GRAYSON COUNTY, TEXAS

FEBRUARY 2012

Multi-Jurisdictional Hazard Mitigation Plan

PLAN ADOPTIONS RESOLUTIONS

In accordance with Part 201.6 of the Disaster Mitigation Act of 2000 (DMA 2000), Grayson County, Texas, has developed this Multi-Jurisdictional Hazard Mitigation Plan to identify hazards that threaten the County and ways to reduce future damages associated with these hazards. Following this page are the signed adoption resolutions of the County and all participating jurisdictions that have adopted this plan, authorizing municipal government staff to carry out the actions detailed herein.

Signed Resolutions of adoption by all participating jurisdictions shall be inserted following this page after the Texas Division of Emergency Management has approved the draft Plan and prior to FEMA's final review and approval of the Plan. This approach is taken to eliminate the possibility that the participating jurisdictions might have to approve the Plan in its multiple drafts through the State of Texas and FEMA review process. Upon receipt of FEMA approval of the Plan contingent upon participating jurisdictions adoption of same, *the resolutions will be obtained and submitted to FEMA.*

SUMMARY – PLAN DEVELOPMENT AND ADOPTION PROCESS

In order to apply for federal aid for technical assistance and post-disaster funding, local jurisdictions must comply with Part 201.3 of the Disaster Mitigation Act of 2000 implemented in the Federal Code of Regulations 44 CRF Part 201.6. While Grayson County has historically implemented measures to reduce their vulnerability to hazards, passage of DMA 2000 helped Grayson County officials to recognize the benefits of a long-term approach to hazard mitigation, which achieves a gradual decrease of impacts associated through the implementation of a Hazard Mitigation Plan Grayson County's Multi-Jurisdiction Hazard Mitigation Plan represents the collective efforts of 16 participating jurisdictions, the general public, and stakeholders.

Organizing the Grayson County Hazard Mitigation Planning Effort

A comprehensive county approach was taken in developing the plan. An open public involvement process was established for the public, neighboring communities, regional agencies, businesses, academia, etc. to provide opportunities for everyone to become involved in the planning process and to make their views known. The meetings were advertised with notices in public places and by media press releases.

In accordance with Part 201.6(c)(5) of the Disaster Mitigation Act of 2000 (DMA 2000), Grayson County, Texas developed this Multi-Jurisdictional Hazard Mitigation Plan. This plan identifies hazards and mechanisms to minimize future damages associated with these hazards, which threaten Grayson County and its jurisdictions.

A Memorandum of Understanding was executed between Grayson County and the other sixteen participating jurisdictions. The purpose of this Memorandum of Understanding is to ensure that the mitigation action plan is consistent with cities' and county's policies and objectives and to outline the responsibilities of all parties. The Memorandum of Understanding identifies the work to be performed by the planning team, the cities, and the county. The Memorandum of Understanding and the adoption resolutions from all sixteen participating jurisdictions authorizing municipal government staff to carry out this plan is provided in Appendix A.

Existing Hazard Mitigation and Watershed Plans

Existing hazard mitigation information and watershed plans were reviewed during the development of the Hazard Mitigation Plan. Data was previously collected by the Cities of Sherman and Denison with the intent of developing a hazard mitigation plan for each individual jurisdiction. This information was evaluated and incorporated into the Grayson County Multi-Jurisdictional Hazardous Mitigation Plan. The mitigation actions proposed in the previous plans were re-evaluated based on existing conditions to determine their current suitability in the multi-jurisdiction hazard mitigation plan.

In addition, watershed plans were evaluated for the different watersheds in Grayson County. The watershed plans provide with a reconnaissance and preliminary investigation of the flood prone areas in each of the watersheds to identify floodwater, sediment, scour, and sediment damage potential. Recommended land treatment and structural measures to be implemented are provided

in each of the watersheds plans to address the issues. Most of the plans were originally developed back in the 60's or early 70's. Some of them were updated but more to reflect changes in sponsorship or increases in capacity or function for the different structural measures. Highlights of each of the plans are as follows:

Choctaw Creek Watershed – mainly impacting Sherman, Denison, Bells, Howe and Tom Bean. The work plan was developed in 1965 identifying land management and structural measures to be implemented to reduce the flooding problems over 11,527 frequently flooded acres within the watershed. The work plan was to be developed in a 7-year period. Benefits from the project were estimated back then at $473,269 annually in savings from reduced damages. The structural controls include 34 retarding structures, 7 multi-purpose structures, 20.87 miles of stream channel improvement, 7 grade stabilization structures, and 4.09 miles of drainage mains and laterals for drainage of 260 acres of wet land. The plan was supplemented in 1970 (to change one of the structures in Sherman to allow recreational amenities), 1971 (identification of requirements of displacements/relocations and the cost involved), in 1972 (Howe would not be a sponsor of the plan, one of the structures will not be constructed due to property owner wishes, and one site in Denison to be added capacity to serve for recreational purposes),and in 1993 (Bells no longer a sponsor of the plan (delete 4 multi-purpose facilities and delete 2 flood retarding structures, add 4 floodwater retarding structures, delete all the stream channel improvements, and delete all the drainage means and laterals). Three of the multi-purpose structures deleted in the plan were located in Sherman. The reasoning provided for the deletion was that alternate water sources not available during the preparation of the original plan would now meet the water and recreation needs more effectively than three multi-purpose structures. Based on this brief review that I conducted, although the latest supplemental is more recent than the original plan, the changes are more based on specific structures and measures set in place that had provided with a change in what was needed; or based on changes in the ability of players to sponsor the plan. The supplemental do not appear to re-assess the needs based on growth and development.

Pilot Grove Creek Watershed Work Plan and Environmental Assessment – mainly impacting the City of Tom Bean. The plan was developed in 1959 and further supplemented in 1971. The environmental assessment is provided for a retarding structure and channel work along the creek dating back to 1976.
East Fork above Lavon Watershed Work Plan and Environmental Assessment – mainly impacting Van Alstyne and Dorchester. The original plan developed in 1956 and further supplemented in 1963, 1971, and 2003. There are a couple of studies for a Dam Restoration project conducted in 2002 and 2003. The plan was to upgrade the dam to meet new safety criteria.

Sister Grove Creek Watershed Work Plan – mainly impacting Howe and Tom Bean. The plan was developed originally in 1956, and further supplemented in 1964 and 1971.
Little Elm and Laterals Watershed – mainly impacting an area East of Gunter. The plan was developed originally in 1957, and further supplemented in 1974.

Details of these plans were taken into consideration to determine the need to include some of the findings into the mitigation actions proposed for the Hazard Mitigation Plan.

Planning Committee

This Hazard Mitigation Plan was developed by the Grayson County Hazard Mitigation Planning Committee (Planning Committee), with support from outside consultants. The efforts of the Planning Committee were led by the Grayson County Emergency Management Coordinator. The Planning Committee was assembled in the summer of 2009 with representatives from all jurisdictions including, mayors, police chiefs, fire chiefs, and general public. AECOM USA Group, Inc. (AECOM) acted as the plan development consultant providing hazard mitigation planning services. The Table below provides a list of the primary entity representative for each jurisdiction on the planning team below. For a complete list of team members see *Appendix A.*

Hazard Mitigation Team – Primary Entity Representatives

Representing	Name and Contact Information
Grayson County	Sarah Somers, Grayson County's Hazard Mitigation Coordinator, somerss@co.grayson.tx.us
Grayson County, unincorporated areas	Don Burcham, dburc13@aol.com
City of Bells	Thomas Carter, City Mayor, twcarter1101@yahoo.com
City of Collinsville	Chief McKee, mckee702@mail.collinsvillefire.com
City of Denison	Gordan Weger, gweger@cityofdenison.com
City of Dorchester	David Smith, Mayor
City of Gunter	Mark Millar, Millar@ci.gunter.tx.us
City of Howe	Jeff Stanley, Mayor / Michael Jones, howetexas@msn.com
City of Knollwood	Elroy Noelke, City Mayor, noelke@knollwoodvillage.com
City of Pottsboro	Kevin Farley, City Manager, kfarley@totalnet.us
City of Sadler	John White, jno.white.803@verizon.net
City of Southmayd	Daniel F. Pepe, Mayor, dpepe@advantagestorage.net
City of Sherman	Theresa Caudle, theresac@ci.sherman.tx.us
City of Tioga	Paul Rodarmer, paul.rodarmer@gm.com
City of Tom Bean	Sherry Howard, Mayor, sherryhoward@cableone.net
City of Van Alstyne	Bill Herrington, City Manager, citymanager@ci.van-alstyne.tx.us
City of Whitesboro	Michael Marter, mmarter@whitesborotexas.com
City of Whitewright	Bill Goodson, Mayor, cityofww@skytex.net

Grayson County served as the coordinator and lead agency for all 17 jurisdictions, including the unincorporated areas of Grayson County, by accomplishing the following activities through the planning process:

1. Assigned the County's Emergency Management Coordinator to provide technical assistance and necessary data to the Planning Committee.
2. Scheduled, coordinated, and facilitated community meetings with the assistance of the Planning Committee.
3. Provided any necessary materials, handouts, etc. for public planning meetings.

4. Worked with the Planning Committee to collect and analyze data and develop goals and implementation strategies.
5. Prepared, based on community input and Planning Committee direction, the first draft of the plan and provided technical writing assistance for review, editing and formatting.
6. Coordinated with the stakeholders within the cities and the unincorporated areas of Grayson County during plan development.

Submitted the Multi-Jurisdictional Hazard Mitigation Plan to the State of Texas and provided follow up technical assistance to the Grayson County Community Mitigation Planning Committee to cure any noted deficiencies subsequent to the review of the plan by the State of Texas. After approval by the State of Texas, Grayson County will provide the following services as described below.

1. Submit the plan to FEMA and provide follow up technical assistance to the Grayson County Community Mitigation Planning Committee to cure any noted deficiencies subsequent to the review of the plan by FEMA.
2. Coordinated adoption and final approval process by all City Councils and the Commissioners Court of the approved FEMA plan.
3. Submit the final plan, with adoption documentation and approval signatures for all participating jurisdictions, to the State and FEMA and ensure plan is noted as completed and approved by both agencies.
4. Prepared for and attended City Council/Commissioners Court/public meetings during plan consideration and plan adoption process.

Each of the individual jurisdictions participated in accomplishing similar activities associated with development of the plan as follows:

1. Coordinated input from representatives of neighborhood stakeholder groups and provided a representative to the County Planning Committee.
2. Attended regular meetings of the planning team as coordinated by Grayson County.
3. Assisted Grayson County staff with identifying hazards and estimating potential losses from future hazard events.
4. Assisted Grayson County in developing and prioritizing mitigation actions to address the identified risks.
5. Assisted Grayson County in coordinating public meetings to develop the plan.
6. Identified the community resources available to support eh planning effort.
7. Assisted with recruiting participants for planning meetings, including the development of a community-wide mailing list and distribution of meeting announcements (as prepared by Grayson County) by mail and other available means.
8. Worked for the support of neighborhood stakeholders for the recommendations resulting from the planning process.

9. Submitted the proposed plan to all appropriate departments for review and comment and worked with Grayson County to incorporate the resulting comments into the proposed plan.

Subsequent to the State of Texas and FEMA approval of the plan, each jurisdiction also is committed to accomplishing the following activities:

1. Appoint members to a Coordinating Committee to monitor and work toward plan implementation.
2. Publicize the plan to neighborhood interests and ensure that new community members are aware of the plan and its contents.
3. Monitor progress in achieving the plan's goals through regular maintenance and implementation projects.

Planning Meetings

During the planning process, the Planning Committee met internally on a weekly basis to obtain relevant information from the participating jurisdictions and to discuss the objectives and progress of the plan. The Planning Committee also held monthly public meetings with AECOM throughout the plan development process. The objectives of these weekly and monthly public meetings were to gather information and to provide guidance for each jurisdiction throughout the planning stages. Public meetings were held on May 14, July 16 and August 13, 2009. Meeting minutes and a list of attendees for these meetings are located in *Appendix A*. Documentation of the weekly planning meetings is available upon request.

On August 13, 2009, AECOM and the Planning Committee held an additional formal mitigation workshop where participants discussed mitigation priorities and were provided with guidance on how to identify effective hazard mitigation actions. Information gathered from this workshop and other meetings was incorporated into this plan.

From September 2009 through October of 2010, the county and city representatives worked within their jurisdiction to further define the proposed mitigation action items and identify the parameters of each, including determination of local personnel having responsible for carrying out the proposed actions.

Public Involvement

Support from the community is vital for any successful hazard mitigation plan. The Planning Committee provided opportunities, announced through public communication means, for public participation and input throughout the planning process prior to this draft and before approval of the finalized Plan. Examples of input requested include the following:

- Second planning meeting held on June 16, 2009. The meeting was open to the public through public notice. Reporters from local Channel 10 (KTEN) and Channel 12 (KXII) filmed the meeting and aired a report on TV and internet. The report from Channel 10

news requested from input from the community regarding historical hazard events in the County via contact with Grayson County's Hazard Management Coordinator, Sarah Somers (*Appendix A*).

- Advertisement and request for public comment on this Hazard Mitigation Plan was published in a local newspaper on November 14, 2010, and public notice of a community meeting to receive comments and input was posted by the Grayson County Clerk on November 15, 2010 (*Appendix A*). The public meeting was held on November 18, 2010. A copy of the Plan was made available to the public from November 14, 2010 through December 14, 2010, at the Grayson County Office of Emergency Management in Sherman, Texas, and also online at www.co.grayson.tx.us

This provided all citizens, stakeholders, neighboring communities, agencies, businesses, academia, non-profit organizations, and all interested parties an opportunity to be involved in the planning process and to take part in the decisions making process that affect the future of the communities that they live in. Public notices for meetings were posted in communities to encourage citizens to participate in the planning process. Information on the development process, worksheets, and other supplemental information was posted on Grayson County web page.

Development of Mitigation Strategy

The preparation of the Hazard Mitigation Plan included the development of a risk assessment, vulnerability assessment, and capability assessment, which provided the basis for the adoption of a mitigation strategy appropriate for the communities. The process used for the development of the mitigation strategy is described in the following paragraphs.

Risk Assessment

A risk assessment was conducted to categorize and prioritize the type of hazards posing a risk to Grayson County. The purpose of this categorization was to provide with a quantifiable tool to determine the type of hazards to which Grayson County is mostly exposed and, thus requiring mitigation. The risk assessment conducted for Grayson County included:

- Researching a full range of natural hazards to identify those hazards that could affect the County.
- Identifying the location and extent of these hazards.
- Identifying the probability of occurrence for these hazards.
- Assessing vulnerabilities for these hazards.
- Identifying assets located within the hazard areas.
- Distinguish existing and potential future assets at risk.

