d. Brief summary of any problem areas, with proposed solution
    e. Brief summary of effectiveness (cost-avoidance) of project, if available

2. Mitigation projects in progress
    a. Affected jurisdiction
    b. Brief description of the project
    c. Source of funding
    d. Brief summary of project status
    e. Anticipated completion date

3. Pending (under review) mitigation projects
    a. Affected jurisdiction
    b. Brief description of the project
    c. Source of funding
    d. Brief summary of project status

Oklahoma Emergency Management has reviewed the mitigation actions and determined that they were implemented as planned when funds and personnel allowed. The action items were reviewed and it was determined that each project contributed to meeting the States Goals and Objectives.

4.12 Current Sources of Federal, State, local and private funding

Note: Funding sources have remained the same throughout this planning period.

The State of Oklahoma has a variety of programs available to assist with funding for hazard mitigation projects. They include but are not limited to the following:

4.12.1 Hazard Mitigation Grant Program (HMGP)

The Hazard Mitigation Grant Program (HMGP) was created in 1988 by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended. This program is activated during Presidential Disaster Declarations to assist in identifying mitigation projects, and funding these projects on a 75% Federal / 25% non-Federal cost share basis. The program is administered at the State level; in Oklahoma, through Emergency Management. Note: In Oklahoma, the 25% share is normally absorbed by the local, city or county government.

- Objectives of this program include: Prevent future loss of lives and property due to disasters; implement State or local hazard mitigation plans; enable mitigation measures to be implemented during the immediate recovery of a disaster; and, provide funding for previously identified mitigation measures that benefit the disaster area.
- Eligible applicants for the HMGP are: State and local governments; certain non-profit organizations; and Indian tribes.
- Types of projects that may be funded are structural hazard control; retrofitting; acquisition/relocation; and development of State and local standards to protect and substantially improve structures from disaster damage. See Appendix A for the 5% Set-Aside Initiative and the 7% Planning Initiative.

The HMGP is designed to reduce the State's or local government's vulnerability to risk through a thoroughly coordinated all-hazards approach to mitigation activities, with a heavy emphasis on planning. This focus on planning includes updating plans; implementing the measures identified in all-hazard mitigation plans; developing local mitigation plans; developing State legislation; or adopting local ordinances. The key here is the coordination and implementation of an all-hazards approach using a strong partnership at the State and local level.

4.12.2 Pre-Disaster Mitigation (PDM) Program

FEMA has long been promoting disaster resistant construction and retrofit of facilities that are vulnerable to hazards in order to reduce potential damages due to a hazard event. The goal is to reduce loss of life, human suffering, economic disruption, and disaster costs to the Federal taxpayer. This has been, and continues to be, accomplished through a variety of programs and grant funds.

Although the overall intent is to reduce vulnerability before the next disaster threatens, the bulk of the funding for such projects actually has been delivered through a "post-disaster" funding mechanism, the Hazard Mitigation Grant Program (HMGP). This program has successfully addressed the many hazard mitigation opportunities uniquely available following a disaster. However, funding of projects "pre-disaster" has been more difficult, particularly in States that have not experienced major disasters in the past decade. In an effort to address "pre-disaster mitigation," FEMA piloted a program from 1997-2001 entitled "Project Impact" that was community based and multi-hazard oriented. In Oklahoma, there were four "Project Impact" named cities: Tulsa, Miami, Durant and Lawton.

Through the Disaster Mitigation Act of 2000, Congress approved creation of a national Pre-disaster Hazard Mitigation program to provide a funding mechanism that is not dependent on a Presidential disaster declaration. This authorization is in Section 203 of the Stafford Act, 42 USC 5121-5206, as amended by Section 102 of the Disaster Mitigation Act of 2000. For FY2002, $25 million was appropriated for the new grant program entitled the Pre-Disaster Mitigation Program (PDM). This new program builds on the experience gained from Project Impact, the HMGP, and other mitigation initiatives. There is a one-time grant each year for the State for this program.

The high points of the PDM program are:

(1) The program will be administered by each State.

Eligible projects include:

- State and local hazard mitigation planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects
- Community outreach and education (up to 10% of State allocation)

(2) The emphasis for FY2002, the first year of the program, was on mitigation planning, to help localities meet the new planning requirements of DMA 2000.

Each State establishes grant selection criteria and priorities based on:

- The State Hazard Mitigation Plan
- The degree of commitment of the community to hazard mitigation
- The cost effectiveness of the proposed project
- The type and degree of hazard being addressed

(3) For project grants, "good standing" of the community in the National Flood Insurance Program (NFIP)

(4) The funding is 75% Federal share, 25% non-Federal, except as noted below.

- The non-federal match can be fully in-kind or cash, or a combination
- The grant performance periods will be 18 months for planning grants, and 24 months for mitigation project grants
- The PDM program is available to regional agencies and Indian tribes

(5) Special accommodation will be made for "small and impoverished communities," that will be eligible for 90% Federal share, 10% non-Federal.

4.12.3 Flood Mitigation Assistance (FMA) program

The Flood Mitigation Assistance program is a State administered cost-share program through which States and local communities can receive grants for flood mitigation planning; flood mitigation projects; and FMA technical assistance. It is a Federal grant program, similar to the Hazard Mitigation Grant Program; however, FMA provides assistance to States and communities for flood mitigation planning and activities to fund cost-effective measures that reduce or eliminate the long-term risk of damage to buildings, manufactured home, and other NFIP-insurable structures in some cases by providing funds for acquisitions and removal or Repetitive loss and Severe Repetitive loss properties, and it is not disaster dependent. Note: In Oklahoma, the 25% local share will be absorbed by the local, city or county government, and one-half of the 25% (or 12.5% of the total grant) share must be a "hard match."

(1) FMA is part of the National Flood Insurance Act of 1968, Sections 1366 and 1367 as amended by Sections 553 and 554 of the National Flood Insurance Reform Act (NFIRA) of 1994.

(2) Goals of the program include: Reduce the number of repetitively damaged structures and associated claims against the National Flood Insurance Fund; and encourage long-term comprehensive mitigation planning.

4.12.4 National Flood Insurance Program (NFIP)

The National Flood Insurance Program, enacted in 1968, made federally subsidized flood insurance available to property owners located in communities participating in the flood program. Communities wanting to participate in the National Flood Insurance Program must establish minimum floodplain management regulations in their special flood hazard areas and enforce these regulations.

(1) In 1973, Congress passed the Flood Disaster Protection Act. This law required the purchase of flood insurance as a condition for Federal or Federally-related loans or other Federal financial assistance for property located in identified floodplain areas. This provided the incentive for participation in the Program.

(2) Most counties in the State of Oklahoma lacked proper authority concerning land use regulation necessary to participate in the Flood Insurance Program. In 1980, the legislature passed the Oklahoma Floodplain Management Act to allow citizens that desired to participate in this Program to procure flood insurance. This legislation enables any county or community in the State to form a Floodplain Board and enact floodplain regulations to allow participation in the Program.

(3) The National Flood Insurance Program requires communities to adopt and enforce a minimum amount of floodplain management criteria. These criteria includes such items as: Requiring permits for construction within designated floodplains; reviewing development plans and subdivision proposals to determine if proposed building sites will be reasonably safe from flooding; requiring protection of water supply and sanitary sewage systems to minimize infiltration of flood water and discharges from the system into the flood waters; obtaining, reviewing, and utilizing all available base flood elevation data; and assuring the maintenance of flood carrying capacities within all water courses.

(4) A current list of Oklahoma communities participating in the Program, consists of counties (unincorporated areas), tribes and municipalities, is provided in **Appendix B** of this plan.

4.12.5 Community Rating System

The Community Rating System (CRS) is an element of the NFIP. This program is designed to promote the availability of flood insurance, reduce future flood damages and insure the accurate rating of flood insurance policies. Participating communities may receive credit for proven mitigation measures, thus reducing the cost of flood insurance within their communities.

4.12.6 Disaster Housing Program

The Disaster Housing Program is available to provide disaster hazard mitigation measures in the form of home repair grants to eligible homeowners following a federally declared disaster. If the home repair costs exceed the Disaster Housing Grant, the applicant can be referred to the Individual and Family Grant Program for additional grants not to exceed the maximum grant limitations of the Individual and Family Grant Program.

4.12.7 Oklahoma Water Resource Board

In addition, the Oklahoma Water Resource Board (OWRB) has several financial assistance programs available to Oklahoma communities. Applicants eligible for water/wastewater project financial assistance vary according to the specific program's purpose and requirements, but include towns and other municipalities with proper legal authority, various districts established under Title 82 of Oklahoma Statutes (rural water, master/water conservancy, rural sewage, and irrigation districts), counties, public works authorities, and/or school districts.

FAP LOANS-provides loans for water and wastewater system improvements in Oklahoma. CWSRF LOANS-created in 1988 to provide a renewable financing source for communities to draw upon for their wastewater infrastructure needs.

- The CWSRF program is Oklahoma's largest self-supporting wastewater financing effort, providing low-interest loans to communities in need.
- DWSRF LOANS is an initiative of the OWRB and Oklahoma Department of Environmental Quality to assist municipalities and rural water districts in the construction and improvement of drinking water systems.
- REAP GRANTS were created by the State Legislature in 1996. REAP grants, used for water/wastewater system improvements, target primarily rural communities with populations of 7,000 or less, but priority is afforded to those with fewer than 1,750 inhabitants.
- EMERGENCY GRANTS, limited to $100,000 are awarded to correct situations constituting a threat to life, health, and/or property and are an indispensable component of the agency's financial assistance strategy
- CAP-SSSE (Community Assistance Program-State Support Services Element): The State administers the CAP-SSSE Grant available through the Emergency Management Preparedness Grant (EMPG). The grant provides funds for assistance to communities participating in the National Flood Insurance Program. This assistance is directed at the administration of each community’s floodplain development permit system to insure compliance with flood loss reduction guidelines.

Chapter Five: Coordination / Integration of Local Planning

Requirement 44 CFR §201.4(c)(4)(ii): *To be effective the plan must include the following elements: The section on the **Coordination of Local Mitigation Planning** that includes the following: … A description of the State process and timeframe by which the local plans will be reviewed, coordinated, and linked to the State Mitigation Plan.*

Requirement 44 CFR §201.4(d): *Plan must be reviewed and revised to reflect changes in development, progress in Statewide mitigation efforts, and changes in priorities…*

Each section of this Plan Update from the period of prior approval through September 30, 2013 was analyzed and reviewed by the planning team and revisions were recommended.

Changes to this chapter include:

-Revised explanations and instructions regarding Local Plan development
-Included new resource partners

The purpose of this section is to present the process and timeframe that the State of Oklahoma uses to review local plans prior to submission to FEMA. Under federal law, in order to be eligible for HMGP, PDM, SRL, as well as "406" FEMA-administered disaster funding, communities must have, or be included in, a FEMA-approved hazard mitigation plan. This regulation makes mitigation planning a priority for the State of Oklahoma. Prior to 2008, hazard mitigation planning was a relatively new concept to communities and information was scarce, but increased availability of information and the successful formulation of local plans have led to greater public awareness of hazard mitigation initiatives within Oklahoma.

5.1 State Assistance for Development of Local Mitigation Plans

The Oklahoma Department of Emergency Management (OEM) oversees the preparation of local hazard mitigation plans. According to FEMA regulations, local government *is any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.* (44 CFR §201.2)

Without people, there would be no disasters – only natural hazards. Oklahoma's population shift from rural to urban areas has put more people in harm's way. Due to this, Oklahoma's disasters have become more frequent and more intense. The purpose of hazard mitigation planning is to engage a community of stakeholders in mitigation awareness. The most meaningful steps in mitigating hazards are those untaken at a local level by citizens who have a stake in the outcome, and when communities understand the life-saving benefits that hazard mitigation measures provide, they can devise their own solutions.

Once the community's plan ("local plan") is approved by FEMA, the community is eligible to receive federal grants to implement these solutions to help them be more disaster-resistant and sustainable.

5.1.1 Getting Started in Local Plan Development

Local governments desiring to develop a hazard mitigation plan currently have two choices: formulate an independent plan, or participate in a multi-jurisdictional planning process. Small jurisdictions (fewer than 5000 population) are encouraged to join with their larger neighbors and develop a multi-jurisdictional plan. Both single- and multiple-jurisdiction plans require review and approval every five years. Local plans may also include the incorporated and unincorporated areas within the county. In the long run, the investment made in an effective mitigation plan is recovered in the ability to receive federal grants for HM projects. Regardless of the option selected, all participating jurisdictions must meet the requirements of 44 CFR §201.6:

- The risk assessment must assess each jurisdiction's risks where they may vary from the risks facing the entire area. (44 CRF §201.6(c)(2)(iii))

- There must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan. (44 CRF §201.6(c)(3)(iv))

- Each jurisdiction requesting approval of the plan must document that it has been formally adopted. (44 CRF §201.6(c)(5))

Once a local government determines the need to have a hazard mitigation plan, it has several formulation options: it may utilize the services of its own staff; contract with plan writers associated with Oklahoma's Councils of Government (COGs); seek out assistance from colleges and universities; or hire a private consulting firm. Regardless of the choice, it is important to note that the plan writers do not replace the planning process but rather facilitate it. Plan writers do not determine the risk findings, the strategies, or the priorities but instruct communities in making their own determinations, drawing their own conclusions, and proposing their own mitigation solutions.

OEM stresses that the local jurisdictional plans must reflect the unique demographic, geographic, technical, and political considerations of *each* participating jurisdiction. When stakeholders are engaged in the planning process, an effective plan will include both existing hazards, as well as cost-effective mitigation solutions to be implemented in the future. A commitment of time and effort, however, is required of all stakeholders to ensure the effectiveness of the plan. Prior to choosing a consultant to prepare a hazard mitigation plan, a community must determine these variables:

Project timeline
This is very important because the proposed timeline will be impacted by citizens' ability to attend public meetings, staff availability, as well as the time required for OEM and FEMA to review the product.

Deliverables
It is important to note that the contracted service is not complete until FEMA approves the hazard mitigation plan.

Scope of Work
Before requesting proposals or agreeing to a fee schedule, the community should have a clear idea of what the project entails. The community has a right to demand that their plan will be unique and not merely a revised copy of a plan prepared for another community. Ultimately, the plan is the product and responsibility of the community, not the planning consultant.

5.1.2 The State's Role in Local Plan Development

The Hazard Mitigation Division of OEM provides financial and technical assistance for the development of local plans. OEM's ability to provide financial assistance is entirely dependent on the availability of post-disaster funding from FEMA. When the President declares a disaster for the State of Oklahoma and FEMA determines the cost of the disaster, additional funding (typically 15%) is provided to the State exclusively for HM efforts. This is referred to as HMGP, or "*404 funding,*" because it is provided under Section 404 of the *Robert T. Stafford Disaster Relief and Emergency Assistance Act.* Approval of the State's 2015 Hazard Mitigation Update will result in Oklahoma's eligibility for FEMA disaster assistance and HMGP funding for *State agencies*, but it does not substitute for the requirement of local governments to have a FEMA-approved plan to be eligible for local hazard mitigation grants.

Dissimilar to disaster funding administered by FEMA, 404 funding is administered by each state which determines how to best appropriate this money to local governments for cost-effective HM projects. The State of Oklahoma provides limited funding for the preparation of plans ("*planning grants*") but local governments are free to use any funding available to them for this purpose. Local jurisdictions with limited resources are encouraged to consider joining with a larger or even several jurisdictions in a multi-jurisdictional plan.

Since 2008, OEM has implemented a formula which stipulates the base cost for plans depending on the number of participating jurisdictions. Above the base price, it considers the number of incorporated jurisdictions, public school districts, and the population of the jurisdiction.

OEM's Hazard Mitigation Division currently maintains a staff of three reviewers ("*Plan Review Staff*") to provide technical support in the preparation of local mitigation plans, with the ultimate goal that all plans be approved by FEMA Region VI. This support includes providing local planners with ongoing information regarding appropriate mitigation projects that are appropriate to their needs and which can be incorporated into local plans, as well as interpretations of policy and terminology which have proved acceptable to FEMA. The approval of over 114 local plans encompassing 493Oklahoma jurisdictions through June 2013 attests to the success of OEM's support which it will continue to provide to keep jurisdictions apprised of the ever-changing hazard mitigation planning environment.

Oklahoma's local governments, private contractors and COGs are invited to utilize the information contained in this 2014 State Hazard Mitigation Plan to help develop local HM mitigation plans. As local plans are developed and updated, information provided in those planning efforts will be incorporated into the *State Hazard Mitigation Plan*, thereby contributing to the continuous improvement of all the plans.

Following FEMA acceptance of a local plan, the jurisdictions contained within the plan are eligible to individually apply to OEM to fund local HMGP projects. Oklahoma's *State Hazard Mitigation Administration Plan* (Chapter IV; Section B) establishes criteria for local mitigation projects:

1. Be sponsored by a jurisdiction with a FEMA-approved Local Hazard Mitigation Plan.
2. Protect lives and reduce public risk.
3. Reduce the level of disaster vulnerability in existing structures.
4. Reduce the number of vulnerable structures through acquisition, relocation, flood proofing, or seismic retrofitting.
5. Avoid inappropriate future development in areas known to be vulnerable to future disasters.
6. Solve a problem independently, or function as a beneficial part of an overall solution with assurance that the whole project will be completed.
7. Provide a cooperative, inter-jurisdictional solution to reduce future disaster damage.
8. Provide a long-term mitigation solution.
9. Address emergency hazard damage issues such as urban storm water, trees in power rights of way, etc.
10. Restore or protect natural resources, recreation, open spaces, and other environmental values.
11. Develop and implement comprehensive programs, standards, and regulations that reduce disaster damage.
12. Increase public awareness of natural hazards, preventative measures, and emergency responses to disasters.
13. Upon completion, have affordable operation and maintenance costs.
14. Illustrate how the project improves the applicant's ability to protect its critical areas.

5.2 Integrating Planning Information with Other Mitigation Partners

The State Hazard Mitigation Plan identifies Oklahoma's hazards, risks, vulnerabilities, goals, objectives, priorities and strategies to enable effective mitigation planning. In addition to working with FEMA in all aspects of hazard mitigation projects and plans, OEM has established partnerships with a variety of agencies for the purpose of exchanging information. This dialog has provided valuable data for the planning and execution of many HM projects throughout the State, as well as those that will be carried out in the future as funding becomes available.

Some of these partnerships are ongoing, while others are formed to solicit expert advice on specific projects. Contributors include trade associations such as the **Oklahoma Home Builders Association**, **Oklahoma Portland Cement Association**, and the **Oklahoma Lumbermen's Association**. Academic advisors include **Texas Tech University's National Wind Institute** which provided input and advice regarding Oklahoma's first safe room initiative. **The University of Oklahoma** provides current data on hazard profiles and risk analysis, and **Oklahoma State University** contributes information on earthquake mitigation including retrofits, public education, soil mapping and seismic studies.

The **Oklahoma Water Resource Board** is the State agency that administers the Oklahoma Floodplain Management Act, and also serves as the State Coordinator for the National Flood Insurance Program [NFIP]. The **Oklahoma Insurance Commissioner** is an excellent advocate for flood and earthquake insurance, and the **Oklahoma Conservation Commission** works with OEM on flood buyouts, hazardous material planning, earthquake mitigation and dam safety issues. The **Oklahoma Department of Transportation** [ODOT], the **U.S. Department of Transportation** and the **Federal Highway Administration** [FHWA] work with OEM on flood buyouts, open space restriction, earthquake planning, and bridge retrofits. Additionally, the **U.S. Geological Survey**, the **Central U.S. Earthquake Consortium** [USEC], the **American Institute of Architects** [AIA/OK], the **American Society of Civil Engineers** [ASCE], the **Oklahoma Society of Professional Engineers** [OSPE], Oklahoma's electric cooperative industry, and private businesses support HM initiatives.

Since the 2011 State Plan Update, the **National Weather Service** [NWS] has enhanced its program offerings, as they are integral tools for hazard mitigation and emergency response. NWS has upgraded its weather radio transmitter system so that its broadcast coverage area, as of 2013, encompasses the entire state. Currently, NWS is partnering with **FEMA** and the **Federal Communications Commission** [FCC] to develop a platform to send emergency alerts to cell phones.

SoonerSafe Program

Following the 1999 and 2003 Oklahoma tornado outbreaks, OEM partnered with FEMA to utilize HMGP funds to construct nearly 10,000 residential safe rooms across the state. Since the 2011 State Plan Update, OEM initiated the "SoonerSafe Program" (October 2012) to utilize HMPG funds to provide a maximum rebate of $2,000 to homeowners for residential safe room construction, with recipients being chosen by random computer drawing.

During the 2013 Oklahoma tornadoes, lives were spared and injuries were at a minimum due, in part, to these State-administered programs which encouraged residential safe room construction. As of July 2013, the SoonerSafe Program has approved over 1,200 rebate applications. OEM will continue to offer the SoonerSafe Program.

5.3 Local / State Plan Integration

The Oklahoma Emergency Management, Mitigation Division will play a key role relative to general oversight, reviewing goals and objectives, and developing a Pre-Disaster Mitigation implementation planning strategy. After reviewing approved plans as well as multiple drafts that were submitted for State approval, the State Hazard Mitigation Planning Team determined which goals and objectives of the local plans most closely tracked with the State goals and incorporated them into the State plan. This review also indicated that hazards and risks were evaluated in a similar manner and supported the findings found within this State plan. FEMA approved plans are reviewed within 30 days of approval and stored in the State of Oklahoma Plan Data Base where they are linked and coordinated with the State of Oklahoma Hazard Mitigation Plan. The **Project Status** information is a part of this coordination and is shown in Appendix E: of this plan update.