Consistent with the State of Texas Hazard Mitigation Plan, nineteen natural hazards were identified in the State Plan for the development of the Grayson County's Multi-jurisdictional Mitigation Plan. Based on a ranking system developed to assess risk, of the nineteen hazards

evaluated, twelve were considered to pose a hazard to Grayson County. These hazard types include atmospheric, hydrologic, geologic, and other hazards listed below:

- Extreme Temperature
- Extreme Windstorms
- Hailstorms
- Lightning
- Severe Winter Storms
- Tornados
- Dam and Levee Failure
- Drought
- Floods
- Earthquakes
- Expansive Soils
- Wildfires

Vulnerability Assessment

A vulnerability assessment was conducted in order to identify and characterize property and population potentially at risk to the identified hazards. Based on the type of information available for analysis, Grayson County's multi-jurisdictional vulnerability assessment was conducted using two distinct methodologies, a Geographic Information System-based analysis and a statistical risk assessment methodology.

Capability Assessment

The capability assessment examines the ability of Grayson County and participating jurisdictions to implement and manage a comprehensive mitigation strategy. Capability survey questionnaires were distributed to the Grayson County Office of Emergency Management and to the Planning Committee in order to initiate this assessment. These capability assessments were distributed to the participating jurisdictions to request information pertaining to existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation actions including legal and regulatory capability, administrative and technical capability, and fiscal capabilities. The capabilities identified in this assessment are evaluated collectively to develop recommendations that are considered feasible given existing local conditions, which support the implementation of effective mitigation actions throughout Grayson County.

Mitigation Strategy

For the development of the mitigation goals, Grayson County took into consideration both state and jurisdictional needs. After considering these needs, the jurisdictions agreed on adopting the State's mitigation goals for their Multi-jurisdiction Hazard Mitigation Plan. Once the mitigation goals were adopted, a workshop open to the public was held on August 13, 2009. The purpose of the workshop was to present the jurisdictions and public with the different groups for which mitigation actions can be developed including: prevention, property protection, public education and awareness, natural resource protection and structural projects, as cited in the mitigation planning guideline. In addition to the categories, the attendants were introduced to the STAPLEE method, the technique for identifying, evaluating, and prioritizing mitigation actions based on existing local conditions as presented in FEMA's *Developing the Mitigation Plan* (FEMA 386-3) highlights. The mitigation actions worksheets requested information regarding the priority of the hazard, description of the mitigation action, cost-effectiveness, potential funding source, responsible party, implementation schedule, and effects on new and existing buildings. Each jurisdiction worked separately on the development of mitigation action, prioritizing each of them based on the perception of its cost-effectiveness.

Any questions or comments regarding this Multi-Jurisdictional Hazard Mitigation Plan for Grayson County, Texas can be obtained by contacting:

Sarah Somers
Emergency Management Coordinator
Grayson County, 100 W. Houston, Sherman, TX 75090
Phone: 903.813.4217
Fax: 903.893.5207
Somerss@co.grayson.tx.us

TABLE OF CONTENTS

FIGURES

TABLES

1 INTRODUCTION

Grayson County is susceptible to a number of different natural hazards that have potential to cause property loss, loss of life, economic hardship, and threats to public health and safety. Occurrence of natural disasters cannot be prevented, however hazard mitigation measures are efforts taken before a disaster happens to minimize the impact that future disasters will have on people and property in the community.

Grayson County Multi-Jurisdictional Natural Hazard Mitigation Plan has been developed by the Grayson County Hazard Mitigation Planning Committee, with support from outside consultants at AECOM USA Group, Inc (AECOM). The plan represents collective efforts of citizens, elected and appointed government officials, business leaders, volunteers of non-profit organizations, and other stakeholders.

Through the development of this plan, the Planning Committee has identified the natural hazards that could affect Grayson County, and has evaluated the risks associated with these hazards. The implementation of this plan will make Grayson County more disaster-resistant because the benefits that can be gained by planning ahead and taking measures to reduce damages before the next disaster strikes have been recognized. The plan will allow Grayson County and participating jurisdictions to comply with the Disaster Mitigation Act of 2000 (DMA 2000) and its implementing regulations 44 CFR Part 201.6, thus resulting in eligibility to apply for Federal aid for technical assistance and post-disaster hazard mitigation project funding.

1.1 JURISDICTIONS AND GEOGRAPHY

Grayson County is located in the North Texas region approximately 60 miles north of Dallas (*Figure 1.1*). The northern portion of the County is bordered by Lake Texoma and the Red River, dividing Grayson County from the state of Oklahoma. Cooke County is adjacent west, Denton County borders the southwest portion of the county, Collin County is adjacent south, and Fannin County is adjacent east of Grayson County.

Figure 1-1 Grayson County

Source: Texas National Resource Inventory

Grayson County is integrated by 16 jurisdictions; Bells, Collinsville, Denison, Dorchester, Gunter, Howe, Knollwood, Pottsboro, Sadler, Sherman, Southmayd, Tioga, Tom Bean, Van Alstyne, Whitesboro, and Whitewright (*Figure 1.2).*

Water Resources

Grayson County lies within the Red and the Trinity River Basins. The county is located within the Elm Fork Trinity, Bois D'Arc Island, Lake Texoma, and the East Fork Trinity watersheds. The Lake Texoma watershed occupies the northwest quarter of the county, while the Bois D'Arc Island watershed is located on the northeast quarter. The Elm Fork Trinity watershed is located

on the southwest portion, and the East Fork Trinity watershed occupies the lower southeast portion. Grayson County is underlain by the Trinity Aquifer.

Major waterways that assist in the drainage of the area include the Big Mineral Creek and Mustang Creek, which flow north- northeast into Lake Texoma. The Choctaw, Mill, and Iron Ore creeks flow east- northeast and eventually merge with the Trinity River, slightly northeast of Grayson County. The Buck, Range, and Jordan creeks flow southwest into Lake Ray Roberts, located in the southwest corner of the county. The lower southeast portion of Grayson County drains southbound into Sister Grove Creek, Pilot Grove Creek, and the East Fork of the Trinity River.

Lake Ray Roberts Reservoir is a 41,303-acre body of water formed by a dam on the Elm Fork of the Trinity River and located across Denton, Cooke and Grayson Counties. Lake Texoma is a Red River impoundment on the Texas-Oklahoma border, in the northern portion of the county. Both reservoirs contain designated wildlife management areas and are managed by the United States Army Corps of Engineers. Other reservoirs in Grayson County include Randell and Valley lakes.

Figure 1.3 is a visual representation of the major watershed features in Grayson County.

Physiography and Geology

Grayson County's territory is composed of 934 square miles with an elevation ranging from 600 to 800 feet above sea level. The county is made up of two major physiographic regions, Oakwoods & Prairies in the northern half, and Blackland Prairie in the southern portion.

The Oakwoods & Prairies ecoregion is characterized by post oak savannahs with rolling to hills and clay pan soils. Tall grasses and scattered oaks are commonly found in this region. The Blackland prairie ecoregion is underlain by Upper Cretaceous chalks, marls and limestone which yield high alkalinity soils making them ideal for cropland, grazing and agricultural use. Common trees that inhabit this region include pecan, cedar elm, various oaks and mesquite.

1.2 DEMOGRAPHICS

According to the 2000 U.S Census, the county has a total population of 110,595 *(Table 1.1)* with a 7.4% increase from April 2000 to July 2008. The population density per square mile is 55.

Table 1.1 Population for Grayson County

City	Population
Grayson County	35,561
Bells	1,288
Collinsville	1,072
Denison	22,510
Dorchester	70
Gunter	1,123
Howe	2,455
Knollwood	282
Pottsboro	1,435
Sadler	382
Sherman	34,457
Southmayd	736
Tioga	693
Tom Bean	903
Van Alstyne	2,502
Whitesboro	3,611
Whitewright	1,709

Source: Texas Hazard Mitigation Plan

There were an estimated 42,849 households in 2000, with an average of three people per household. In 2007, the median household income was reported to be $44,392 with 12.7% of households living below the federal poverty levels. The population of individuals in the labor force in 2000 was 53,380. Leading industries that employ the labor force include educational, health and social services, manufacturing, and retail trade.

Small and Impoverished Communities.

The definition of "small and impoverished communities," as relevant to hazard mitigation planning, is provided in Chapter 44, Code of Federal Regulations, Part 201 (44 CFR § 201.2). The identification of "small and impoverished communities" for the purpose of mitigation planning is related to such a community receiving special consideration in meeting the requirements for a mitigation plan (44 CFR § 201.6(a)(3)).

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.

Census data was analyzed, per jurisdiction, based on population size, per capita income, and unemployment statistics. As a result of these observations, no small and impoverished communities are identified in Grayson County.

According to the Handbook of Texas Online, sponsored by the Texas Historical Association, Grayson County has become a distribution and trade center for North Texas and southern Oklahoma, with manufacturing and agriculture playing essential roles in the local economy. In 2002, the county had 2,597 farms and ranches covering 441,246 acres, 53 percent of which were devoted to cropland and 40 percent to pasture. In that year farmers and ranchers in the area earned $41,865,000, livestock sales accounted for $21,857,000 of the total. Beef cattle, wheat, nurseries and turf, forage, and horses were the chief agricultural products. Major stakeholders in the local economy in Grayson County include Tyson foods, Inc. and Texas Instruments.

1.3 MAJOR INFRASTRUCTURE

Major roadways in Grayson County include:

U.S. Highway 75	State Highway 56
U.S. Highway 82	State Highway 503
U.S. Highway 69	State Highway 289
U.S Highway 37	State Highway 160

According to the Texas Hazard Mitigation Package, there are 422 bridges in Grayson County (*Figure 3.5*). There are two publicly owned airports in Grayson County, Sherman Municipal Airport, and North Texas Regional Airport – Perrin Field. Fifteen privately owned airport facilities are scattered throughout the county.

Public Water and Sewer

There are 36 water treatment facilities (wells, tanks, water towers, and treatment plants) throughout the county. In addition to these facilities, there are 16 wastewater treatment operations dispersed throughout the county. Lake Texoma and Lake Ray Roberts are two major water reservoirs in the county. Figure 3.4 provides a visual overview of the critical infrastructure in Grayson County.

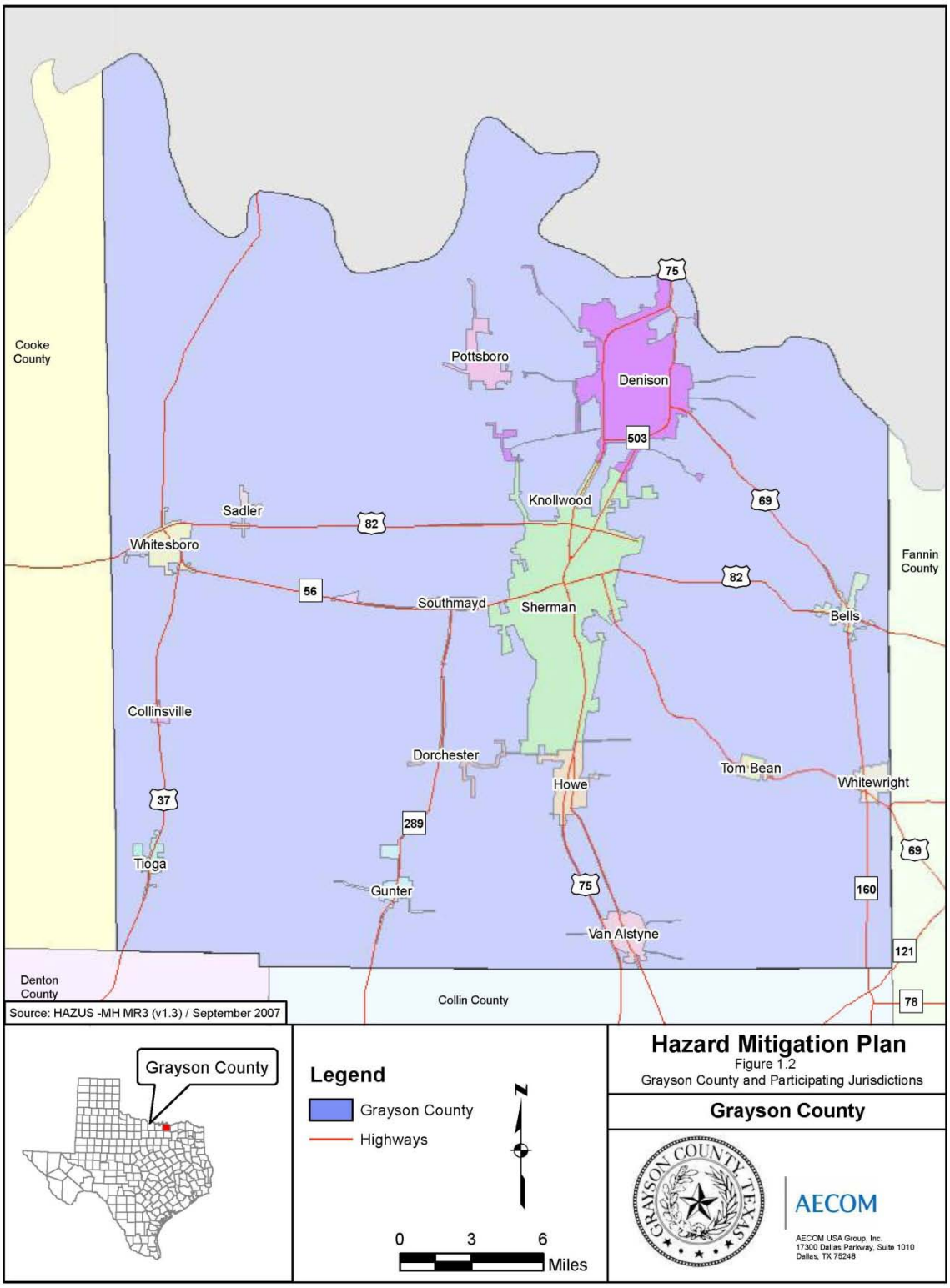
1.4 FEMA DISASTER DECLARATIONS

When a disaster occurs, local government officials may determine that the effort needed for recovery appears to be beyond the combined resources of both the state and local governments and that federal assistance may be required. FEMA then manages the process investigating to determine the need for federal aid and makes a recommendation to the president for supplemental assistance. Disaster declarations are affirmed by the president of the United States under The Robert T. Stafford Disaster relief and Emergency Assistance Act. Forms of assistance include response efforts, emergency resources, and public and individual assistance programs. *Table 1.2* provides a list of previous Presidential Disaster declarations where Grayson County was indicated as part of the declared disaster area.