The State of Oklahoma has 77 counties and 1922 communities. As of December 9, 2013, the State has 114 local plans approved, which covers 43 counties and four hundred fifty communities. In addition, of the 37 federally-recognized tribes in Oklahoma, seventeen have approved plans. It should be noted that in some jurisdictions, the school system is included in the local plan, but in some instances, the Independent School System may be preparing their Hazard Mitigation Plan separately. After reviewing the above-referenced plans, as well as a number of draft plans submitted for state review, it has been determined that the goals and objectives of these local plans and the goals and objectives of this state plan closely track with one another. Further, the review indicated that based upon information provided by the state, local jurisdictions evaluated hazards and risks in a similar manner and came to similar conclusions as those found within this state plan. One hazard, Sinkholes/Subsidence has been added to the State plan.

After a plan receives Approved Pending Adoption status from FEMA Region VI the local jurisdictions are required to send to the State 2 CD's that are the same, each having the complete plan including resolutions as one file and all of the resolutions as a separate file. When these CD's are received they are checked for accuracy by the State and saved in the FEMA Approved Plans file on the OEM network drive. The plans are reviewed immediately for information that needs to be included into the State Plan Updates in the future. When found the information is noted and placed in a State plan update file for inclusion in the next State Plan update. When this process is complete one of the CD's is sent on to FEMA Region VI for final approval. This process is ongoing and is applied to this planning period ending in 2010 and will continue on until this practice is changed.

The State Hazard Mitigation Planning Team has reviewed each risk assessments and mitigation strategies of approved local plans when preparing this edition of the State plan. Information in local plans that supplements and improves the accuracy and depth of the State plan have been added to the plan.

Such information may include, but not be limited to:

- Locations of hazard areas identified by the local jurisdiction
- Information on populations and structures located in or near local hazard/critical areas
- Information on projected growth in or near identified hazard/critical areas.
  Identify mitigation goals and strategies that require State attention through inclusion in the State plan

Consideration will be given to communities with the highest risks, repetitive loss properties, and most intense development pressures. For non-planning grants, a principal criterion for prioritizing grants shall be the extent to which benefits are maximized according to a Benefit Cost Analysis of proposed projects and their associated costs.

Historically, information contained in this *State Hazard Mitigation Plan* has been, and will continue to be, integrated into the planning documents of other state agencies, local governments, universities, businesses, and private associations. OEM invites all interested entities to freely use information provided in the State Plan in the development and management of their mitigation plans and programs. The *Oklahoma Hazard Mitigation Plan* is accessible through the OEM website, or free compact disk copies will be provided upon request.

5.3.1 OEM's Plan Review Procedure

Local plans submitted to OEM for review are evaluated on a first come, first served basis. Each plan is received at the State Recovery Office where it is date stamped and forwarded to the OEM's Hazard Mitigation Division which maintains a comprehensive log of the local plans which includes the sponsoring applicant, the sponsoring agent (e.g., contractor, planner, COG), the plan's participating jurisdictions, the date the plan was received, and the dates of internal review. This log also includes the date the plan was provided to FEMA, its disposition following FEMA review, and the current status of the plan.

OEM's internal reviews take approximately one week from the date the reviewer begins the evaluation. OEM's review staff may suggest corrections or request additional information before the plan is transmitted to FEMA. If the plan is determined to be deficient, OEM provides an in-depth critique and remediation instructions. Depending upon the extent and scope of the remediation effort, the applicant is allowed one to two weeks to make the corrections and resubmit the plan. OEM's plan review objective is to have the plan acceptable to pass the State review and forwarded on to Region VI within 45 days of the original receipt of the plan. The following is the current process used by OEM to review both new and updated plans:

1. Draft of plan is submitted to OEM for review.
2. OEM's Plan Review Staff performs an internal review of the plan.
3. After all required revisions are completed, OEM transmits plan to FEMA Region VI.
4. FEMA approves plan and notifies OEM of its approval, pending adoption of the plan by the participating jurisdictions.
5. OEM notifies the sponsoring agent of pending approval.
6. The participating jurisdictions adopt the plan and send the resolutions to OEM.
7. The sponsoring agent provides two copies of the plan, and two CDs of the same, to OEM.
8. OEM retains one copy of the plan and CD, and submits the other copy of the plan and CD to FEMA Region VI.
9. FEMA grants approval of the plan and sends a notification letter with the approval date, to OEM.
10. OEM notifies each participating jurisdiction, via certified mail, of the plan's approval.
11. Each Plan Update must be approved no later than five years after the initial approval date.

5.3.2 OEM Support of Local Plan Preparation

In an effort to streamline the review and approval of local plans, OEM's Plan Review Staff supports and assists local jurisdictions in the formulation of local plans. This assistance includes:

- Site meetings with local jurisdictions to review hazard mitigation planning requirements and to assist local officials with plan development activities.

- Review of local plan drafts prior to final submission to FEMA Region VI. The Plan Review Staff uses FEMA's *Planning Tool* to evaluate the plan according to FEMA guidelines. OEM's critique includes written comments to identify deficiencies, and suggestions for improvement.

- Providing current information from FEMA regional planning meetings to local planners, identifying information sources at state and national levels; interpreting State and Federal guidelines; and distributing new planning tools and documents as they are published by FEMA.

- Providing local governments with planning grants through the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Management Assistance Program.

- Providing Planning Development Workshops. OEM has hosted numerous workshops and seminars around the State to share information regarding cost-effective mitigation technologies. These are provided at no charge to local jurisdictions, emergency managers, Councils of Government, flood-plain administrators, and planning consultants.

- Sharing data regarding hazard profiles, regional socioeconomic descriptions, and assessments of regional vulnerability for the State-identified hazards. Since OEM has more available resources than the majority of local governments, it freely shares its findings to help shorten the local plan development cycle by providing well-researched hazard information which local planners can tailor to their own conditions. This information is also included in the State Hazard Mitigation Plan.

- Referring local jurisdictions to other State and Federal agencies that have proven helpful in providing information including, but not limited to, the following:

  FEMA
  U.S. Geological Survey
  U.S. Army Corps of Engineers
  U.S. Census Bureau
  U.S. Department of Agriculture
  National Flood Insurance Program
  National Climatic Data Center
  National Weather Service
  Natural Resource Conservation Service
  National Geophysical Data Center
  National Transportation Safety Board
  Oklahoma Water Resource Board
  Oklahoma Floodplain Managers Association
  Oklahoma Department of Transportation
  Oklahoma Department of Commerce
  Oklahoma Department of Agriculture, Food & Forestry
  Oklahoma Uniform Building Code Commission
  Oklahoma State Fire Marshal
  Oklahoma Geological Survey
  Oklahoma Department of Environmental Quality

5.4 OEM Strategy for Grant Selection

Unlike federal disaster funds, funding for State-administered mitigation projects is contingent upon availability. Further, jurisdictions are competing with each other for access to the same funding. OEM may prioritize funding requests based on whether the requesting jurisdiction has demonstrated the desire and ability to complete the project; however, this desire to comply with the initiatives in the local mitigation plan should not be dependent on the availability of State or Federal funds.

Oklahoma's local governments may apply for hazard mitigation grants through the on-line eGrants system, (accessible through the OEM website), or by mail. Oklahoma's SHMO reviews the applications for completeness. In an effort to provide equitable distribution of mitigation funding, the following general guidelines were developed by OEM for the evaluation of local mitigation projects:

1. The jurisdiction must have a FEMA-approved Hazard Mitigation Plan, and the proposed project must be identified as an "*Action Item*" within the plan.
2. The jurisdiction must have the ability to provide the non-federal cost share.
3. OEM will consider the Benefit Cost Analysis [BCA] for each project, with projects with the most favorable BCA receiving the highest priority.
4. OEM may consider past experience in dealing with the applicant on other grants (such as disaster grants, mitigation projects, etc.).
5. OEM may contact other State and federal agencies as well as councils of government, to inquire as to past experiences with the applicant.
6. OEM may review the applicant's susceptibility to the natural or man-made hazard the project seeks to address. Consideration will be given to communities with the highest risk.
7. OEM may review previous presidential disaster declarations, as well as non-declared events, to determine the number of times the applicant has been impacted by the events and the magnitude of damages resulting from the events. This review would consider the impact on infrastructure, as well as human suffering.
8. OEM will consider whether the applicant participates in the National Flood Insurance Program.
9. OEM will consider the number of insured, repetitive loss structures within the applicant's jurisdiction.
10. OEM may consider the applicant's status as a small or impoverished community.
11. OEM may consider if the applicant has demonstrated ability to form effective disaster response and recovery partnerships.
12. OEM may offer special consideration to jurisdictions experiencing extreme growth.

Grant applications that meet these considerations, as determined by the SHMO, are then presented to the State Hazard Mitigation Team for further discussion and selection.

5.5 Administration of the Pre-Disaster Mitigation (PDM) Program

OEM will administer the Pre-Disaster Mitigation Program based on the requirements and guidelines established by FEMA under the Disaster Mitigation Act of 2000. The Mitigation Division will have the primary responsibility for implementing this program within the State. All jurisdictions are potential candidates for the pre-disaster mitigation program. Ideally, all communities would participate in some form of pre-disaster mitigation; however, due to differences in local capabilities and priorities, the degree of participation will vary greatly from community to community.

The pre-disaster mitigation program is designed to provide technical and financial assistance to State and local governments to assist in the implementation of pre-disaster hazard mitigation measures that are:

- Cost-effective;
- Designed to solve a problem to reduce injuries, loss of life, and damage or destruction of property (including damage to critical State or local government services and facilities); and
- Complement current State and local mitigation goals and objectives.

Technical assistance will be primarily through the use of personnel from Oklahoma Emergency Management Agency (OEM) Mitigation division and funding assistance will be based on the availability of funds through the programs administered.

Financial assistance under PDM is provided with a Federal cost share of up to 75% of the total cost of approved mitigation activities. Funds provided to communities shall be used principally to implement cost-effective pre-disaster mitigation measures.

They may also be used to:

- Support effective public-private natural disaster hazard mitigation partnerships;
- Improve the assessment of a community's vulnerability to natural hazards; or
- Establish hazard mitigation priorities, and an appropriate hazard mitigation plan, for a community.

The State will use the criteria mentioned above to assist in determining which communities should receive technical and financial assistance under this program. In addition to those criteria, the State will also consider the basic Criteria for Assistance Awards established in the Disaster Mitigation Act of 2000.

<u>Those criteria are as follows:</u>

1. The jurisdiction must have a FEMA approved Hazard Mitigation Plan.
2. The extent and nature of the hazards to be mitigated.
3. The degree of commitment of the local government to reduce damages from future natural disasters.
4. The degree of commitment of the local government to support the hazard mitigation measures to be carried out using the technical and financial assistance.
5. The extent to which the hazard mitigation measures to be carried out using the technical and financial assistance contribute to established State/Local mitigation goals and priorities;
6. The extent to which prioritized, cost-effective mitigation activities that produce meaningful and definable outcomes are clearly identified,
7. If the local government has submitted a mitigation plan, the extent to which the activities identified under paragraph (5) above is consistent with the mitigation plan,
8. The opportunity to fund activities that maximize net benefits to society, and
9. The extent to which assistance will fund activities in small impoverished communities.

5.6 Small and Impoverished Community Provisions

Small and impoverished communities means a community of 3,000 or fewer individuals that is identified by the State as a rural community, and is not a remote area within the corporate boundaries of a larger city; is economically disadvantaged, by having an average per capita annual income of residents not exceeding 80 percent of national, per capita income, based on best available data; the local unemployment rate exceeds by one percentage point or more, the most recently reported, average yearly national unemployment rate; and any other factors identified in the State Plan in which the community is located.

OEM has received assistance from the Oklahoma Department of Commerce in determining those communities that meet the criteria. These communities appear to meet the intent of the Disaster Mitigation Act of 2000's definition of small and impoverished.

The President may increase the Federal cost share to 90% of the total cost of mitigation activities carried out by small impoverished communities. For non-planning grants, the FEMA funding programs and the State require that projects be cost effective and consideration of the extent to which benefits are maximized is one of the criteria that must be met. Prioritizing criteria is discussed in greater depth in Appendix E.

For several years, OEM has worked directly with FEMA Region VI NFIP coordinator and the NFIP coordinator for the State of Oklahoma to assist them in public education with local jurisdictions and tribal nations throughout Oklahoma. OEM has incorporated NFIP information in most of its public education programs where the subject was relevant to the program. Because the NFIP program is administered directly by FEMA, this is simply a matter of coordination and making public information available by OEM. In addition, OEM Hazard Mitigation Planning staff members have encouraged local jurisdictions to incorporate FMA planning, repetitive loss and severe repetitive loss property issues into their local mitigation plans.

In March, 2008, Oklahoma Emergency Management received the latest report regarding repetitive loss properties from FEMA Region VI and will be receiving a new one prior to the approval of this 2010 plan. Using this report indicating repetitive loss properties by counties, OEM will be contacting those jurisdictions with eligible repetitive loss properties to provide technical assistance in the eligibility and application process. Because of severe flooding on several occasions during 2007, the number of eligible properties has almost tripled. OEM will aggressively approach the reduction of repetitive loss properties by specifically contacting eligible jurisdictions to encourage and assist them in applying for mitigation funds through available programs which address repetitive loss properties. These programs currently include HMGP, RFC, SRL, PDM and FMA.

Chapter Six: Plan Maintenance Process

Requirement 44 CFR §201.4(c)(5)(i): *To be effective the plan must include… An established method and schedule for monitoring, evaluating, and updating the plan.*

Each section of this Plan Update from the period of prior approval through September 30, 2013 was analyzed and reviewed by the planning team and revisions were recommended.

Changes to this chapter include:

-Additional emphasis on Monitoring, Evaluating, and Updating
-Relocation of the Monitoring, Evaluating, and Updating of "Projects" to Chapter Four

6.1 Monitoring, Evaluating, and Updating the State Hazard Mitigation Plan

Chapter Six describes the formal process that will ensure that the State Hazard Mitigation Plan remains an active and relevant document available for reference and guidance to the public in mitigating the risks associated with natural hazards. The plan maintenance process includes annual evaluations, revisions and updates as required. The Plan will be resubmitted for FEMA review every three years.

The Oklahoma State Hazard Mitigation Plan is a living document and will be reviewed and updated annually, or as situations and events dictate. The need for meetings will be dependent on current happenings within the State, as well as changes in federal and state laws. If situations dictate proposed changes to the State Plan, the process will be as follows:

- Proposed changes will be included in the agenda for regularly-scheduled meetings of the State Hazard Mitigation Team (SHMT) to be discussed by the team.
- If the State Hazard Mitigation Officer (SHMO) determines the need for changes to be urgent, the SHMO can schedule a special session of the SHMT. Proposed legislative measures or changes in FEMA policies would be examples of exigent circumstances.

6.1.1 Plan Monitoring

OEM's plan review staff will be responsible for monitoring the Plan on a quarterly basis and as disaster events occur. While each chapter of the Plan will be monitored for possible update requirements, Chapters Three (Risk Assessment) and Four (Goals and Objectives) will receive the closest attention due to the frequency of changes to "Previous Occurrences" and processing of "Action Items."

OEM's plan review staff will respond to the State Hazard Mitigation Team's (SHMT) status requests regarding the Plan in the Team's quarterly meetings. Copies of the State Plan will be provided upon request to the State Hazard Mitigation Officer's office, and the Plan will be available on the OEM website (http://www.oem.ok.gov).

6.1.2 Plan Evaluating

OEM's planning team will be responsible for evaluating the Plan. The planning team will continuously evaluate the State Hazard Mitigation Plan to determine the effectiveness of the Plan's processes.

Plan evaluation will address the following:

- Chapter One – "About the Plan":
  Are there any changes in Scope, Funding, and or Strategy?
  Are there any changes in the State's demographics & growth trends?
    - Maintain contact with local jurisdictions concerning major changes in populations or development.
- Chapter Two – "Planning Process":
  Are the existing Plans / Programs still relevant to the maintenance and upkeep of the Plan?
    - Determine if there were any implementation problems, such as technical, political, legal, or coordination issued with other agencies.
    - Are contact lists being maintained to the responsible agency heads and resources?
    - Evaluate how other agencies and partners have participated.
- Chapter Three – "Risk Assessment"
  Are there any changes or updates required in the hazard risk assessment?
    - Evaluate magnitude of risk and determine if it has changed.
- Chapter Four – "Goals and Objectives"
  Are there any changes in the Goals and Objectives of the Plan?
    - Following a disaster in the state, whether declared or not, large or small, the OEMHMS will review the events in that disaster to evaluate their impact upon the Plan's Goals and Objectives.
    - Evaluate the Mitigation Action Items per the process outlined in Chapter Four.
- Chapter Five – "Coordination of Local Mitigation Planning"
  Are there any changes in Coordination processes with Sub-Grantees and other State Partners?
    - Maintain close contact with local jurisdictions regarding the status of their plans and mitigation projects.
    - Have changes in Plan development requirements been communicated to the Sub-Grantees by OEMHMS?
- Chapter Six – "Plan Maintenance Process"
  Are there any changes to the Plan Maintenance Process that will enhance or improve its effectiveness?
    - The State Hazard Mitigation Officer will evaluate the Plan Maintenance Process during each Update cycle.
    - Other changes as required by the State Hazard Mitigation Officer, the State Hazard Mitigation Team, and Federal/State Statutory Regulation Updates

Following evaluation review, the OEM's plan review staff will recommend updates and changes to the Plan.

6.1.3 Plan Updating

OEM's plan review staff, along with the SHMT, will be responsible for updating the Plan. The Plan will continue to be evaluated and updated annually during the three-year cycle process and any time there is a disaster. Beginning the second year, OEM's staff will review all revisions to be finalized based on review of the evaluation data received and sent to FEMA six months before the end of the third year in order for the State of Oklahoma to maintain eligibility for federal disaster assistance programs. The Plan will be resubmitted for FEMA review every three years.

6.2 Plan Maintenance Process Effectiveness

Analyses by OEM Management of the Monitor, Evaluate and Update section of this plan revealed that these methods, schedules and processes are proper, effective and will continue to be appropriate for use in the future.

APPENDICES

Appendix: A

7% Planning & 5% Discretionary Initiatives

Each section of the plan update from the period of prior approval through September 30, 2013 was analyzed and reviewed by the OEM HM planning staff to determine whether updates to the plan were necessary. Appendix A was reviewed and it was determined that updating was not required.

A.1 The 7% Planning Initiative:

Post-disaster funding of the Hazard Mitigation Grant Program (HMGP) is made available to state and local governments, tribal governments and certain private-non-profit (PNP) agencies. However, eligibility for this funding hinges upon one primary criterion: the jurisdiction must have a federally-approved Hazard Mitigation Plan (HMP). This criterion is further explained and defined in 44 CFR 201. There are currently four types of authorized plans: (1) standard state plan; (2) enhanced state plan; and (3) tribal jurisdiction plan (4) local plans. A mitigation plan outlines processes for identifying the natural hazards, risks, and vulnerabilities of the area under the jurisdiction of the government and proposed mitigation measures to reduce loss of life and damage. Under the guidance of 44 CFR 206.434, et seq., the state or tribal government may apply to the federal government for receipt of HMGP funds. As a grantee, that governmental entity may then set aside 7% of the total HMGP funds to be used to fund Hazard Mitigation Plans to be prepared and submitted by sub-grantees (local levels of government and/or tribal governments). These grants are currently funded at a level of not more than 75% federal funds for the project and 25% or more in local funding. Plan guidance includes the following requirements:

- Local and tribal government plans shall:
  - Describe actions to mitigate hazards, risks, and vulnerabilities identified under the plan; and
  - Establish a strategy to implement those actions.

- The State process of development of a mitigation plan under this section shall:
  - Identify the natural hazards, risks, and vulnerabilities of areas in the state;
  - Support development of local mitigation plans;
  - Provide for technical assistance to local and tribal governments for mitigation planning; and
  - Identify and prioritize mitigation actions that the state will support, as resources become available.

A.2 The 5% Set-Aside Initiative:

Some hazard mitigation measures are difficult to evaluate against traditional program cost-effectiveness criteria. Up to 5 percent of the total Hazard Mitigation Grant Program (HMGP) funds may be set aside by the state to pay for measures such as these.

To be eligible for the 5% Set-Aside Initiative, measures must:

- Be identified in the State Hazard Mitigation Plan as a measure that would reduce or prevent damage to property or prevent loss of life or injury.

- Be submitted for review with a narrative rationale that identifies the mitigation benefits and indicates that there is a reasonable expectation that future damage or loss of life or injury will be reduced or prevented.

- Comply with any other applicable HMGP eligibility criteria, and federal, state, and local laws and ordinances.

NOTE: Proposed measures may include activities traditionally considered “preparedness-related” as long as they meet all other HMGP criteria.

The 5% Set-Aside Initiative, like all HMGP funds, should not be used as a substitute for other federal programs. Projects that fall under the responsibilities of other federal agencies are not eligible.

The State may also submit project applications under the 5% Set-Aside Initiative that have previously been denied by the HMGP due to difficulty in measuring their cost-effectiveness. This avenue is preferable to the state submitting an appeal.

Types of projects that could be funded under the 5% Set-Aside Initiative include:

- The use, evaluation, and application of new, unproven mitigation techniques, technologies, methods, procedures, or products that are developmental or research based.

- Equipment and systems for the purpose of warning residents and officials of impending hazard events.

- Hazard identification or mapping and related equipment that is tied to the implementation of mitigation measures.

- Geographical Information System software, hardware, and data acquisition whose primary aim is mitigation (this may be included in 7% funding if being used in preparation, or maintenance of a Hazard Mitigation Plan).

- Development of studies or plans that are expected to lead to reduction of losses.

- Other activities, clearly falling under the goal of mitigation, for which benefits are unproven or not clearly measurable and which the state has identified as a priority in its Hazard Mitigation Plan.

Appendix: B Oklahoma Communities Participating in NFIP

Each section of the plan update from the period of prior approval through September 30, 2013 was analyzed and reviewed by the OEM HM planning staff to determine whether updates to the plan were necessary. Appendix B was reviewed and it was determined that updating was required.