Table 1.2 Presidential Disaster Declarations that include Grayson County

Year	Date	Disaster Number	Disaster Type	Assistance
1981	29-Oct	648	Severe Storms & Flooding	Individual Assistance, Public Assistance
1989	8-Jun	828	Severe Storms, Tornadoes & Flooding	Individual Assistance, Public Assistance
1990	2-May	863	Severe Storms, Tornadoes & Flooding	Individual Assistance
2001	12-Dec to 15-Jan	1356	Severe Winter Ice Storm	Public Assistance
2007	18-Jun	1709	Severe Storms, Tornadoes & Flooding	Individual Assistance, Public Assistance

Source: Federal Emergency Management Agency: Texas Disaster History- April 2009


Cooke County
Pottsboro
Denison
75
503
Knollwood
69
Sadler
82
Whitesboro
Fannin County
56
Southmayd
Sherman
82
Bells
Collinsville
Dorchester
Tom Bean
Howe
Whitewright
37
289
69
Tioga
Gunter
75
160
Van Alstyne
121
Denton County
Collin County
78
Source: HAZUS -MH MR3 (v1.3) / September 2007
Grayson County
Legend
Grayson County
Highways
N
0 3 6
Miles
Hazard Mitigation Plan
Figure 1.2
Grayson County and Participating Jurisdictions
Grayson County
GRAYSON COUNTY TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

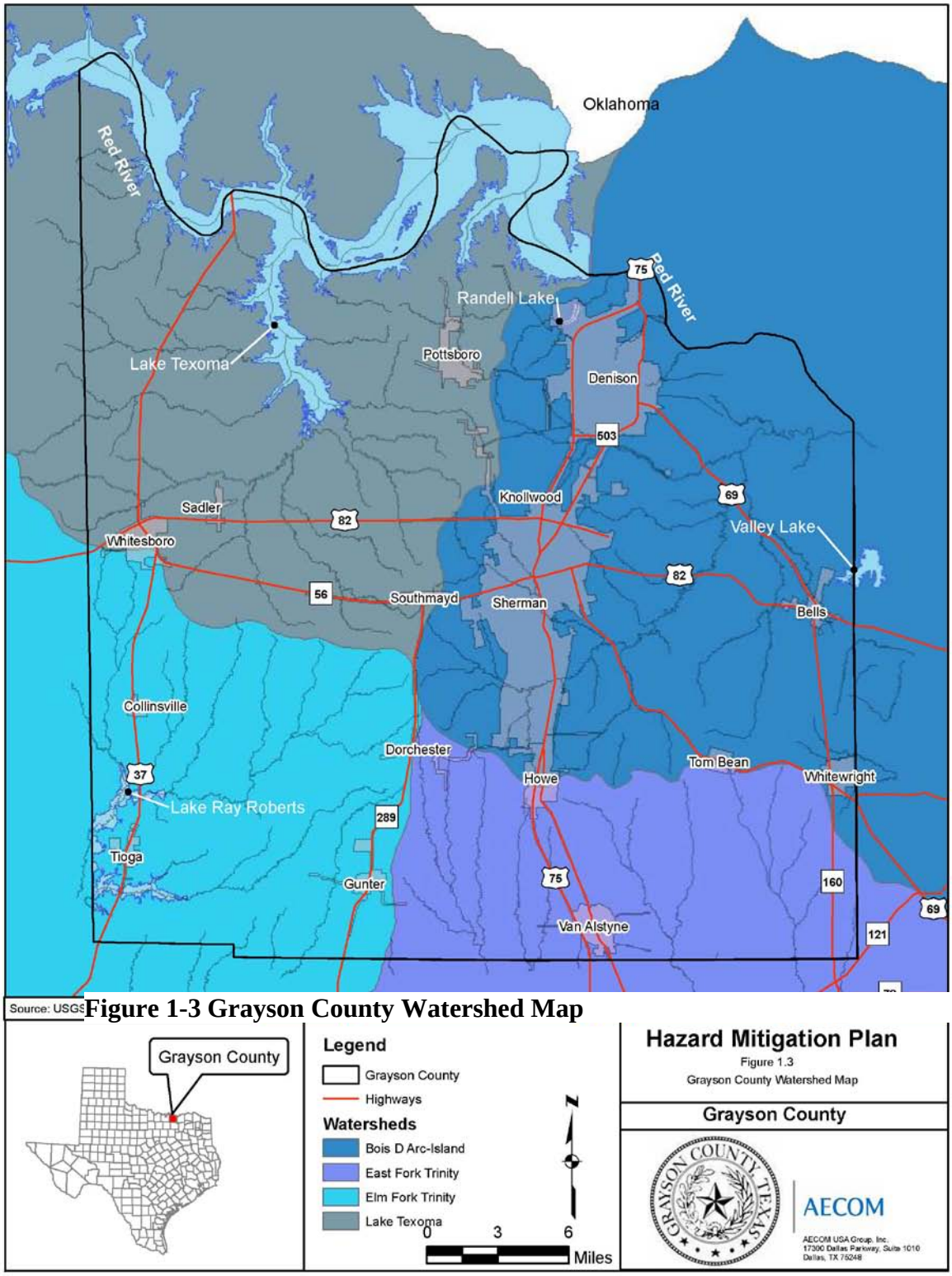


Figure 1-3 Grayson County Watershed Map

2 IDENTIFICATION OF POTENTIAL HAZARDS

Following the Federal Emergency Management Agency regulations and guidelines, a full range of natural hazards were screened for the development of Grayson County Hazard Mitigation Plan. Using the State of Texas Hazard Mitigation Plan, and the Mitigation Plan Review Crosswalk, 19 hazards were selected for further consideration in the development of the Hazard Mitigation Plan (*Table 2.1*).

Table 2.1 Summary of Hazard Events

ATMOSPHERIC	**GEOLOGIC**
√ Avalanche	√ Earthquake
√ Extreme Temperature	√ Expansive Soils
√ Extreme Wind	√ Landslide
√ Hailstorm	√ Land Subsidence
√ Coastal Storm , Hurricane and Tropical Storm	√ Tsunami
√ Lightning	√ Volcano
√ Severe Winter Storm	
√ Tornado	
HYDROLOGIC	**OTHER**
√ Coastal Erosion	√ Wildfire
√ Dam and Levee Failure	
√ Drought	
√ Flood	

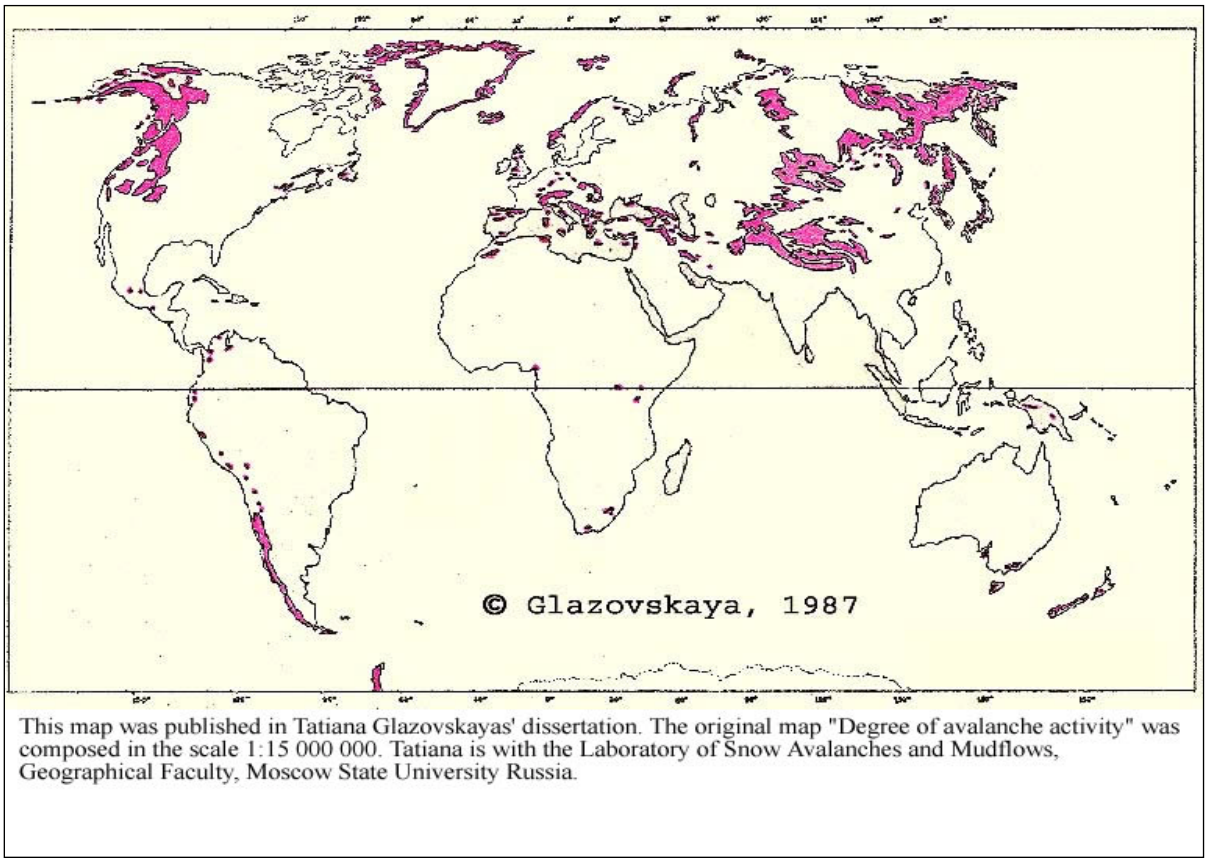
Further evaluation and profiling of each hazard was conducted in the Risk Assessment presented later in this Section. The hazard profiling identifies the location and extent of the natural hazard, summarizes recorded historical events (regional and local), and determines the probability for the natural hazard to occur in Grayson County and its 16 participating jurisdictions. Generally, those hazards which occur less than one year in a 100-year period (or have a likelihood of occurrence of less than 1%) are considered unlikely or of a **low** probability. Hazards that have an occurrence probability of between 1-10 % are considered to be possible and of **medium** probability, while hazards with an annual probability between 10-100 % are likely and have a **high** probability of reoccurrence. Information obtained from the National Climatic Data Center may represent regional losses in which Grayson County is included. Additionally, detailed maps are provided at the end of Section 3, which illustrate relevant data for each jurisdiction and for all of Grayson County regarding many of the hazards.

2.1 DESCRIPTION – AVALANCHE

According to the U.S. Forest Service National Avalanche Center, an avalanche is described as a mass of snow sliding, tumbling, or flowing down an inclined surface. Characterized by three different types, avalanches range from; slab avalanche, loose, and wet avalanches. Avalanches most often occur on slopes steeper than 30 degrees and have unstable snowpack.

Location and Extent – Avalanche

Figure 2.1 represents "Degree of avalanche activity" provided by the USFSNAC, Grayson County is not located in an area with any degree of avalanche activity, and is not mentioned in the State of Texas Mitigation Plan.



This map was published in Tatiana Glazovskayas' dissertation. The original map "Degree of avalanche activity" was composed in the scale 1:15 000 000. Tatiana is with the Laboratory of Snow Avalanches and Mudflows, Geographical Faculty, Moscow State University Russia.

Figure 2-1 "Degree of Avalanche Activity"
Source: U.S. Forest Service National Avalanche Center

Probability of Occurrence – Avalanche

The topography and climate in Grayson County would not support conditions needed for an avalanche to occur. Therefore, the probability of occurrence for this hazard event is no risk and this hazard event in not ever expected to occur in Grayson County.

2.2 DESCRIPTION – EXTREME TEMPERATURES

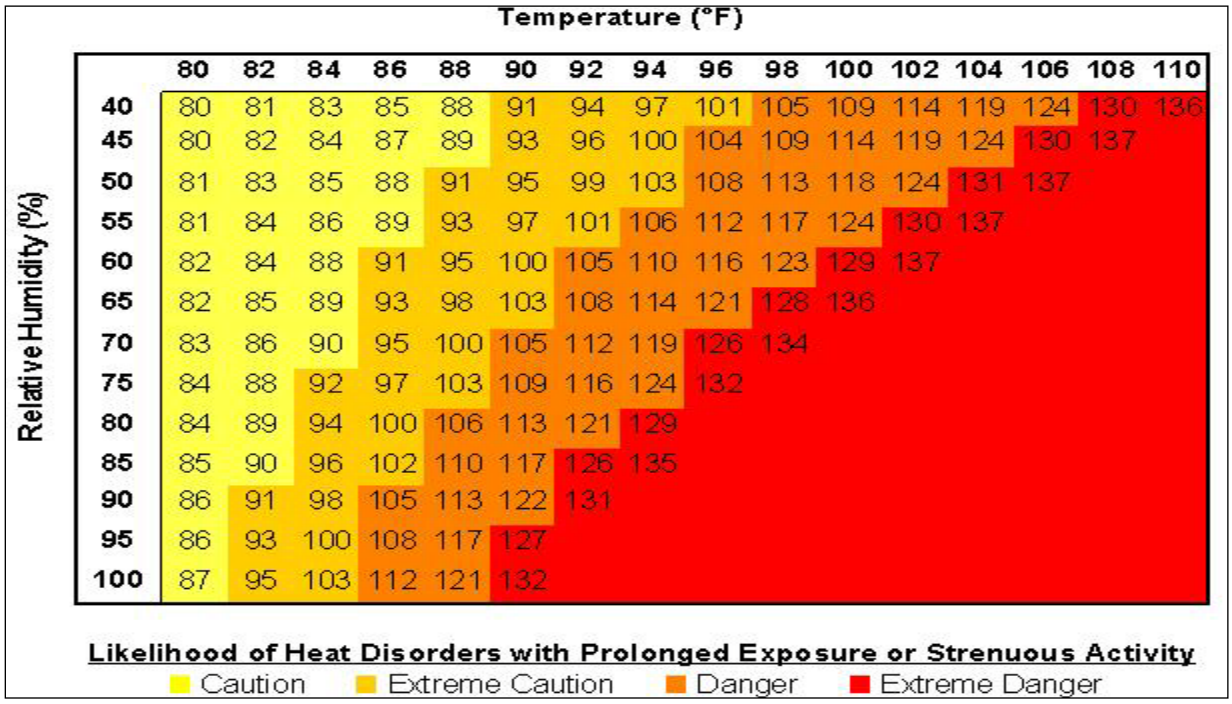
Extreme temperatures primary threat is to human life and health. Livestock, agricultural crops, and occasional threat of property and infrastructure, are also impacted by extreme temperatures.

Extreme Heat – Extreme Temperatures

Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region lasting for several weeks. According to the National Oceanic and Atmospheric Administration (National Oceanic Atmospheric Administration), heat is the number one weather-related killer. On average, more than 1,500 people in the U.S. die each year from excessive heat. This number is greater than the 30-year mean annual number of deaths due to tornados, hurricanes, floods and lighting combined. Young children, elderly people, and those who are sick or overweight are more likely to become victims of extreme heat. When heat waves are accompanied by drought conditions, agricultural loss can be high.

The National Weather Service bases their guidance on the "Heat Index" (HI). *Table 2.2* is used to measure how hot it feels when relative humidity is factored into the actual air temperature. The National Weather Service will initiate alert procedures when the HI is expected to exceed 105°- 110° for at least two consecutive days.

Table 2.2 National Weather Service "Heat Index"



Source: National Oceanic Atmospheric Administration

Extreme Cold – Extreme Temperatures

Extreme cold is defined as temperatures that drop significantly below normal. Extreme cold can bring on dangerous situations that lead to health emergencies for those individuals who are more susceptible to cold conditions. Poorly insulated homes or people without shelter are at risk. People exposed to extreme cold conditions are prone to health risks including hypothermia and frostbite. Extreme cold conditions often accompany severe winter storms that cause power outages, creating extremely dangerous situations for those relying on electricity for heat. Other potential impacts of extreme cold include property damage caused by pipe freezes and ruptures, and agricultural losses when temperatures remain below the freezing point for long durations of time.

Location and Extent – Extreme Temperatures

Grayson County is located in a region that is highly susceptible to extreme heat and occasional extreme cold temperatures. During periods of extreme temperature conditions, the effects will be felt over widespread geographic areas, and it is generally assumed that Grayson County and all of its municipalities are uniformly exposed to any extreme heat and extreme cold events occurring within the region.

Historical Occurrences – Extreme Temperatures

According to the National Climatic Data Center, five-recorded extreme heat and one recorded extreme cold event have affected Grayson County from 1997 to 2000. These incidents resulted in a reported 53 deaths in Grayson County. Notable extreme temperature events include those described in the following paragraphs.

April 13, 1997
"An unusually strong arctic cold front moved into North Texas on the 11th, setting the stage for a night of strong radiational cooling as high pressure built into the southern plains behind the front. Clear skies combined with light winds and a dry atmosphere to produce temperatures in the mid 20s to lower 30 across much of the area on the morning of the 12th. Even colder readings were realized on the morning of the 13th. The last freeze of the season usually occurs in mid to late March in northern Texas and this month's freeze was one of the latest on record. Unfortunately, mild late winter and early spring weather resulted in an early start to the growing season. The extended period of below freezing temperatures and a heavy frost over the two day period took a tremendous toll on the area's agriculture. The fruit crop, including melon, peach, cantaloupe, plum, and apricot, as well as the vegetable crop, took a 75 to 90 percent loss in several counties in the northwestern portion of the area."

July 1, 2000
"An unusually strong upper level ridge of high pressure built over North Texas early in the month. This allowed afternoon high temperatures to climb into a range from the upper 90s to around 106 degrees for most of the month. The heat and humidity was particularly bad during the period from the 12th through the 21st, when afternoon highs

were over 100 degrees. At the D/FW Airport, the average high during that ten day period was 103.3 degrees F, with the highest temperature of 106 degrees occurring on the 16th. Overnight lows during that period also contributed to discomfort and stress, as they ranged from the upper 70s to the lower 80s. The combination of prolonged exposure to the high heat and humidity contributed to the deaths of several people in Dallas County. Most of the heat related deaths were among the elderly. The heat was oppressive across the rest of North Texas, but no other heat deaths were reported."

September 1, 2000

"Excessive Heat a strong ridge of high pressure remained over the region, bringing record heat to Texas for the month of September, and the hottest weather of the summer. Temperatures reached 111 degrees at DFW Airport on September 4, which set the all-time record for the month of September. Daily records were set over North Texas during the first 4 days of September. The cooperative stations had September high temperatures ranging from 108 degrees at Emory to 114 degrees at Possum Kingdom Lake."

A complete list of these events are provided in Appendix B

Probability and Extent of Occurrence – Extreme Temperatures

Extreme temperature events will remain a very frequent occurrence in Grayson County, and the probability of future occurrences in Grayson County is high. Although both extreme heat and extreme cold events are certain occurrences, the probability for extreme heat is much higher. For estimating severity and planning mitigation actions for extreme temperatures, the following range has been used:

- Extreme Heat – exceeds 127 – 130° F for three days.
- Extreme Cold – below 0° F for three days.

2.3 DESCRIPTION – EXTREME WINDSTORM

Defined as the motion of air relative to the earth's surface, extreme wind is commonly associated with severe thunderstorm winds which exceed over 58 miles per hour (mph), tornados, hurricanes, tropical storms, and nor'easters (addressed individually in this section). Extreme winds, often referred as windstorms, can also occur with the absence of these definable hazards, and occur suddenly without warning.

Extreme winds typically occur when large air masses of varying temperatures meet. Rapidly rising moist air serves as the ignition for tornados, thunderstorms, and various windstorm events. According to the National Oceanic Atmospheric Administration National Severe Storms Laboratory, damage from severe thunderstorm winds account for half of all severe reports in the lower 48 states and is more common than damage from tornados. Damaging winds are classified as those exceeding 50-60 mph

Extreme winds pose a threat to lives, property, and infrastructure through direct wind force, and to flying debris such as rocks, lumber, fuel drums, sheet metal, and loose materials that can be picked up by wind and hurled with great force.
As listed in *Table 2.3* there are seven types of damaging winds.

Table 2.3 Damaging Winds

Type of Wind	Description
Straight-line winds	A term used to define any thunderstorm wind that is not associated with rotation, and is used mainly to differentiate from tornado winds.
Downdrafts	A small-scale column of air that rapidly sinks toward the ground. A downburst is a result of a strong downdraft.
Downbursts	A strong downdraft with horizontal dimensions larger than 4 kilometers (km) (2.5 miles (mi)) resulting in an outward burst or damaging winds on or near the ground. (Imagine the way water comes out of a faucet and hits the bottom of the sink.) Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
Microbursts	A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally small (less than 4km across) and short-lived, lasting only 5-10 minutes, with maximum windspeeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.

Gust front	A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
Derecho	A derecho is a widespread thunderstorm wind event caused when new thunderstorms form along the leading edge of an outflow boundary (a surface boundary formed by the horizontal spreading of thunderstorm-cooled air). The thunderstorms feed on this boundary and continue to reproduce themselves. Derechos typically occur in the summer months when complexes of thunderstorms form over the plains and northern plains states. Usually these thunderstorms produce heavy rain and severe wind reports as they rumble across several states during the night. The word "derecho" is of Spanish origin and means "straight ahead." They are particularly dangerous because the damaging winds can last a long time and can cover such a large area.
Bow Echo	A radar echo that is linear but bent outward in a bow shape. Damaging straight-line winds often occur near the "crest" or center of a bow echo. Bow echoes can be over 300 km in length, last for several hours, and produce extensive swaths of wind damage at the ground.

Table 2.4 illustrates the scales, severity, and typical effects of various wind speeds for extreme wind events.

Table 2.4 Severity and Typical Effects of Various Wind Speeds

Maximum Wind Speeds (mph)	Equivalent Saffir-Simpson Scale* (Hurricanes)	Equivalent Fujita Scale* (Tornadoes)	Severity	Typical Effects
40-72	Tropical Storm = 39-73 mph	F0	Minimal	Some damage to chimneys; breaks twigs and branches off trees; pushes over shallow-rooted trees; damages signboards; some windows broken.
73-112	Cat. 1 = 74-95 mph Cat. 2 = 96-110 mph Cat. 3 = 111-130 mph	F1	Moderate	Peels surfaces off roofs; mobile homes pushed off foundations or overturned; outbuildings demolished; moving autos pushed off the roads; trees snapped or broken.

Maximum Wind Speeds (mph)	Equivalent Saffir-Simpson Scale* (Hurricanes)	Equivalent Fujita Scale* (Tornadoes)	Severity	Typical Effects
113-157	Cat. 3 = 111-F3130 mph Cat. 4 = 131-155 mph Cat. 5 = 155+ mph	F3	Considerable	Roofs torn off frame houses; mobile homes demolished; frame houses with weak foundations lifted and moved; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
158-206	Cat. 5 = 155+ mph	F4	Severe	Roofs and some walls torn off well constructed houses; trains overturned; most trees in forests uprooted; heavy cars lifted off the ground and thrown; weak pavement blown off roads.
207-260	Cat. 5 = 155+ mph	F4	Devastating	Well-constructed homes destroyed; structures with weak foundations blown off some distance; cars thrown and disintegrated; large missiles generated; trees uprooted and carried some distance away. The maximum wind speeds of hurricanes are not likely to reach this level.
261-318	N/A	F5	Incredible	Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 300 feet; trees debarked; incredible phenomena will occur.
319+	N/A	N/A	Inconceivable	The maximum wind speeds of tornadoes are not expected to reach this level.

Source: National Oceanic and Atmospheric Administration
Note: *The Saffir-Simpson Scale and Fujita Scale are described further in the Hurricanes and Tornados sections

Location and Extent – Extreme Windstorm

Extreme wind events are experienced in every region of the United States, *Figure 2.2* illustrates various wind zones throughout the country and are established on design wind provided by the American Society of Civil Engineers. The country is divided into four wind zones, representing frequency and magnitude of potential extreme wind events (severe thunderstorms, tornados, and hurricanes). This figure shows that Grayson County is located within Zone IV and is susceptible to wind speeds of 250mph.

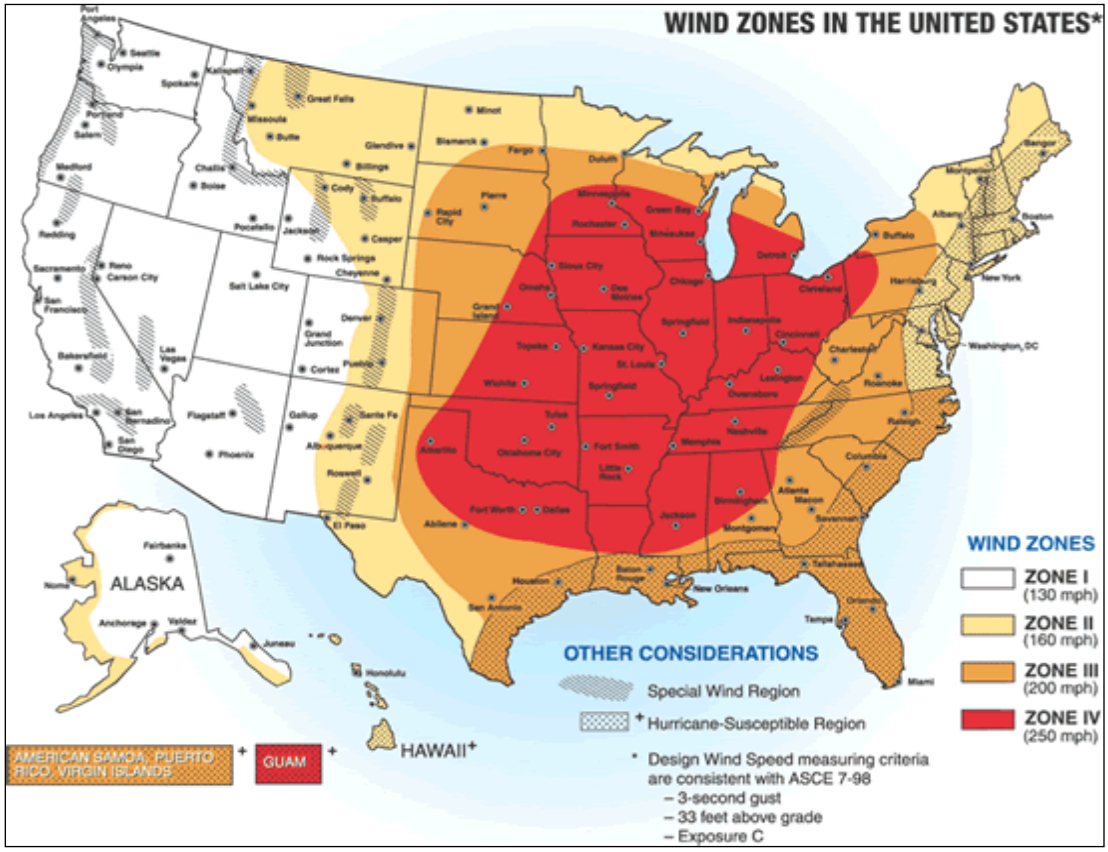


Figure 2-2 Wind Zones in the United States
Source: Federal Emergency Management Agency

Historical Occurrences- Extreme Windstorm

Grayson County has experienced numerous types of damaging extreme wind events in the past, which include severe thunderstorms. According to the National Climatic Data Center, 235 recorded high wind events have affected Grayson County during the period examined from 1957 through 2009(data only includes thunderstorm and high windspeeds). These wind events have resulted in a reported total of nine injuries in Grayson County, and caused an estimated $1.93 million in property damages. Some recent notable events occurring in Grayson County, as recorded by the National Climatic Data Center, are described in the following paragraphs.

April 7, 2002

"The damage path extended from the county line 5 miles ENE Pilot Point to near Gunter. The straight line winds reached peak intensity on Martin Road were some farms were damaged. Outbuildings were destroyed; there was also minor damage to mobile homes. Several barns were heavily damaged, with some damage to fences and chimneys."

August 13, 2002

"A storage shed was destroyed when a tree was blown down on it, and a mobile home was destroyed when it was blown into another mobile home. There were numerous reports of trees blocking roads and streets."

September 28, 2005

"The roof of a bookstore caved in and the front windows were all blown out at the intersection of North Grand and Texoma Parkway. A portable building blew across U.S. 75, leaving a trail of debris on both service roads and the north and southbound traffic lanes. Signs along U.S. 75 blew down near Washington Street. A tree fell on and destroyed a sunroom at a residence on McGee Street. Power lines were blown down across the city."

February 27, 2007

"Hundreds of power lines, trees, and other structures were blown down by high winds, which were between 20 to 30 MPH sustained and gusted between 50 and 60 MPH for hours. In addition, signs and fences were blown down and shingles were blown off roofs. About 40,000 businesses and residents in the county were without power by mid-afternoon. Other wind damage occurred at a still-under-construction indoor practice facility at Texas Christian University. Two high school track students were injured when a first-aid table became airborne at a meet and hit them. Fires were also a problem, as the winds sparked electrical equipment and arcing power lines fell onto structures and grass. Small grassfires became large blazes due to the winds. Visibilities dropped as low as one mile at Dallas/Fort Worth International Airport as a cloud of dust overspread the region. The dust cloud was clearly visible by satellite and was estimated to be 400 miles long, 70 miles wide, and about 18,000 feet high. Operations were suspended at area airports due to the strength of the wind. A strong low pressure system in Kansas caused winds behind a dryline to blow between 20 and 40 MPH sustained, with gusts into the 50 to 60 MPH range, bringing with them a huge cloud of dust. Operations were suspended at area airports due to the strength of the wind. Widespread incidents of wind damage and fires sparked by arcing power lines were reported across much of North Texas. Visibilities dropped as low as one mile at Dallas/Fort Worth International Airport as the cloud of dust overspread the region. The dust cloud was clearly visible by satellite and was estimated to be 400 miles long, 70 miles wide, and about 18,000 feet high."