-An NFIP participation listing for Oklahoma was provided via a link to FEMA's Community Status Book Report.

FEMA provides current NFIP participation data for Oklahoma via the following link -

http://www.fema.gov/cis/OK.html

Appendix: C Oklahoma Hazard Mitigation Success Stories

Oklahoma Mitigation Success Stories

SoonerSafe Program

Following the 1999 and 2003 Oklahoma tornado outbreaks, OEM partnered with FEMA to utilize HM GP funds to construct nearly 10,000 residential safe rooms across the state. Since the 2011 State Plan Update, OEM initiated the “SoonerSafe Program” (October 2012) to utilize HMPG funds to provide a maximum rebate of $2,000 to homeowners for residential safe room construction, with recipients being chosen by random computer drawing.

During the 2013 Oklahoma tornadoes, lives were spared and injuries were at a minimum due, in part, to these State-administered programs which encouraged residential safe room construction. As of July 2013, the SoonerSafe Program has approved over 1,200 rebate applications. OEM will continue to offer the SoonerSafe Program.

(Guthrie, Oklahoma):

The City of Guthrie is a small community in central Oklahoma located along Cottonwood Creek. After repetitive flooding, the citizens and local officials said enough was enough. A comprehensive flood hazard mitigation plan that detailed a downtown rehabilitation and flood mitigation project outlined a multi-year project combining historic rehabilitation with acquisition and demolition involving 100 structures. Guthrie has also prevented future development near the creek by acquiring land and converting it to recreational space. This was all accomplished with a grant from the Department of Commerce. The City's priority was and is: economic development, historic preservation, and Tourism and flood mitigation.

(Miami, Oklahoma):

Another good example of innovative, sustainable thinking can be found in Miami, Oklahoma. This is a town of about 13,000 on the banks of the Neosho River and Tar Creek in northeast Oklahoma. With the occurrence of repeated flooding, the residents decided to relocate outside of the floodplain rather than construct levees. Citizens chose to work with the river rather than attempt to control it. EM Director, Terry Durborrow, applied for HMGP funds to acquire and demolish 10 structures under DR 1058. Additional funding is being applied for under DR 1355.

On May 3, 1999, more than 70 tornados tore through Oklahoma.

As a result of these tornados, 44 persons died, and almost 800 were injured. The State of Oklahoma launched an initiative to promote and support the construction of storm shelters in homes. The initiative was the first large scale effort to build thousands of safe rooms through a rebate program and its success is a direct result of the involvement and strong support of the Governor of Oklahoma and the participation of partners in industry, business, government and the private sector. Thousands of safe rooms were built and although funding for this rebate program has ended, the initiative continues to result in the construction of safe rooms throughout the State through #1465 and #1355.

The Oklahoma Safe Room Initiative continues through Project Impact and HMGP. The city of Lawton and Logan County are constructing over 1000 shelters to protect their citizens. The Chickasaw Nation is building shelters for over 400 in their area. Through the USDA, citizens can apply for a 1% interest loan to build a safe room or shelter. Following the May 8, 2003 tornado disaster, a $3.6 million HMGP project will acquire approximately 1800 more shelters for the citizens of Oklahoma.

(Moore, Oklahoma):

*Above ground safe room: D*on Stanley and his family are no strangers to storms and tornados. Their first home was hit twice by tornados, in October 1998 and then again on May 3, 1999, when it was destroyed. In December 2000, the Staley's new home was ready in Moore, Oklahoma. Shortly after moving in, they had an above ground safe room constructed on the back patio. When the warning sirens sounded on Thursday, May 8, 2003, Don along with his dog and two cats took shelter in the safe room. When he later emerged from the shelter, he found his house in shambles with the roof ripped off.

This house was among the more than 300 homes destroyed in the City of Moore, Oklahoma. Moore also was hit by a severe tornado in May of 1999, which claimed 44 lives; there were no deaths in 2003. The absence of fatalities is being attributed to community preparedness, improved early warning systems and the many safe rooms and shelters that have been built since the last tornado. Mr. Staley summed it all up, "The safe room saved my life. It came through with flying colors. It's worth a million bucks to me."

(Moore, Oklahoma):

*In-Ground Safe room: C*harles Atchley and his wife escaped unscathed after the 1999 Oklahoma tornado, but decided not to take their good fortune lightly. They took advantage of the tornado initiative ($2,000 rebate) and installed a belowground safe room. During the tornado of May 8, 2003, which struck Moore, Oklahoma, Mr. Atchley took shelter in his safe room along with his three grandchildren. When the storm passed, his family left the shelter, safe and sound. Mr. Atchley said the storm shelter gives him "peace of mind" that he wouldn't trade for anything."

(Oklahoma):

*Below Ground Safe room: T*he Price family has lived in Oklahoma for many years. Severe storms and tornados are frequent occurrences in the area and are a cause of great anxiety for the residents. Twenty seven years ago, Mr. Price had a below ground storm shelter installed in the backyard. On May 9, 2003, Mrs. Price heard about the approaching storm on TV. A tornado watch was in effect. Mrs. Price described the sounds of the storm as a lot of noise like rocks hitting the door of the shelter and a loud roar. When they opened the door, debris had blown and blocked visibility to the house and the power poles were all down. There was some roof and window damage to the Price home and the car was damaged. "Fifteen people walked out of the shelter without a scratch. I don't have one thing in this house worth a life. I feel safe in the shelter" stated Mrs. Price. She is going to give tornado shelters as a lifetime gift to each of her four children.

(Porum, Oklahoma):

Public School Safe room

In September of 2002, Porum Public Schools requested a grant through the Hazard Mitigation Grant Program (HMGP) under FEMA 1355-DR-OK to build an above ground storm shelter that would hold approximately 700 people. The grant was approved in March of 2003 and construction began on the safe room, along with a new gym and auditorium. The project was completed on time and closed out the 2nd quarter of 2005.

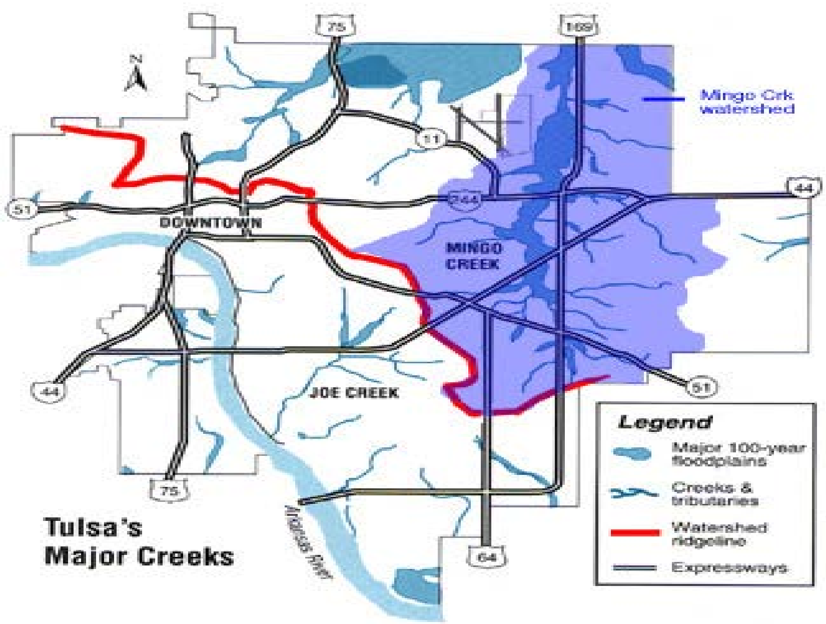
(Skiatook, Oklahoma):

The river overflowed the banks of the Bird Creek Basin and inundated Skiatook in 1985, 1986, 1988, 1990, 1993, and 1995. The flooding affected the city of about 5000 people. In a referendum after the flood, the people of Skiatook decided they would not try to rebuild back in the same path of the flooding. They voted to relocate to higher ground. In 1998, City Manager Eric Wiles applied for HMGP funding, to acquire and demolish 19 structures, completing this project in May 2002. This project was also incorporated into a FMA grant to include several additional structures.

(Tulsa, Oklahoma)

Mingo Creek Greenway Corridor:

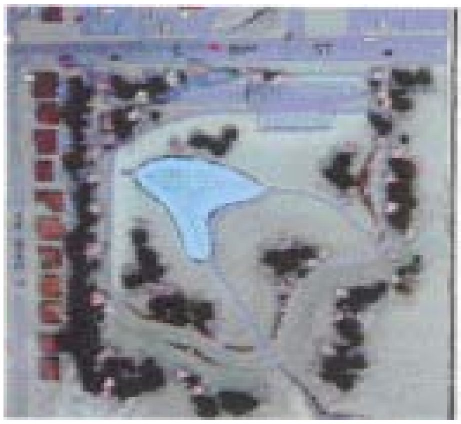
Mingo Creek Basin in Tulsa, Oklahoma had caused over $216 million in flood damage since 1959 and $180 million in property damage and the loss of five lives in 1984. Plans designed to control flooding were developed. The City of Tulsa retained R.D. Flanagan & Associates to review the designs, work with the U.S. Corps of Engineers and to develop and refine an alternative plan sensitive to the ecological, visual and cultural needs of the community. This effort resulted in the development of an open multi-jurisdictional, multi-objective design process that changed the way drainage and flood control facilities are planned and designed.

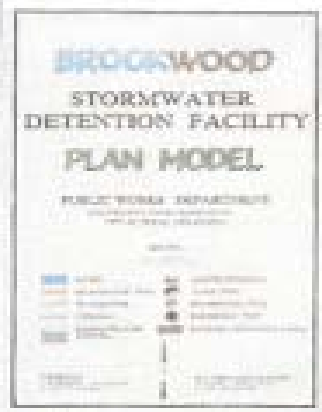


(Tulsa, Oklahoma)

Vensel Creek Master Drainage Plan:

R.D. Flanagan & Associates was retained by the Engineering Department, City of Tulsa, to develop a process for the comprehensive planning of drainage basins within the city. The project included performing a pilot study on a developing basin in south Tulsa and development of a standard planning format for subsequent studies. Since the Vensel Creek Trail Plan, the City of Tulsa has completed master drainage plans on all drainage basins and multi-use trails within its jurisdiction of over 150 square miles. Detailed design and implementation plans were developed for the Brookwood Detention Facility. This plan involved extensive citizen participation and resulted in a park-like facility with a permanent water feature, landscaping and trails.