May 2, 1990

According to Presidential Disaster Declaration (#863), this event occurred in conjunction with flooding. Record of this event was listed on the National Climactic Data Center database; however, detailed information was not available.

June 18, 2007 – Presidential Disaster Declaration # 1709

"Trees were blown down in Pottsboro and Collinsville. An upper level low lingered in the area for several days. An unstable atmosphere helped kick off several rounds of showers and storms. Boundaries helped focus rainfall totals over the same areas...leading to flash flooding."

January 29, 2008

"Power lines and trees were blown down across the county, causing numerous power outages. A building in the Bonham town square was damaged when the single-story addition was torn off the back of it. There were dozens of reports of damage due to strong winds as a powerful low pressure system and cold front moved through the state."

A complete list of these events are provided in Appendix B

Probability and Extent of Occurrence – Extreme Wind

Extreme wind events will remain a very frequent occurrence in Grayson County. Based on the geographic location and the frequency of past events, probability of future occurrences in Grayson County is very high. The entire planning area is susceptible to a wide variety of recurring events that cause extreme wind conditions. For planning purposes, Zones IV with winds exceeding 250 mph has been used for estimating damages and planning mitigation actions in the future.

2.4 DESCRIPTION – HAILSTORM

Hail can be described as frozen precipitation formed in storm clouds when updrafts transport raindrops upward into extremely cold areas of the atmosphere. The hail falls when the clouds are no longer able to carry its weight. *Table 2.5* below shows The Tornado and Storm Research Organization Hailstorm Intensity Scale.

Table 2.5 Tornado and Storm Research Organization Hailstorm Intensity Scale

Intensity Category		Typical Hail Diameter (mm)	Typical Damage Impacts
H0	Hard Hail	5	No damage
H1	Potentially Damaging	5-15	Slight general damage to plants, crops
H2	Significant	10-20	Significant damage to fruit, crops, vegetation
H3	Severe	20-30	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-40	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-50	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-60	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-75	Severe roof damage, risk of serious injuries
H8	Destructive	60-90	Severe damage to aircraft bodywork
H9	Super Hailstorms	75-100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: The Tornado and Storm Research Organization

Location and Extent – Hailstorm

Since 1980, the United States has averaged 3,000 hailstorms a year, with four states accounting for 42% of the total: Texas with 500 events, Oklahoma 400 events, Kansas 400 events, and Nebraska 135 events. According to National Oceanic Atmospheric Administration, damage from hail approaches $1 billion in the US each year. Buildings, vehicles and crops can all be damaged by hail. Citizens can avoid damage to their property by using roofing materials that are more resistant to hail damage. According to the State of Texas Mitigation Plan, Texas officials

estimate that up to 40 % of all homeowners' insurance claims in Texas result from hail damage. Within Grayson County, the entire County jurisdiction is susceptible to significant property damages from frequent and intense hailstorms.

Historical Occurrences – Hailstorm

According to the National Climatic Data Center, there are 213-recorded hailstorms in Grayson County from January 1, 1950 to February 28, 2009. There were no reported deaths or injuries associated with the recorded storms. These incidents resulted in a total of $30,375,000 in property damage. Descriptions of recent notable events are provided in the following paragraphs.

> **May 7, 2008**
> *"A cold front and bulging dryline moved into north Texas during the afternoon hours as an upper level low pressure system moved from west Texas into Oklahoma. Numerous severe storms were the result with several reports of severe hail and wind damage. A cyclic supercell produced three tornadoes in Robertson County."*
>
> **April 28, 2006**
> *"Baseball to teacup-size hail reported. A total of $30,000 in property damage was reported. There we no injuries, fatalities or crop damages reported."*
>
> **March 30, 2006**
> *"Golf ball to baseball-size hail reported. A total of $10,000 in property damage was reported. There were no injuries, fatalities or crop damages reported."*

A complete list of these events is provided in Appendix B and, as expected, shows the location of historic hailstorms to be widespread throughout the County and impacting almost all jurisdictions within the County.

Probability and Extent of Occurrence – Hailstorm

The probability of future hailstorm occurrences in Grayson County is high. According to the National Climatic Data Center data, there has been at least one hailstorm reported in Grayson County each year since 1979. Given this regular frequency of occurrence, future hailstorm events will continue to cause significant property damages throughout Grayson County. Therefore, based on historical damaging occurrences of hailstorms and the probability of future occurrences, a Hailstorm Intensity Scale of H10 is anticipated to reoccur and has been used as the most severe storm to be expected and as the basis for planning mitigation actions.

2.5 DESCRIPTION – COASTAL STORMS, HURRICANE & TROPICAL STORM

Hurricanes and tropical storms are classified as cyclones and are developed by counter-clockwise circulation of winds around a low-pressure center in the Northern Hemisphere.
Latent heat from condensation of warm water is the key energy source for these storms.
The ingredients for a hurricane and tropical storm to form include a pre-existing weather disturbance such as warm tropical oceans, moisture, and relatively light winds aloft. If these conditions persist long enough, they can combine to produce the violent winds, waves, torrential rains, and floods, all of which are more thoroughly addressed as separate hazards within this section.

According to National Oceanic Atmospheric Administration's Atlantic Oceanographic and Meteorological Laboratory, specific terms are used to describe the progressive levels of this hazard event as show in *Table 2.6.*

Table 2.6 Progressive Levels of Coastal Storm

Name	Description
Tropical Disturbance	A discrete tropical weather system of apparently organized convection – generally 200 to 600 km (100 to 300 nmi) in diameter – originating in the tropics or subtropics, having a nonfrontal migratory character, and maintaining its identity for 24 hours or more. It may or may not be associated with a detectable perturbation of the wind field. Disturbances associated with perturbations in the wind field and progressing through the tropics from east to west are also known as easterly waves .
Tropical Depression	A tropical cyclone in which the maximum sustained wind speed (using the U.S. 1 minute average standard) is up to 33 knots (kn) (38 mph, 17 m/s). Depressions have a closed circulation.
Tropical Storm	A tropical cyclone in which the maximum sustained surface wind speed (using the U.S. 1 minute average standard) ranges from 34 kt (39 mph,17.5 m/s) to 63 kt (73 mph, 32.5 m/s). The convection in tropical storms is usually more concentrated near the center with outer rainfall organizing into distinct bands.
Hurricane	When winds in a tropical cyclone equal or exceed 64 kt (74 mph, 33 m/s) it is called a hurricane (in the Atlantic and eastern and central Pacific Oceans). Hurricanes are further designated by categories on the Saffir-Simpson scale. Hurricanes in categories 3, 4, 5 are known as Major Hurricanes or Intense Hurricanes.

Source: National Oceanic Atmospheric Administration

As a hurricane develops, the barometric pressure falls and winds increase. Hurricane intensity is further classifies by the Saffir-Simpson Scale (*Table 2.7*), which rates hurricane intensity in categories on a scale of 1 to 5, with category 5 being the most intense. Categories 3, 4, and 5 are classified as "major hurricanes." While hurricanes within this range only comprise only 20 % of total tropical cyclone landfalls, they account for over 70 % of the damage in the United States.

Table 2.7 Saffir-Simpson Scale for Hurricanes

Category	Maximum Sustained Wind Speed (mph)	Minimum Surface Pressure (Millibars)	Storm Surge (Feet)
1	74-95	Greater than 980	3-5
2	96-110	979-965	6-8
3	111-130	964-945	9-12
4	131-155	944-920	13-18
5	155 +	Less than 920	19 +

Source: National Oceanic and Atmospheric Administration

The National Oceanic Atmospheric Administration and Federal Emergency Management Agency has created a list that describes the damage expected according to the hurricane's category. These damages might also result from inland flooding associated with heavy rainfall, spawned tornados, and storm surge (*Table 2.8)*

Table 2.8 Hurricane Damage Classifications

Storm Category	Damage Level	Description of Damages
1	Minimal	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery and trees. Also, some coastal flooding and minor pier damage.
2	Moderate	Some roofing material, door and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings might break their moorings.
3	Extensive	Some structural damage to small residences and utility buildings, with a minor amount of curtain wall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain might be flooded well inland.
4	Extreme	More extensive curtain wall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain might be flooded well inland.
5	Catastrophic	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas might be required.

Location and Extent – Coastal Storms, Hurricane and Tropical Storm

The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and the Gulf of Mexico. According to National Oceanic Atmospheric Administration, an average of eleven tropical storms develops, with at least six of these storms becoming hurricanes each year. In an average 3-year period, roughly five hurricanes strike the US coastline killing approximately 50 to 100 people anywhere from Texas to Maine.

Hurricanes and tropical storms threaten the Atlantic and Gulf seaboard of the United States. While coastal areas are impacted directly, their impact is often felt hundreds of miles inland. Grayson County is located in a region of the country that is not susceptible to direct effects of hurricanes and tropical storms, but is affected by the hazards of extreme wind, flooding, and tornados associated with these storms. These hazards are covered independently within this plan. Grayson County is located sufficiently inland from the coast that it is only susceptible to dying hurricanes or the remnants of hurricanes which would be classified as tropical storms or tropical depressions typically below Category 1 with wind speeds below 40 MPH, and which would pose minimal direct threat for damages to the area. The indirect effects are covered independently within this plan under the discussion of hazards for extreme wind, flooding, and tornadoes and can impact the entire County and all jurisdictions.

Historical Occurrences – Coastal Storms, Hurricane and Tropical Storm

According to the National Climatic Data Center historical records, one recorded hurricane/tropical storm event affected Grayson County. This was recorded as a tropical depression with an estimated $5,000 in property damage. A description of this event as recorded by the National Climatic Data Center is provided below.

> **September 2, 2008**
> *"Sustained wind speeds over 20 MPH with gusts as high as 40 MPH were recorded in Sherman-Denison as T.D. Gustav passed to the east. Large limbs broke and fell onto power lines, causing power outages. The remnants of Hurricane Gustav moved through Louisiana and Arkansas causing gusty winds to spread across east Texas."*

Probability of Occurrence – Coastal Storms, Hurricane and Tropical Storm

Grayson County is not located on the coast and once a storm hits land, the storm event loses momentum. Based on the lack of past occurrences, the probability of future hurricane and tropical storm events for Grayson County is very low and the potential for damage is extremely low. The annual potential for occurrence of a damage-causing event in Grayson County is less than 1% and the direct damages are expected to be extremely low; consequently, this hazard has not been further evaluated.

2.6 DESCRIPTION – LIGHTNING

Lightning is a result from the buildup and discharge of electrical energy between positively and negatively charged areas within thunderstorms, creating a "bolt" when the buildup becomes strong enough. A flash of light occurs within the clouds or between the clouds and the ground.

Bolts of lightning can reach temperatures approaching 50,000° Fahrenheit. While lightning is mostly affiliated with thunderstorms, lighting often strikes outside of these storms, as far as 10 miles away from any rainfall. The Federal Emergency Management Agency states that an average of 300 people are injured, and 80 people are killed in the United States each year by lighting. Direct strikes have the power to cause significant damage to buildings, critical facilities, infrastructure, and ignition of wildfires, which can result in widespread damages to property.

Location and Extent – Lightning

According to the lightning flash density map for the years 1996-2000 provided by Vaisala's U.S. National Lightning Detection Network, Grayson County is located in a region of the country that is highly susceptible to lighting strikes (*Figure 2.3).*

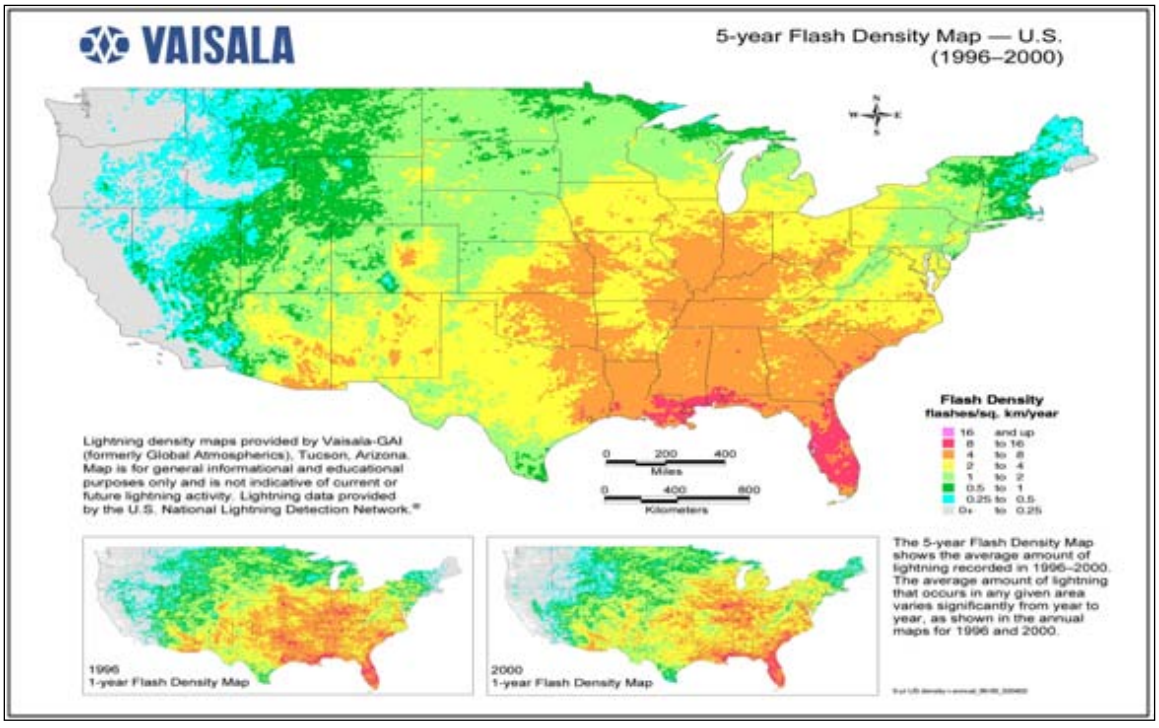


Figure 2-3 5-year Flash Density Map
Source: Vaisala's U.S. National Lightning Detection

All areas of Grayson County are equally susceptible to lighting strike. Grayson County is located in an area of the county that experiences about four lightning flashes per square kilometer per year (approximately 15,000 flashes countywide per year). While lightning occurs

randomly anywhere and anytime, the most common location for lighting fatalities and injuries to people is in open areas such as parks, beaches, golf courses, and other recreational areas.