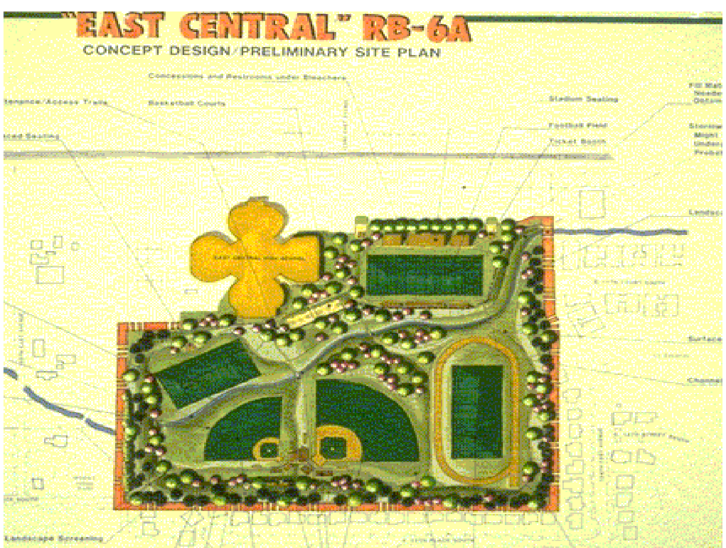




(Tulsa, Oklahoma)

Cooley/Tupelo Corridor Plan:

R.D. Flanagan & Associates was the design team leader in a consortium of planners and landscape architects retained to develop multi-use plans and detailed designs for eight regional storm water detention facilities in the Cooley Creeks drainage basins. The drainage basins are major tributaries to Mingo Creek in eastern Tulsa. The Cooley Lake and Sampson Lake sites were designed to serve as passive recreation facilities with a permanent water feature and trail systems.



(Tulsa, Oklahoma)

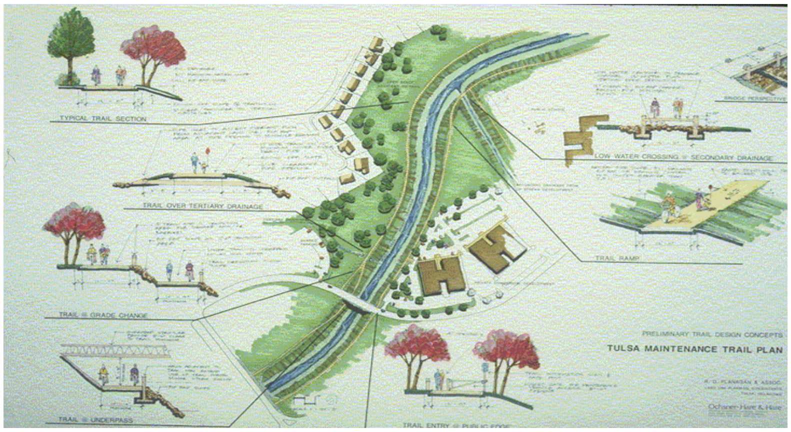
Mooser Creek Greenway Corridor:

R.D. Flanagan & Associates was selected as the chief planner in assisting the City of Tulsa and the Rivers, Trails, and Conservation Assistance Program of the National Park Service in the development of a pilot greenway and trails project for the Mooser Creek Basin in southwest Tulsa. The solution presented was to create artificial sites that imitate nature by ponding runoff during spring and fall rains, but for the rest of the year serve as parks, playing fields and wildlife habitat. The project involved extensive citizen involvement, interagency inter-governmental cooperation and coordination, extensive inventory, alternative development and refinement of the selected plan.

(Tulsa, Oklahoma)

Tulsa Trails:

R.D. Flanagan & Associates developed the first Tulsa Trails Master Plan for the City of Tulsa in 1987. This first “Blue-Greenway” plan illustrated the trails concept utilizing the River Parks trail system, major drainage corridors, traffic ways, and connector systems linking public facilities, parks, schools, commercial and employment centers, and storm water detention ponds. This early trails master plan served as the basis for the later INCOG Tulsa Area Parks and Trails Plan. In July 1992, FEMA selected Tulsa for its Outstanding Public Service Award because of the city’s “Significant contributions and distinguished leadership” to the nation in floodplain management.



(Tulsa, Oklahoma)

Community Rating System:

A 1976 study identified Tulsa, Oklahoma as the most flood-prone community in the nation. In 1984, Tulsa lost 14 people and $180 million in damages to nearly 7,000 homes and businesses. Tulsa County was leading the nation in flood frequency. Due to the dedicated effort of citizens and the government, less than 20 years later Tulsa was generally recognized as having the best floodplain management program in the nation. In September 2003 the City of Tulsa was honored by FEMA under the Department of Homeland Security for becoming the first city in the nation to receive a Community Rating System rating of 2. As a result Tulsans in the Special Hazard Flood Areas receive a 40% discount on flood insurance. Today, Tulsa's floodplain and storm water program is based on respect for the natural systems. It includes comprehensive watershed management, dedicated funds for maintenance and operation, a prototype alert system, and a $200 million capital improvements program.

Tulsa's Acquisition Program began in the mid 1970s as a part of the storm water management and flood control program. It now is part of the city's larger Natural Hazards Mitigation Plan that began in 2002. To date, Tulsa has cleared more than 900 buildings from its floodplains under the Acquisition program and the land is now managed as open space. Prior to 1995, Tulsa had acquired demolished and removed structures with only local funding. Now the primary source of funding for the Acquisition Program is HMGP and

FMA so the program has become entirely voluntary. Local match comes from sales tax and bond issue packages.

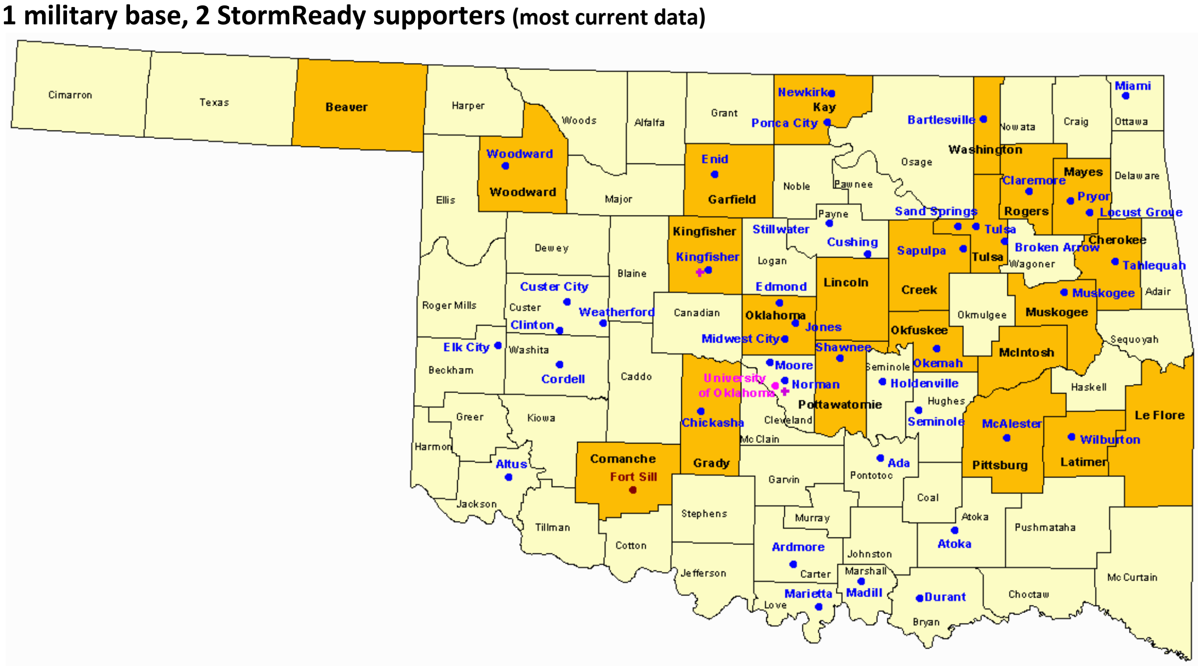
(Tulsa, Oklahoma)

StormReady

Some 90% of all presidentially declared disasters are weather related, leading to around 500 deaths per year and nearly $14 billion in damage. StormReady, a program started in 1999 in Tulsa, Oklahoma, gives communities skills and education needed to survive severe weather-before and during the event. StormReady communities are better prepared to save lives from the onslaught of severe weather through better planning, education, and awareness. To be recognized as StormReady, a community must:

1. Establish a 24-hour warning point and emergency operations center,
2. Have more than one way to receive severe weather forecasts and warnings and to alert the public,
3. Create a system that monitors local weather conditions,
4. Promote the importance of public readiness through community seminars,
5. Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Oklahoma: 65 StormReady Designations: 22 Counties and 41 Communities 1 University, 1 military base, 2 StormReady supporters (most current data)



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Gold Shading</td><td colspan="3">StormReady Communities:
Blue Dot</td><td>University:
Purple Dot</td></tr>
<tr><td>• Beaver</td><td>• McIntosh</td><td>• Ada</td><td>• Edmond</td><td>• Newkirk</td><td>University</td></tr>
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• Cherokee • Comanche • Creek • Garfield • Grady • Kay • Kingfisher • Latimer • Le Flore • Lincoln • Mayes	• Muskogee • Okfuskee • Oklahoma • Pittsburg • Rogers • Pottawatomie/ Shawnee • Tulsa • Washington • Woodward	• Altus • Ardmore • Atoka • Bartlesville • Broken Arrow • Chickasha • Claremore • Clinton • Cordell • Cushing • Custer City • Durant	• Elk City • Enid • Holdenville • Jones • Kingfisher • Locust Grove • Madill • Marietta • McAlester • Miami • Midwest City • Moore • Muskogee	• Norman • Okemah • Ponca City • Pryor • Sand Springs • Sapulpa • Seminole • Stillwater • Tahlequah • Tulsa • Weatherford • Wilburton • Woodward	of Oklahoma **Government Site:** **Brown Dot:** Fort Sill Supporters: Purple Plus Sign Pioneer Telephone Cooperative Kingfisher Sooner Mall

<u>Appendix: D</u> Current Local Mitigation Projects Summary

Current Project Status Summary

CATEGORY	OPEN PROJECTS						CLOSED OUT PROJECTS					
	2008	2009	2010	2011	2012	2013	2008	2009	2010	2011	2012	2013
Acquisitions	7	7	5	6	3	7	3	3	5	2	4	1
Drainage	0	0	0	4	6	6	0	0	0	0	0	0
EOC Retrofit	1	1	1	1	0	0	0	0	0	0	1	0
Flood	0	0	0	0	1	0	0	0	0	0	0	0
Generator	0	30	34	43	32	28	0	0	7	21	16	9
Mapping	2	2	2	1	0	0	0	0	0	1	0	0
Other	7	21	19	5	1	1	0	2	2	0	4	0
Plans	174	153	104	71	51	47	45	54	40	15	25	9
Individual Safe Rooms	4	3	3	18	36	44	0	3	1	1	2	2
School Safe Rooms	56	13	9	7	13	13	15	46	4	4	0	0
Warning	12	27	18	16	8	7	1	2	12	8	12	3
NOAA Radios	10	15	14	7	4	5	15	6	8	13	5	0
Totals	273	272	199	179	155	158	79	113	79	64	79	24

Other = NOAA Weather Radios, Reverse 911, Hardwire Switch, Fixed Weather Stations, Hearing Impaired, NOAA Weather Repeaters, EMWIN (Emergency Management Weather Information Network)

Appendix: E Other Planning Initiatives & Project Prioritization

Integration with Other Planning Initiatives

Clearly, the concept of hazard damage reduction and / or state hazard mitigation planning should be integrated into other important state planning initiatives such as economic development, capital improvement, comprehensive emergency management, disaster recovery, and restoration planning. Hazard mitigation planning is integrated into several key state planning initiatives and mitigation programs. Among the best examples are the Floodplain Management Programs and the FEMA-funded, state administered hazard mitigation programs.

In 1999, HB 1841 established the *first* State of Oklahoma flood mitigation program. This amended the Oklahoma Emergency Management Agency enabling legislation; created a flood mitigation account, and set criteria for flood assessment and mitigation projects. The Oklahoma Water Resources Board (OWRB) coordinates state efforts under the National Flood Insurance Program including floodplain management activities of 381 member communities throughout Oklahoma (see Oklahoma Floodplain Management Association).

As the NFIP State Coordinator, the Oklahoma Water Resources Board (OWRB) partners with other state and federal agencies and local governments to prevent and mitigate the catastrophic effects of flooding disasters in Oklahoma. There is a close working relationship between Oklahoma Emergency Management and the Oklahoma Water Resources Board whose programs and input are solicited and integrated into the State Hazard Mitigation Plans as appropriate. The OWRB promotes community enrollment in the NFIP and advises its 381 current members on steps to ensure future participation. The Water Board's aggressive and proactive efforts to mitigate the impacts of flooding in Oklahoma have been consistently recognized by FEMA and other organizations as the best in this region and one of the top programs in the country.

The Community Rating System (CRS) is an element of the NFIP. This program is designed to promote the availability of flood insurance; reduce future flood damages; and insure the accurate rating of flood insurance policies. Participating communities may receive credit for proven mitigation measures, thus reducing the cost of flood insurance within their communities.

The Oklahoma Department of Commerce provides the CDBG Capital Improvement Planning (CIP) grant funds to help communities update an existing Local Inventory of Governmental Capital Assets and a Local Capital Improvement Plan and Budget. The CIP process requires communities to create strategic plans for addressing the needs for publicly owned capital assets. By prioritizing capital budget needs, a community is better prepared to meet the financial requirements for enhancing its local infrastructure and paving the way for future community and economic growth and stability.

Both the Oklahoma Water Resources Board and the Oklahoma Department of Commerce are active members of the Oklahoma State Hazard Mitigation Team.

State hazard mitigation planning is integrated into the 1) Hazard Mitigation Grant Program; 2) Flood Mitigation Assistance (FMA) Program, 3) Pre-Disaster Mitigation Assistance (PDA) Program, 4) Repetitive Flood Claims (RFC) Program, and the 5) Severe Repetitive Loss (SRL) Program. The State requires recipients of Hazard Mitigation Grant Program grants to develop a natural hazard mitigation plan according to the Disaster Mitigation Act of 2000 (DMA 2000), 44 CFR Parts 201.6 requirements as amended, as a condition of receipt of a project grant. This requirement added approximately 200 hazard mitigation plans for communities and counties that otherwise might not have developed a plan. For several years the Flood Mitigation Assistance (FMA) Program has required that all applicants have an approved Flood Mitigation Plan. These requirements may now be met by incorporating the FMA language into the jurisdictions hazard mitigation plan.

Since the inception of the Capital Improvement Planning (CIP) program, the Oklahoma Department of Emergency Management and the Oklahoma Department of Commerce have been in a partnership with the state's eleven regional Councils of Government (COG). Each individual COG is responsible for converting information gathered with the CIP toolkit into a digital data format.

Benefits:

- Provides an inventory and mapping of community owned assets.
- Establishes a local administrative and policy framework for making responsible capital budgetary decisions.
- Clarifies and projects economic and demographic trends likely to influence the needs for new and expanded local capital facilities.
- Estimates the cost for repairs, replacements and expansions that incorporate mandatory, essential, desirable and deferrable needs.

Capital Improvement Planning (CIP)

CIP aids in validating to the county and municipal residents the amount of fiscal resources available to devote to natural hazard mitigation actions/projects during any given fiscal year. It should be noted that after the occurrence of a natural hazard event, CIP priorities might have to be rearranged or new priorities adopted.

Emergency Operation Plans

Present an overview of the ideal responses to a natural hazard occurrence and also provide a prioritization of what post disaster actions should occur and in what order. Both of these planning efforts should be consulted while constructing mitigation plans, actions/projects, and priorities.

State Administrative Plan

For all Federal mitigation programs: HMGP, PDM, FMA, RFC and SRL requires all construction-related mitigation projects to support the general mitigation objectives in the state's hazard mitigation strategy, adopted and published in 2008 as the strategy of record.

Oklahoma's State Hazard Mitigation Team was used to form the base of the State Hazard Mitigation Planning Committee. By incorporating team members from 21 different departments and agencies, plus private non-profit agencies and tribal nations, the State of Oklahoma insures that its Hazard Mitigation Plan is integrated into as many key state planning initiatives as practicable. For example, O.S. Title 63 §695.5 Oklahoma Emergency Management Act of 2003 amends certain sections to include:

1. Providing for the rendering of mutual aid among the political subdivisions of this state and with other states to cooperate with the Federal government with respect to carrying out emergency management functions and hazard mitigation

2. Provide sufficient organization to meet, prevent or reduce emergencies in the general interest and welfare of the public and this state

3. It is the purpose of the Oklahoma Emergency Management Act of 2003 and the policy of the State of Oklahoma that all emergency management and hazard mitigation functions of the state be coordinated with the comparable functions of the Federal government, including its various departments and agencies, with local government, and where necessary with other states, and with private agencies in order to expedite the most effective preparation and use of available workforce, resources and facilities for dealing with disasters and hazard mitigation.

4. It is also mandated that each state agency, board, commission, department or any other state entity having responsibilities in the State Emergency Operations Plan or by the nature of the service it provides to the citizens of Oklahoma will have written plans and procedures in place to protect individual employees, administrators and visitors from natural and man-made disasters and emergencies.

Hazard Mitigation Team members are familiar with the Oklahoma Hazard Mitigation Plan goals and action items.

Quarterly meetings will continue to ensure an exchange of ideas, problems and solutions and allow team members to incorporate new and existing mitigation ideas into each of their planning initiatives. State agencies will use this plan in conjunction with their Emergency Operations Plan (EOP)

- For example, the Oklahoma State Mitigation Plan complements and integrates with the recommendations of the Oklahoma Comprehensive Water Plan (OCWP). The OCWP recommended coordination for hazard mitigation activities within federal, state and local regulatory activities. Examples of activities include encouragement of local community buyouts of repetitive loss properties in floodplains, structural measures to reduce flood losses, emergency action planning below high hazard dams, annual engineering inspections of high hazard dams, encouragement of above minimum standard floodplain ordinances and activities, formation of the Oklahoma Drought Management Team and development/implementation of the Oklahoma Drought Management Plan, financing of water system improvements to mitigate the effects of drought through the State Financial Assistance Program and creation of the State Hazard Mitigation Fund. In 2009 the OCWP anticipates complete a water demand assessment. Following this, an assessment of ground and surface water will be done. The results of these two assessments will be compared to define any needs for which supply is inadequate.

DEQ has developed a program to help municipalities eliminate dilapidated buildings in an economical and environmentally sound manner. The program has many positive features such as:

1. Eliminating eyesores and safety hazards
2. Saving thousands of dollars in landfill disposal costs
3. Saving valuable space in landfills
4. Reclaiming land damaged by such things as strip mining or erosion

The State of Oklahoma through DEQ has the ***State of Oklahoma Environmental Quality Code***. *T*his can be used for enforcement and funding in the Tar Creek Superfund area. The Tar Creek Superfund Site is one of the special event/man-made hazards profiled in the Plan.

The Waste Management Division of DEQ has the responsibility of carrying out the activities as required by the *State of Oklahoma Environmental Quality Code* and the EPA's CERCLA laws. In January 2000 DEQ completed a pilot project by closing three mine shafts northeast of Quapaw, Oklahoma. There are several state and local agencies such as DEQ, the Oklahoma Conservation Commission, the Oklahoma Department of Environmental Quality and the Ottawa Reclamation Authority, which have been and continue to be involved with reclamation of abandoned mines that pose a threat to public health and safety in Oklahoma. Their respective laws allow technical, legal, and financial help to be provided to the communities and citizens in the Tar Creek Superfund area.

Oklahoma Natural Hazard Mitigation Plan integrates with the goals and objectives of the Oklahoma Conservation Commission (OCC). The OCC is responsible for reclaiming over 32,000 acres of abandoned surface coal mines and another 40,000 acres of abandoned underground coal mines in a 16-county area of eastern Oklahoma.

Project Prioritization & Eligibility Criteria

The Oklahoma Department of Emergency Management Mitigation Division and the Oklahoma State Hazard Mitigation Team developed state criteria for determining eligibility of proposed multi-hazard mitigation measures. The following criteria are listed in the state administrative plan (latest edition September 26, 2012) and used for all Federal mitigation programs, i.e. HMGP, PDM, FMA, RFC and SRL.

State Eligibility Criteria

In addition to published Federal eligibility criteria, a project must also support the general hazard mitigation objectives contained in the state mitigation plan. Specifically, these projects should implement as many of the following as practical:

1. Show adoption of a FEMA approved local hazard mitigation plan.
2. Protect lives and reduce public risk.
3. Reduce the level of disaster vulnerability in existing structures.
4. Reduce the number of vulnerable structures through acquisition, relocation, flood proofing, or seismic retrofitting.
5. Avoid inappropriate future development in areas known to be vulnerable to future disasters.
6. Solve a problem independently, or function as a beneficial part of an overall solution with assurance that the whole project will be completed.
7. Provide a cooperative, inter-jurisdictional solution to reduce future disaster damage.
8. Provide a long-term mitigation solution.
9. Address emergency hazard damage issues such as urban storm water, trees in power right of ways, etc.
10. Restore or protect natural resources, recreation, open spaces, and other environmental values.
11. Develop and implement comprehensive programs, standards, and regulations that reduce disaster damage.

12. Increase public awareness of natural hazards, preventative measures, and emergency responses to disasters.

13. Upon completion, have affordable operational and maintenance costs.

14. Illustrate how the project improves the applicant's ability to protect its critical areas.

Applicants are responsible for prioritizing projects by urgency of the need with the disaster being mitigated, financial impact to the jurisdiction, human losses, and timeframe for completion. The State is responsible for prioritizing each project application with respect to how much and when state assistance is available. The form previously used for this purpose was ambiguous, subject to personal interpretation, and an irrational grading system. Following is the form now used to prioritize projects submitted to OEM for approval.

The State provides support to the applicants in several ways, including actual project implementation, seeking other funding resources, project support, public involvement activities and the provision of additional information.

The Mitigation Division tracks when and how projects are being implemented, as well as how their funding is being used. If there is a problem or conflict with a project, the state acts as a mediator to resolve the problem as quickly and efficiently as possible. As projects are completed, the state performs closeout procedures and all files are maintained in each applicant folder.