Historical Occurrences – Lightning

According to the National Climatic Data Center, nine recorded lighting strike incidents have affected Grayson County since 1995. These incidents resulted in a reported $280,000 in property damages. Grayson County emergency management officials believe that lightning strikes resulting in property damage are under-reported and under-represented in these national statistics. Some recent notable events as recorded by the National Climatic Data Center are described in the following paragraphs.

> **August 6, 2006**
> *"Lightning struck a house and followed the electrical system inside. The house was a total loss, but firefighters were able to save some of the owners' possessions."*
>
> **June 6, 2004**
> *"Lightning set two oil storage tanks on fire."*
>
> **March 18, 2006**
> *"Lightning struck a radio antenna and ignited a fire in the attic of a Red Cross Building. Damage was mostly confined to the attic, where the fire destroyed wiring and electricity, as well as the roof of the building. Smoke and water damage also occurred inside the building."*

A complete list of these events is provided in Appendix B.

Probability of Occurrence – Lightning

The probability of occurrence of future lightning events in Grayson County is high. According to National Oceanic Atmospheric Administration, Grayson County is located in an area of the Country that experiences about four lightning flashes per square kilometer per year (approximately 15,000 flashes countywide per year). Given this regular frequency of occurrence, future lightning events will continue to threaten life and cause property damages throughout Grayson County.

2.7 DESCRIPTION – SEVERE WINTER STORM

Severe winter storms consist of extreme cold and heavy concentrations of snowfall or ice. Some winter storms can be widespread enough to affect several states, while some might affect only limited, localized areas. Accompanying these storms includes low temperatures, heavy or blowing snow, sleet, freezing rain, or a mix.

Sleet occurs when raindrops freeze into ice pellets before reaching the ground and accumulate like snow, thereby causing a hazard. Freezing rain is a form of rain that falls onto a surface with a temperature below freezing which forms a glaze of ice, and affects roadways, power lines, and trees. An ice storm occurs when freezing rain falls and freezes immediately upon impact on trees, power lines, communication towers, structures, roadways, and other hard surfaces. The smallest accumulation of ice can cause extreme hazards.

Severe winter storms are classified as heavy snowfall, blizzards, blue north'er, and ice storms. Snowfall with an accumulation of four or more inches in a 12-hour period is considered a heavy snowfall. Snow accumulations of that amount are usually experienced in the northern half of Texas and in the higher elevations of West Texas. Blizzards are the most perilous of all winter storms, characterized by low temperatures and strong winds in excess of 35 miles per hour, bearing large amounts of blowing or drifting snow. Blizzards may have a large impact on livestock and people caught in the open. Although rare in Texas, blizzards are most likely to occur in the Panhandle and South Plains Regions. The passage of a winter cold front with a drastic drop in temperature heralds the arrival of a cold wave, usually referred to as a "blue north'er." An ice storm occurs when rain falls out of the warm and moist upper layers of the atmosphere into a cold and dry layer near the ground. The rain freezes on contact with the cold ground and accumulates on exposed surfaces. If a half inch of rain freezes on trees and utility wires, damage can occur, especially if accompanied by high winds. Therefore, half an inch is used as the criteria before an icing event is categorized as an "ice storm." Events with less than half an inch of accumulated ice are simply called "winter storms." Ice storms usually occur from late December into mid-February, with most of them occurring in North Central and Northeast Texas.

Typical property damages resulting from severe winter storms include:

- Traffic Accidents, including deaths, associated with the loss of vehicle control on an icy roadway.
- Structural damage to exposed utilities, especially power lines and other aboveground facilities, with accompanying indirect damages associated with the temporary loss of the utility service.
- Loss of commercial livestock, orchards, and wildlife.
- Damages to urban trees and other landscape vegetation, often-requiring major debris removal expenses.
- Structural damage to roof systems for commercial and residential buildings.
- Loss of business revenue and increased operational expense due to disruption in transportation and utility services, including passenger and freight transport on highways, airfields, and rail.

- Increased medical and rehabilitation expenses due to personal accidents caused by the severe winter storm conditions.

Location and Extent – Winter Storm

According to the State of Texas Mitigation Plan, due to the degree of preparedness and type of infrastructure available, Texas is disrupted more severely by severe winter storms than regions that experience severe weather more frequently. The State of Texas Mitigation Plan identifies the Texas Panhandle and North Central Texas as the most vulnerable area for severe winter storms across the state. Grayson County is located in the North Central Texas Region and all jurisdictions within the County have the potential to experience the full range of property damages listed above including deaths associated with traffic accidents

Generally, the winter storm seasons in Texas run from late November to mid-March. Severe winter weather has occurred as early as October and as late as May in some locations. Some specific storms include; snowstorms, blizzards, blue north'er, and ice storms with ice accumulations of greater than ½ inch and snow accumulations exceeding 3 inches commonly expected.

Historical Occurrences – Winter Storm

According to the National Climatic Data Center, 22 recorded winter storm events have affected Grayson County between the years of 1994 and 2009. These incidents resulted in a reported total of 10 deaths, and $65,070,000 in property damage. Some recent notable events as recorded by the National Climatic Data Center are described in the following paragraphs.

> **February 24, 2003**
> *"Freezing rain and sleet began falling across western parts of North Texas late Monday morning the 24th and spread eastward during the afternoon and night, before ending the morning of the 25th. South of a Lampasas to Gatesville to Mexia to Athens line the precipitation was predominantly freezing rain, with ice accumulations of 1/4 to 1/2 inch. North of this line the precipitation was mostly sleet and snow, with most of the snow falling north of interstate 20. Sleet and snow accumulations were generally 1 to 3 inches, with 3 to 5 inches of snow north of a Breckenridge to Decatur to Dallas to Paris line. Schools and businesses closed early on the 24th, many not reopening until the afternoon of the 26th. Thousands of motorists, particularly truckers, were stranded for over 24 hours. Hundreds of flights at DFW International Airport and Love Field were cancelled, thousands delayed, and 2,500 people were stranded at the DFW Airport Monday night. There were hundreds of automobile accidents. The estimated 200 sand trucks across Dallas and Tarrant Counties worked 24 hours a day but could not keep up with the freezing rain, sleet, and snow accumulations Monday and Tuesday. Emergency rooms at area hospitals estimated 20-40 percent of their patient's injuries were snow or ice related from Monday through Wednesday. Conditions did not improve significantly until Thursday afternoon the 27th, when significant melting occurred. Most of the damage was lost revenue due to truckers stranded, airline flights cancelled, businesses and schools closed, and emergency expenditures due to the weather."*

January 13, 2007
"At least 50 accidents were reported across the county in association with a weekend ice storm. Several of the accidents involved injuries. Power was also briefly out to residents as ice accumulated on and pulled down power lines. Cold air in place in combination with ample moisture and an upper level disturbance caused a mix of freezing rain and rain to fall across North Texas. Dozens of winter weather and flash flood incidents were reported with this event."

Dec 12, 2001- Jan 15, 2001- Presidential Disaster Declaration #1356
"A mixture of sleet and freezing rain, with sleet accumulations up to one inch, affected all of North Central Texas from the afternoon of the 12th until midday on the 13th. Hundreds of accidents occurred, with numerous closures of businesses and schools, and hundreds of flights were canceled at the DFW airport. The roof of a supermarket in Boyd, in Wise County, collapsed from accumulations of ice. Electricity outages due to ice covered power lines and trees affected approximately 110,000 people. Some state highways and interstate highways were closed due to ice or accidents."

"The heavy snow that fell on Dec 31st lingered for several days keeping parts of Interstate 20 near Ranger closed until the morning of the 5th."

February 9, 1994
"An arctic cold front moved into Northern Texas during the afternoon of the 8th, causing temperatures to drop 60 degrees within 48 hours in many locations. Up to four inches of ice and sleet accumulated, making this the most significant ice storm across East Texas in two years. Numerous highways, businesses, and schools were closed. Over 30,000 homes suffered power outages, and damage from falling trees was widespread to homes and businesses. Two indirect fatalities occurred as icy roads caused traffic accidents."

A complete list of these events is provided in Appendix B.

Probability and Extent of Occurrence – Winter Storm

Winter storm events will remain a common threat in Grayson County, and the probability of future occurrences is high and exceeds a 1% annual probability. All areas and jurisdictions of Grayson County are susceptible to these events. The impact of snow and ice storms will cause major disruptions to transportation, commerce, electrical power, and create significant property damages and threats to human life and safety. For planning mitigation actions and estimating severity of severe winter storms, 50 mph winds, snow accumulations of greater than one foot, and ice accumulations of greater than one inch have been used as the basis of planning mitigation actions.

2.8 DESCRIPTION – TORNADO

Tornados are violent windstorms characterized by a twisting, funnel-shaped cloud extending to the ground. Tornados are associated with thunderstorms, but sometimes result from hurricanes and other tropical storms, when cool dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. Damages caused by tornados are often a result from high wind velocity, windblown debris, lighting, and hail. The National Weather Service states that tornado wind speeds normally range from 40 to more than 300 mph. The most violent tornadoes create rotating winds of 250 mph or more, and cause extreme destruction.

Depending on the size and intensity of a tornado, damage can range from light to devastating. *Table 2.9* shows the Enhanced Fujita Scale for tornados, which was created to measure tornado strength and associated damages.

Table 2.9 Enhanced Fujita Scale for Tornados

Storm Category	Damage Level	3 Second Gust (mph)	Description of damages
F0	Gale	68-85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
F1	Weak	86-110	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 might be destroyed.
F2	Strong	111-135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe	136-165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
F4	Devastating	166-200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible	200+	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 re-enforced concrete structures badly damaged.

Source: National Oceanic and Atmospheric Administration; Federal Emergency

Management Agency Averages of more than 800 tornados are reported nationwide, resulting in an average of 80 deaths and 1,500 injuries each year. Occurrence for tornados are more likely occur during the months of March through May and can occur anytime throughout the day, but

are likely to form in the late afternoon to early evening. Tornados associated with tropical cyclones are more frequent in the months of September and October, when the incidences of tropical storms are greater.

Location and Extent – Tornado

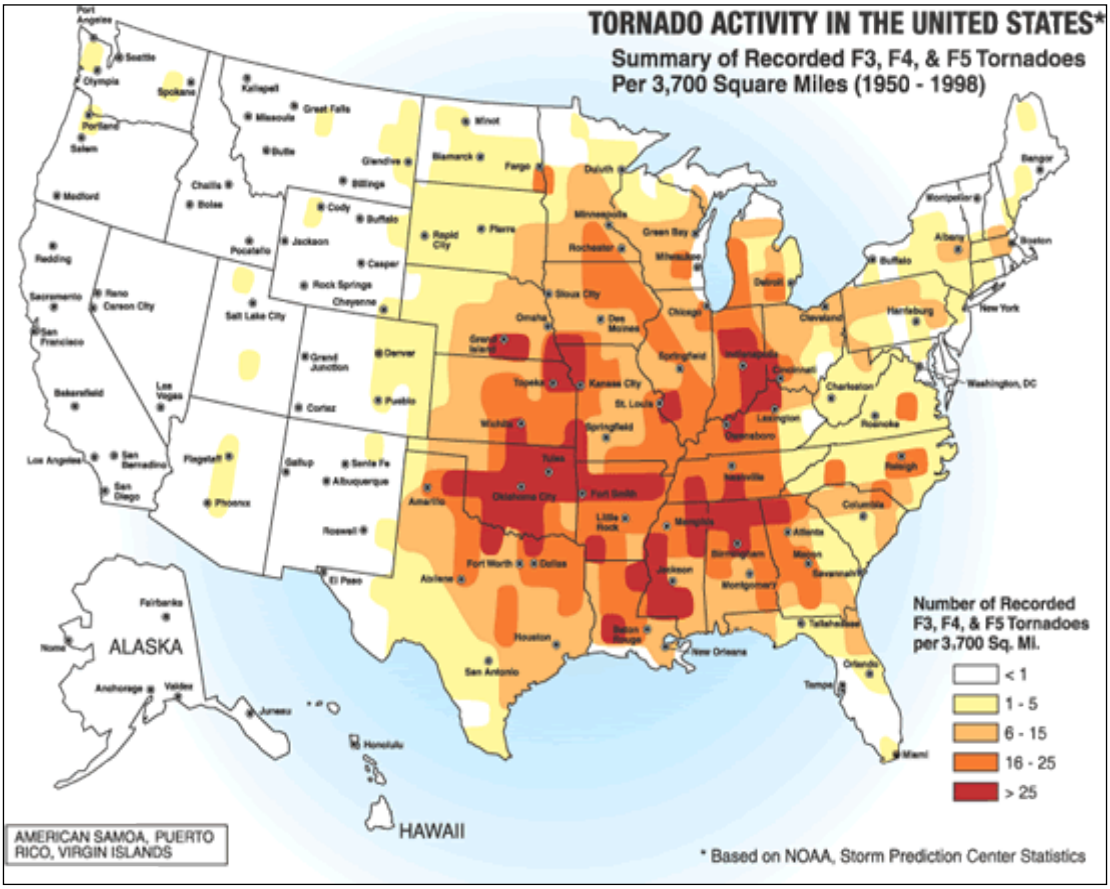


Figure 2-4 Tornado Activity in the United States

Grayson County is located in a susceptible area for tornado events. Texas averages 123 tornadoes annually, 88% are F-0 or F-1 and only 3% are F-3 or F-4. *Figure 2.4* is a summary of recorded F3, F4, and F5 tornado activity in the United States based on the number of recorded tornados per 3,700 square miles from 1950 to 1998. Grayson County is located in a region which experiences more than 25 (>25) tornados per square mile.Source: Federal Emergency Management Agency

Historical Occurrences – Tornados

According to the National Climatic Data Center, there have been 64 recorded tornado events in Grayson County during the period examined from 1952 through 2009. These events range from tornados category F1 to severe F3. These incidents reportedly resulted in two deaths, 49 injuries,

and a cost of $ 6,197,000 in damaged property. Some recent notable events as recorded by the National Climatic Data Center are described in the following paragraphs.

December 8, 2008
"According to a damage survey conducted by the National Weather Service in Fort Worth, a lower F-2 tornado affected areas of south and southwest Denison. Trees and power lines were downed. Dozens of homes, storage shelters, and businesses were damaged. About 500 homes in the area were without power. A dry line moved across north Texas as an upper level trough moved through the Desert Southwest. A line of thunderstorms developed and became severe as the night wore on. Two tornadoes and several downbursts caused significant damage across Grayson County. Strong winds followed behind a cold front and caused damage to power lines."

December 8, 2008
"According to a storm survey conducted by the National Weather Service in Fort Worth, an EF-1 tornado touched down near Collinsville and moved northeast. About 20 homes in the Collinsville area 15 homes in the Southmayd area were damaged. A few businesses were also damaged. Trees, power lines, and sheds were blown down. One injury was reported. A dry line moved across north Texas as an upper level trough moved through the Desert Southwest. A line of thunderstorms developed and became severe as the night wore on. Two tornadoes and several downbursts caused significant damage across Grayson County. Strong winds followed behind a cold front and caused damage to power lines."

May 9, 2006
"A significant tornado which formed in northern Collin County continued into southeastern Grayson County. A damage survey conducted by the National Weather Service in Fort Worth found that the tornado remained strong F3 as it crossed into Grayson County. A fatality occurred on Black Road, just over the border into Grayson County, where permanent homes suffered heavy damage. Numerous trees were snapped or uprooted along Yellow Bridge Road, Durham Road, and Red Moore Road. The tornado damaged outbuildings, rolled over a mobile home, and caused at least minor damage to structures in the area. The tornado, which had briefly weakened to an F1, strengthened again and caused F2 damage as it approached Gordon Road southeast of the Pilot Grove community. At least two additional homes were heavily damaged. The tornado crossed FM 121 and damaged a shed along Bethel Canyon Road, just west of Highway 160. The tornado crossed Highway 160, weakened to an F0, and dissipated approximately three miles south of Whitewright just before 11 PM. In addition to the fatality, several people suffered injuries and were transported to the hospital."

June 8, 1989
According to the Presidential disaster declaration (#328) , this event occurred in conjunction with severe storms and flooding.

A complete list of these events is provided in Appendix B.

Probability and Extent of Occurrence – Tornados

Based on its geographic location and frequency of past events, Grayson County is certain to continue to experience a high frequency of tornado events. Probability data available through National Oceanic Atmospheric Administration's National Severe Storms Laboratory indicates that Grayson County is in an area that experiences more than 25 tornado events per square mile and a high annual probability. Tornadoes will continue to pose a threat to property, infrastructure, and public safety. For planning mitigation actions and estimating severity of tornados, a storm category of F4 has been used with 3-second gusts between 166 – 200 mph.

2.9 DESCRIPTION – COASTAL EROSION

Coastal erosion is the wearing away land and the resultant loss of beach, shoreline or dune material along a coastline. The hazard can be assessed by the rate of change in the horizontal displacement of position of a shoreline over a period of time. Hurricanes and storm surges, windstorms and flooding hazards can cause short-term erosion. The damage can be intensified by human activity, for example boat wakes, removal of dune and vegetative buffers, dredging and shoreline hardening. Multi-year impacts such as wave action, sea level rise, sediment loss, subsidence, and climate change can cause long-term erosion. An above average number of storms and high tides or the long-term effects of changes in sea level can cause increased episodic erosion events. As a response, this will cause a beach from naturally accumulating sediment to eroding.

Further damage to coastal and upland property can occur if a beach and dune system does not recover either naturally or by human action. Natural recovery can take years to decades. Human action for recovery can include beach nourishment, dune stabilization and shoreline protecting structures (sea walls, groins, jetties, etc.). These actions can mitigate the hazard but may also intensify it under some conditions.

Coastal erosion can cause enough damage to destroy buildings and infrastructure. This poses a threat to local economies of coastal communities dependent on the profits from recreational beaches.

Coastal Retreat – Coastal Erosion

Coastal Retreat is defined as any particular section of beach that is accreting or retreating as a result of a complex interaction between the conflicting forces of sediment deposition, tidal movement, long-shore current, and sand storage in dunes and bars. Some portions of Texas beaches are advancing and some are retreating. In general, the beaches are retreating. Annual damages from homes dropping into the surf are relatively minor (mold destroys more homes in Texas than coastal retreat). A substantial reduction of the width and breath of beaches, along with a reduction in dune structures, could allow hurricane driven storm surge to move further inland. A reduction in coastal marshes can have a similar effect.

In general, the State regards coastal retreat as a minor threat. In the areas seaward of most of our major coastal cities, the beach/coastal marsh is stable or accreting.

Coastal Subsidence – Coastal Erosion

Coastal Subsidence is defined as the loss of coastal surface elevation due to the removal of subsurface support. Texas currently regards this hazard as a low threat, although this has not always been so. The rise in the creation of groundwater conservation districts, and their cousin, the coastal subsidence conservation districts, has largely eliminated the risk to the coastal communities. Coastal subsidence has not been an issue along the South Texas coast due to geology characteristics in this area.

Location and Extend – Coastal Erosion

Coastal erosion occurs along coastal regions. As can be seen in the *Figure 2.5* below, Grayson County is not located in a region that would be affected by coastal erosion.

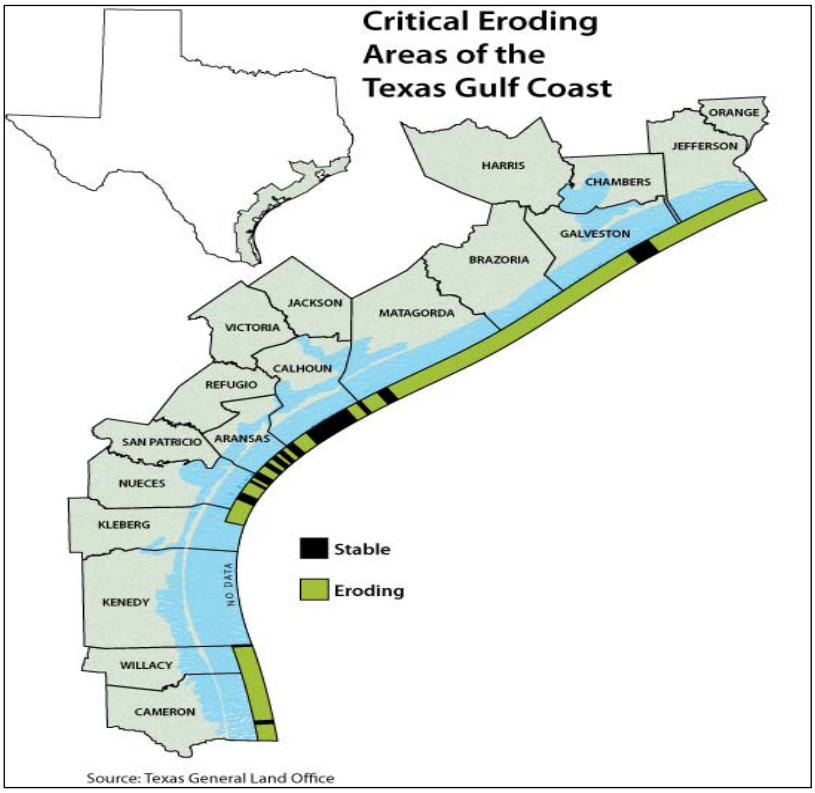


Figure 2-5 Critical Eroding Areas of the Texas Gulf Coast

Source: Texas General Land Office

Probability of Occurrence – Coastal Erosion

Due to its North Central Texas location, there is no risk of coastal erosion affecting Grayson County.

2.10 DESCRIPTION – DAM AND LEVEE FAILURE

According to the State of Texas Mitigation Plan, dam failure is defined as a systematic failure of the dam structure resulting in the uncontrolled release of water, often resulting in floods that could exceed the 100-year floodplain boundaries. A dam failure could create mass fatalities, mass structural damage and/or a cascading potential if urbanized facilities are located below the dam structure. Dams provide water, power, flood control, recreation, and economic possibilities, which is why safe operation and maintenance is essential to sustaining these advantages and avoiding potential disasters.

A combination of natural events and/or human-induced events can result in dam failure. Natural events such as hurricanes, floods, earthquakes, and landslides can create a dam failure. Human induced actions include deterioration of foundation or the material used in dam construction, which can also result in dam failure.

Dams are classified based on potential loss of human life and/or property damage if it were to fail. Classification is based on effects that dam failure it would likely have on population and/or property damage in the downstream inundation zone. Dam classifications descend in order from high to low, with high having the greatest potential for adverse downstream impacts in the event of failure.

High: Dams that upon failure would cause probable loss of life or serious economic damage
Significant: Dams that upon failure might cause loss of life or appreciable economic damage.
Low: Dams that upon failure would lead to no expected loss of life or significant economic damage.

Location and Extent – Dam and Levee Failure

According to the State of Texas Mitigation Plan, there are 7,546 dams in the State of Texas. These dams are over 6-feet high and many may pose a safety hazard to downstream populations. Currently 888 dams are designated as high hazard dams, meaning probability of loss of life if failure occurs. In addition, 805 dams are classified as significant hazard, meaning that there could possibly be loss of life if the dam should fail.

The State of Texas Mitigation Plan states that there are an increasing number of these high-hazard structures. Owners of dams that were built as low hazard dams are finding that the hazard classification has changed due to the increase in population and infrastructure downstream of the dams. Many of these dams may be deficient because they no longer meet State regulations and need to be upgraded.

In Texas, 85% of the dams are over 25 years old. If not adequately maintained, aging dams can present problems due to deterioration of the structure. *Figure 2.6* from the United States Army Corps of Engineers indicated the locations for each dam within the State of Texas.

The State of Texas Mitigation Plan indicates that Grayson County is within the band of high dam concentration within the State of Texas. The best location for major dams is the lowest portion

of the watershed, combined with a narrow channel that reduces dam construction costs. In addition, Grayson County is in a high-risk area for high hazard dam failure to occur.

Additional information regarding these events is not available at the present time, but will be an objective in the five year planning cycle update. For all high and significant hazard dams, the complete failure of the dams will be assumed as the estimated maximum severity level for determining potential impact and possible mitigation actions.

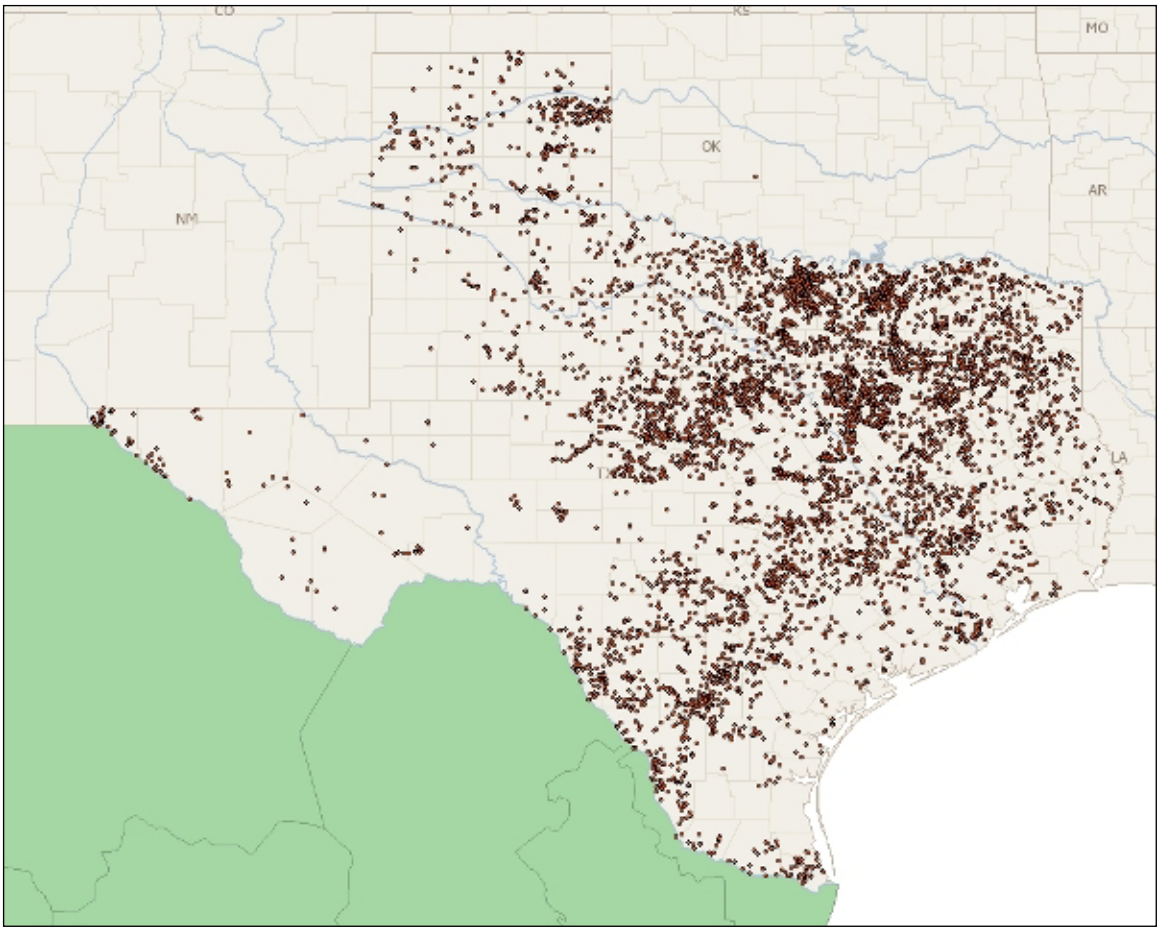


Figure 2-6 Locations of Dams in State of Texas
Source: United States Army Corps of Engineers; National Inventory of Dams

According to Federal Emergency Management Agency's Hazards U.S. Multi-Hazard (HAZUS-MH), software provided by Federal Emergency Management Agency, there are a total of 106 dams located within Grayson County, of which nine are classified as high risk, five are classified as significant risk, and 92 are classified as low risk. A Geographic Information Systems based map has been generated which displays the classification and exact location of each Dam in Grayson County, *(Figure 2.7).* Also shown in Figure 2.7 for the high and significant hazard dams is an approximate area of inundation, which might occur after a dam failure, based on a 2000-foot wide zone mapped along the floodplain for several miles downstream from dams.