Project Evaluation and Prioritization Sheet

Parameter	Yes	No	Score	Yes=1 No=0
Is applicant an eligible entity? (Tribe, County, City, etc.)	Yes	No		
Planning Projects - (7%) Use section **A** below				
Discretionary Projects - (5%) Use section **B** below				
Construction Projects - Use section **C** below				

A.	Planning Projects (7%)	Score

	Is jurisdiction in Federal Declaration Area?	Yes	No	
	Is this funding request for a **New** plan?	Yes	No	
B.	**Discretionary Projects (5%)**			**Score**
	FEMA approved Hazard Mitigation Plan?	Yes	No	
	Is jurisdiction in Federal declaration area?	Yes	No	
	Is project one of the state's priority projects?	Yes	No	
	Project in local hazard mitigation plan?	Yes	No	
C.	**Construction Projects**			**Score**
	FEMA approved hazard mitigation plan?	Yes	No	
	Is jurisdiction a member of the NFIP?	Yes	No	
	Is this a FEMA approvable project?	Yes	No	
	Is jurisdiction in federal declaration area?	Yes	No	
	Is project one of the state's priority projects?	Yes	No	
	Project in local hazard mitigation plan?	Yes	No	
	Cost benefit analysis provided?	Yes	No	
	Past project performance? (Incomplete/Overdue Closeout)	Yes	No	

The State Hazard Mitigation Plan addresses the eligibility criteria for multi-hazard mitigation projects. The criteria listed in this section of the plan are the basic criteria for each type of project. These criteria may be modified based on any of the following issues:

- The specific disaster situation;
- Location of affected areas;
- Availability of funds;
- Unique program requirements of the fund source;
- Current state and/or local hazard mitigation priorities; and
- Number/type of mitigation projects submitted by local governments.

All hazard mitigation projects submitted for consideration must meet the criteria outlined in Code of Federal Regulations (CFR) 44, Section 206.434. There are additional requirements established by the state that must be met before a project is considered for approval. (HM Plan Chapter 5)

To meet FEMA's Minimum Hazard Mitigation Project Criteria, the project must:

1. Be in conformance with the hazard mitigation plan developed as a requirement of Section 322;
2. Have a beneficial impact upon the designated disaster area, whether or not located in the designated area;
3. Be in conformance with 44 CFR part 9, Floodplain Management and Protection of Wetlands, and 44 CFR part 10, Environmental Considerations;
4. Solve a problem independently or constitute a functional portion of a solution where there is assurance that the project as a whole will be completed. Projects that merely identify or analyze hazards or problems are not eligible; and
5. Be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster.

The project must also meet the following state criteria:

1. The project must complement existing or proposed state mitigation goals and objectives;
2. The project must complement existing or proposed mitigation goals and objects for the jurisdiction submitting the project;
3. The jurisdiction requesting the project must be able to complete the project as submitted;
4. The jurisdiction submitting the project must be able to meet any matching funds requirements (if required).
5. The project must be able to make a bigger impact on the local and state mitigation program than other non-selected projects.

While buyouts are not the only mitigation projects considered and undertaken by the state and local governments, they have been the type of project most frequently submitted and approved. In general, OEM works with local governmental entities to acquire and remove, elevate, relocate or perform minor structural projects only on privately owned residential structures and/or privately owned lots that are located in the floodplain and/or floodway. In addition to the requirements listed above, these projects must also meet the following criteria:

1. The project chosen must independently solve or be a functional part of a solution to a problem that is repetitive or poses a significant risk to health and safety. The proposed solution must be the most practical, effective, cost-effective and environmentally sound alternative among a range of alternatives that contribute to a long-term solution of the problem.

2. Local governmental entities (or certain private non-profit entities) must apply through the state, specifically OEM, to FEMA for approval to perform a project or projects. The applications must specifically identify the properties to be included in the project or projects. All projects must be proven cost-beneficial, in accordance with a determination method that is acceptable to OEM/FEMA. This is usually accomplished by using the FEMA benefit cost analysis module.
3. Local governmental/non-profit entities must be in good standing in the NFIP (or have not yet been mapped), and otherwise eligible to receive federal funding. Non-federal matches and all other federal grant requirements must be satisfied by the local entity, sometimes with the monetary assistance of local property owners or possibly with assistance from CDBG.
4. Hazard Mitigation Grant Program, Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) projects must be consistent with the overall State Hazard Mitigation Plan. Projects also must conform to 44 CFR Part 9, Floodplain Management and Protection of Wetlands, and 44 CFR Part 10, Environmental Considerations.
5. Only local governmental/non-profit entities may manage the project or projects. All projects must be managed in accordance with local, state and federal ordinances, laws and regulations. Individual property owners are not eligible to receive federal funds directly as a grantee or sub-grantee and are not authorized to manage grant projects.

Appendix: F Authority References & Acronyms Definition Listings

Authorities and References

Federal:

Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288
Disaster Mitigation Act of 2000 (P.L. 106-390)
Code of Federal Regulations, Title 44, Section 201
Code of Federal Regulations, Title 23, Section 650A
National Flood Insurance Reform Act of 1994
National Flood Insurance Reform Act of 2011
Emergency Management Assistance Compact (P.L. 104-321)
Flood Insurance Reform Act of 2004 (P.L. 108-264)
US Army Corps of Engineers Disaster Operations (P.L. 84-99)
Land and Water Conservation Fund Act of 1965 (P.L. 88-703)
Federal Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87)
Reclamation Act of Congress in 1902
Clean Water Act
Clean Air Act
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
Endangered Species Act
Executive Order 11988 – Floodplain Management

State:

Oklahoma Constitution (1907)
Oklahoma Statutes:

- Oklahoma Emergency Management Act, Title 63 §683.8
- Oklahoma Emergency Response Act, Title 27A §4-2-102
- Oklahoma Intrastate Mutual Aid Compact, Title 29A §695.2
- Oklahoma Floodplain Management Act - Title 23 §1601-1620
- Oklahoma Uniform Building Code Commission Act, Title 59 §1000.20
- Oklahoma Environmental Quality Act, Title 27A §1-1-1-2

State of Oklahoma Emergency Operations Plan
State of Oklahoma Drought Management Plan
State of Oklahoma State Hazard Mitigation Administrative Plan
State of Oklahoma State Fire Management Plan
State of Oklahoma Comprehensive Water Plan

Publications:

FEMA "Hazard Mitigation Assistance Unified Guidance," July 2013
FEMA # 386-1 and 386-3; also "Mitigation Ideas" dated January 2013
FEMA "Local Mitigation Planning Handbook," March 2013
FEMA "Mitigation Ideas," January 2013

FEMA “Local Mitigation Plan Review Guide,” October 2011
FEMA “Design and Construction Guidance for Community Safe Rooms,” August 2008
FEMA “Taking Shelter from the Storm,” August 2008

Acronyms & Definitions

ACCO	Association of County Commissioners of Oklahoma
ADHP	Advanced Hydrologic Prediction Service
AML	Abandoned Mine Land
ARC	American Red Cross
BCA	Benefit cost analysis
BIA	Bureau of Indian Affairs (Federal agency)
BLM	Bureau of Land Management (Federal agency)
BOR	Bureau of Reclamation (Federal agency)
CDBG	Community Development Block Grant program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFM	Certified Floodplain Manager
CFR	Code of Federal Regulations
CIP	Capital improvement plan
CPC	Climate Prediction Center
CPRI	Critical Priority Risk Index
CRS	FEMA's Community Rating System
DEQ	Department of Environmental Quality (State agency)
DHS	Department of Human Services (State agency)
DMA 2000	Disaster Mitigation Act of 2000
DOB	Duplication of Benefits
DOE	Department of Education (Oklahoma State agency)
DRC	Disaster Recovery Center
EMPG	FEMA's Emergency Management Planning Grants program
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency (Federal agency)
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency (federal agency)
FEMA Region VI	Regional Office located in Denton, Texas (oversees AR, LA, NM, OK, TX)
FHA	Federal Housing Administration (Federal agency)
FHWA	Federal Highway Administration (Federal agency)
FIRM	Flood Insurance Rate Map
FMA	FEMA's Flood Mitigation Assistance programs
GRDA	Grand River Dam Authority (State agency)
HMPG	Hazard Mitigation Plan Grant
HUD	Housing and Urban Development (Federal agency)
IRS	Internal Revenue Service (Federal agency)
MOA	Memorandum of agreement

NCDC	National Climatic Data Center
NAWAS	National Warning System
NCDC	National Climatic Data Center
NFIP	FEMA's National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NHPA	National Historic Preservation Act
NPS	National Park Service (Federal agency)
NRCS	National Resource Conservation Service
NRP	National Response Plan
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
OAS	Oklahoma Archeological Survey (State agency)
OCC	Oklahoma Conservation Commission (State agency)
OCES	Oklahoma Cooperative Extension Services
OCS	Oklahoma Climatological Survey
ODC	Oklahoma Department of Commerce (State agency)
ODOT	Oklahoma Department of Transportation
ODWC	Oklahoma Department of Wildlife Conservation
OEM	Oklahoma Department of Emergency Management
OEQA	Oklahoma Environmental Quality Act
OEMA	Oklahoma Emergency Management Association
OFMA	Oklahoma Floodplain Managers Association
OGS	Oklahoma Geological Survey (State agency)
OUBBC	Oklahoma Uniform Building Code Commission (State agency)
OWRB	Oklahoma Water Resource Board (State agency)
PDM	FEMA's Pre-Disaster Mitigation program
REAP	Rural Economic Action Plan
RFC	FEMA's Repetitive Flood Claims program
RISA	Regional Integrated Science and Assessment teams
RUS	Rural Utility Service
RFC	River Forecast Center (operated by the NWS)
SBA	Small Business Administration
SCIPP	Southern Climate Impacts Planning Program
SHMO	State Hazard Mitigation Officer
SHMT	State Hazard Mitigation Team
SHPO	State Historic Preservation Office (State agency)
SNAP	Supplemental Nutrition Assistance Program
SRL	FEMA's Severe Repetitive Loss program
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic & Environmental
USACE	United States Army Corps of Engineers (Federal agency)
USGS	United States Geological survey (Federal agency)

USDA	United States Department of Agriculture (Federal agency)
VOAD	Voluntary Organizations Active in Disaster
WMA	Wildlife Management area

Appendix: G

State Critical Facilities

Each section of the plan update from the period of prior approval through September 30, 2013 was analyzed and reviewed by the OEM HM planning staff to determine whether updates to the plan were necessary. Appendix G was reviewed and it was determined that updating was required.

- A current listing of all major state facilities was updated
- A current listing of all unincorporated area Fire Departments was added

THE INFORMATION CONTAINED IN THIS ANNEX IS NOT TO BE DISTRIBUTED TO THE PUBLIC DUE TO SECURITY CONCERNS. FOR ADDITIONAL INFORMATION ON THIS APPENDIX CONTACT THE STATE HAZARD MITIGATION OFFICER AT 405-521-2481.

NOTE: This section contains information for some State Agencies that are critical to the health, safety and security of the public in Oklahoma.

Withheld from public disclosure

For information regarding release of this data please contact:

State Hazard Mitigation Officer

(405) 521-2481

<u>**END OF OKLAHOMA STATE PLAN DOCUMENT**</u>