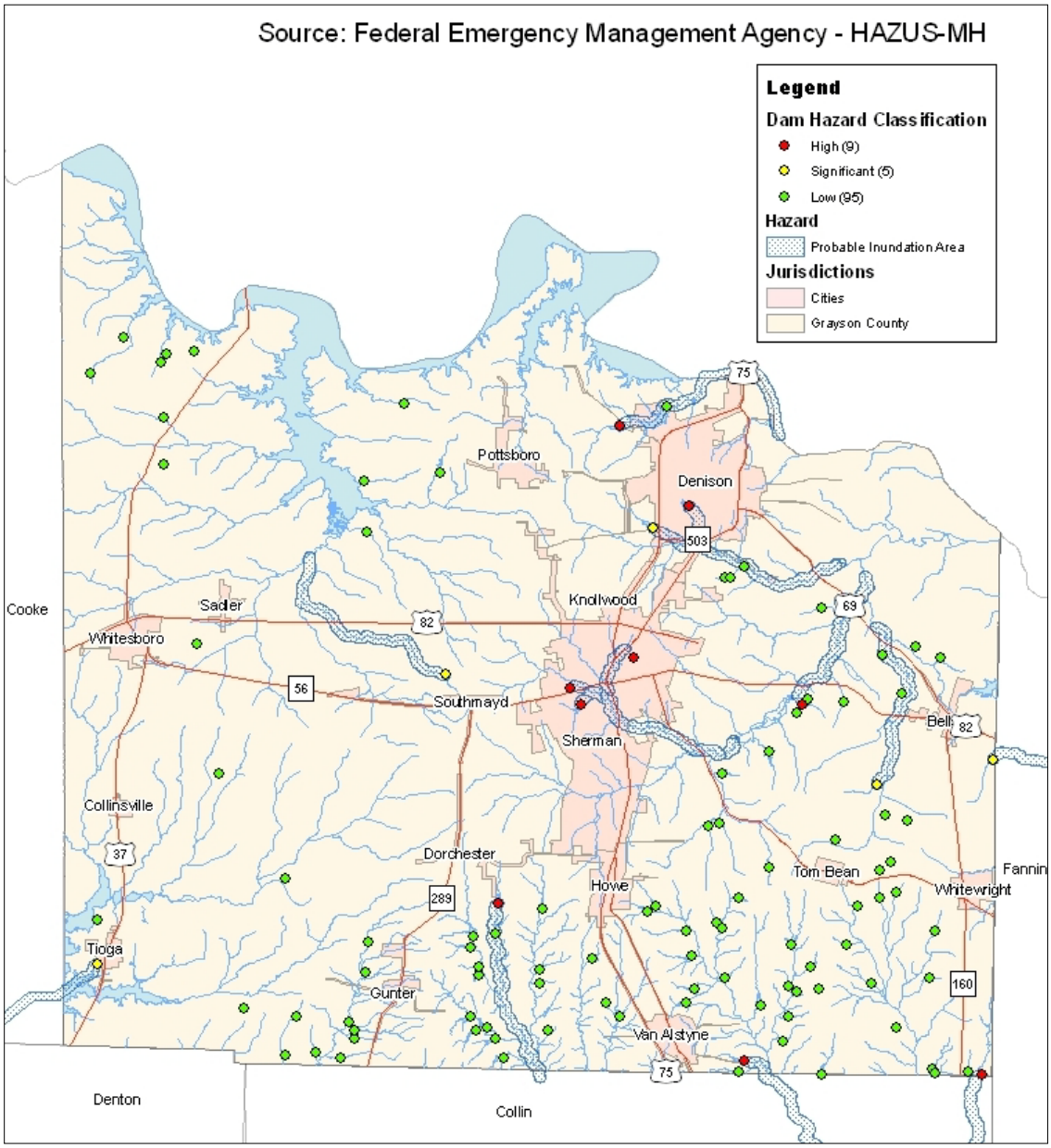


Figure 2-7 Classifications and Locations of Dams in Grayson County
Source: Federal Emergency Management Agency- HAZUS-MH

The uncontrolled release of water from these structures could potentially result in floods that could exceed the 100-year floodplain boundaries and could create mass fatalities, mass structural damage and/or a cascading potential for damages to the urbanized facilities that are located below these dam structures. These approximate areas of potential inundation, as shown in Figure 2.7, primarily impact the unincorporated area of Grayson County, but also could potentially impact the Cities of Bell, Denison, Dorchester, Sherman, and Tioga. This potential area of inundation has been used as the basis for estimating the extent of damages that are possible for this hazard within Grayson County.

Levee failure is defined as a systematic failure of the levee structure resulting in the uncontrolled release of water, often resulting in floods that could exceed the 100-year floodplain boundaries. This failure could create mass fatalities, mass structural damage, and/or mass cascading potential if a city or farmland is protected by a levee. This damage scenario has been used as the extent of possible damages within Grayson County for this hazard.

According to the State of Texas Mitigation Plan, levees have been constructed in Texas for over 100 years to protect farm and ranch land, and populated areas from flood flows. Maintenance programs are essential, and because there has been only a limited regulatory program, there have been no regular inspections and limited maintenance. In addition, no database identifying and locating the levee systems is available in Texas, which puts populated areas behind levees at risk during major flood events.

Historical Occurrences – Dam and Levee Failure

According to the Dam Safety Sections of the Texas Commission on Environmental Quality (TCEQ), no recorded dam or levee failures have been reported in Grayson County. TCEQ records date back to 1900. A copy of the correspondence with TCEQ is provided in Appendix B.

Probability of Occurrence – Dam and Levee Failure

Based on the information available regarding the number of dams in Grayson County of high and significant risk, the probability of dam failure occurrence in Grayson County is medium. No information is available to estimate the probability of levee failures; however, given that dam and levee failure is often associated with severe flood events, and the probability of flooding in Grayson County is high, levee failure is a potential occurrence. Collecting additional data on these events has been established as an objective in the five year planning cycle update.

2.11 DESCRIPTION – DROUGHT

Drought is a natural climatic condition caused by an extended period of limited rainfall occurring naturally in a broad geographic area. Droughts are classified as one of the following four types: meteorological, agricultural, hydrological or socio-economic.

Meteorological droughts are typically defined by the level of "dryness" when compared to an average, or normal amount of precipitation over a given period of time. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts, when the amount of moisture in soil does not meet the needs of a particular crop. Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land cover, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that affect people and limit the ability to supply water-dependent products in the marketplace.

Typically, drought conditions do not cause property damages or threaten lives, but rather drought effects are most directly felt by agricultural sectors. At times, drought may also cause community-wide impacts as a result of acute water shortages, regulatory use restrictions, drinking water supply and salt-water intrusion. The magnitude of such impacts correlates directly with local groundwater supplies, reservoir storage and development densities.

In 1965, Wayne Palmer developed the Palmer Drought Severity Index, an index to "measure the departure of moisture supply" (*Table 2.10*). The index is based on the supply and demand concept of water balance equations, taking into account more than only the precipitation deficit at specific locations. The objective of the Palmer Drought Severity Index, is to provide a measurement of moisture conditions that is "standardized" so that the comparisons using the index can be made between locations and between months.

Table 2.10 Palmer Drought Severity Index

Palmer Classifications	
4.0 or more	extremely wet
3.0 to 3.99	very wet
2.0 to 2.99	moderately wet
1.0 to 1.99	slightly wet
0.5 to 0.99	incipient wet spell
0.49 to -0.49	near normal
-0.5 to -0.99	incipient dry spell
-1.0 to -1.99	mild drought
-2.0 to -2.99	moderate drought
-3.0 to -3.99	severe drought
-4.0 or less	extreme drought

Source: National Oceanic Atmospheric Administration National Weather Service, Climate Prediction Center

Location and Extent – Drought

Depending on temperature, and precipitation over time, drought occurs in all parts of the County and at any time of year. The State of Texas is vulnerable to droughts. *Figure 2.8* shows the PSDI summary map for the United States from 1895 to 1995. These drought classifications are based on observed drought conditions, and range from -0.5 to -4.0. According to the map, Grayson County is in a zone that experienced anywhere between 10 to 14.9 %, meaning that severe drought conditions are relatively high for Grayson County.

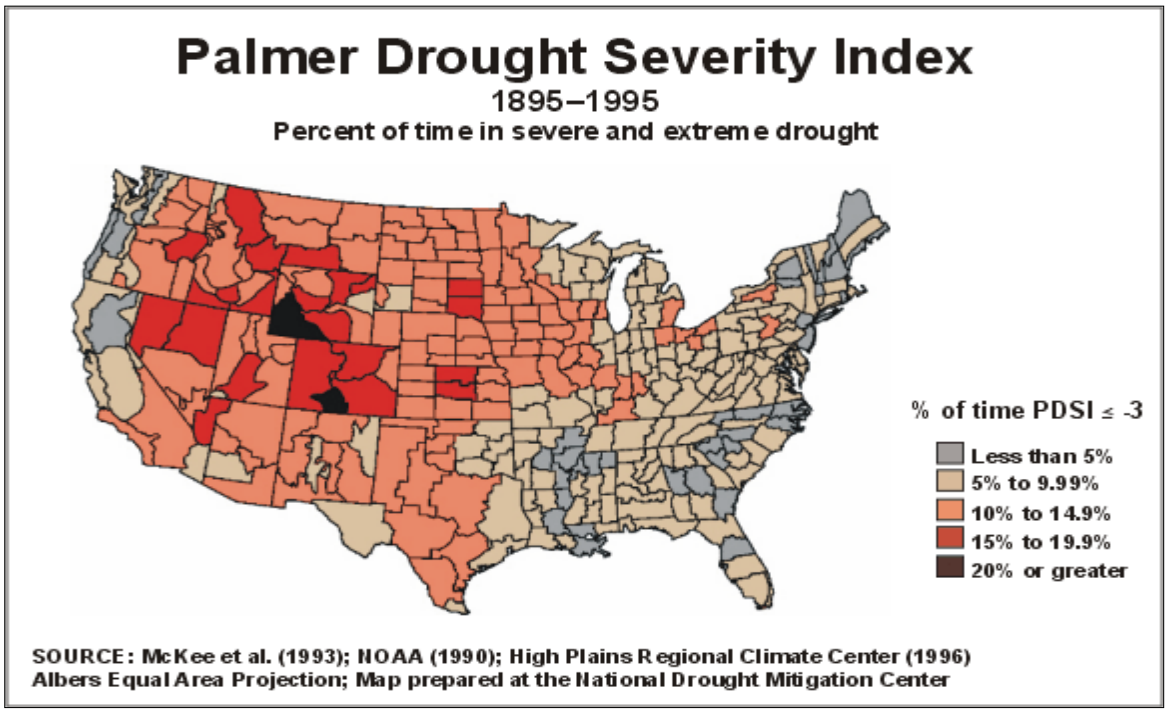


Figure 2-8 U.S. Palmer Drought Severity Index

The extent of drought impacts for Grayson County includes public water supply issues and agricultural impacts, such as crop damages. The most severe effects of drought in the area are likely to be experienced by farmers, who suffer heavy financial losses due to crop loss.

Historical Occurrences – Drought

According to the National Climatic Data Center, 24-recorded instances of drought conditions have affected Grayson County since 1996, causing a reported $100,500,000 in property damages and $2,581,000,000 in crop damage. Some significant events as provided by National Climatic Data Center are described in the following paragraphs.

January 1, 2006

"Drought conditions continued across north Texas as precipitation deficits increased. This month, all of north Texas was classified in either extreme drought (D3) or exceptional drought (D4) as classified by the U.S. Drought Monitor. Every county in

north Texas was eligible for federal disaster relief due to the drought. The weather continued to be unseasonable warm. The average high temperature this January was 68.3 degrees, a full 14.2 degrees above normal. This figure broke an 83-year-old record. Wildfires continued to be a major problem in January, with a burn ban in place in every county. A quarter of a million acres burned across Texas in the first half of the month, more than during all of 2005. The ongoing drought combined with strong winds and low humidities to create a volatile fire situation in Texas. On New Year's Day, several devastating wildfires erupted across north Texas. Forty homes were destroyed in Montague County as a 17-mile long fire burned between Ringgold and Nocona. Another grass fire in Johnson County burned 13 buildings and charred 1,800 acres. In Eastland County, a fire encompassing more than 35,000 acres forced the evacuations of several communities and destroyed the city of Kokomo. Thirty-six buildings were lost in the fire. Several firefighters and civilians suffered burns, smoke inhalation, and heat exhaustion due to the fires. Hydrological and agricultural impacts worsened over the past month due to the lack of rainfall. Most water reservoirs across north Texas were 60% to 85% of normal capacity. Several lakes across the region were 10 to 15 feet below normal pool elevation. The North Texas Municipal Water District implemented watering restrictions earlier than normal this year due to the lowering lake levels. Watering restrictions were also in effect on a voluntary basis in some cities. The Texas Cooperative Extension estimated agricultural losses for north Texas to be close to $1 billion in January. Only half of the state's hay crop was fit for harvesting, and hay prices were three to four times their normal price. Many other crops failed to grow at all. Agricultural groups appealed for federal grants to aid the cattle industry. One emergency measure considered by the federal government included providing cash to ranchers to offset high feed costs and losses due to the drought and wildfires. A drought summit was held in San Antonio to discuss the crisis. The drought was also affecting wildlife in north Texas. The Texas Department of Parks and Wildlife reported an overall decline in habitat conditions, and noted that the lack of green plants would affect the survival rate of certain animals."

May 1. 2006

"All areas of north Texas that were considered to be in severe (D2) or moderate (D1) drought last month are now only counted as abnormally dry (D0), according to the U.S. Drought Monitor. While a few heavy rain events have helped ease the drought, relief remains marginal at best, and drier than normal conditions continue. Comanche, Jack, and Palo Pinto Counties continue to impose burn bans. Vegetation is stressed, especially in far west north Texas where recent rains have been less plentiful. Voluntary water restrictions are ongoing in most north Texas Counties. The latest forecast from the Climate Prediction Center indicates that the next three months are expected to be hotter and drier than normal across north Texas."

May 1, 2005

"Continued below normal rainfall caused portions of north Texas to be upgraded from moderate drought (D1) to severe drought (D2), as classified by the U.S. Drought Monitor. Portions of Montague, Cooke, Grayson, Fannin, Jack, Wise, Denton, and Collin Counties were considered to be in severe drought by late May. By the end of the month, the drought had made significant agricultural and hydrological impacts on the region.

High winds and dry conditions contributed to high fire danger. According to the Drought Impact Reporter, cattle grasses were reported as low to none, and stock ponds were low to dry. The drought continued into June."

A complete list of these events is provided in Appendix B.

Probability of Occurrence – Drought

Grayson County is in a zone that experiences a Palmer Drought Severity Index rating of less than three between 10 to 14.9 % percent of the time. The annual probability of future drought conditions is high, posing threats to agricultural practices, water supply, and making specific areas more susceptible to other hazardous events such as wildfires.

2.12 DESCRIPTION – FLOOD

Flooding is the most frequent and costly natural hazard in the United States, a hazard which has caused more than 10,000 deaths since 1900. Nearly 90 % of presidential disaster declarations result from unnatural events where flooding was a major issue.

Floods are generally the result of excess precipitations, and can be classified as general floods and flash floods. General floods are when precipitations occurring over a given river basin for long periods of time. Flash floods are the product of heavy localized precipitation in a short period of time over a given location. Flooding events are typically determined by a combination of factors, including stream and river basin topography and physiographic, precipitation and weather patterns, recent soil moisture conditions, and the degree of vegetative clearing and impervious surface.

Floods are usually long-term events that may last for several days. Primary types of general flooding include riverine, coastal, and urban flooding. Riverine flooding is a function of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. Coastal flooding is typically a result of storm surge, wind-driven waves and heavy rainfall produced by hurricanes, tropical storms and other large coastal storms. Urban flooding occurs where manmade development obstructs the natural flow of water and decreases the ability of natural groundcover to absorb and retain surface water runoff.

Most flash flooding is caused by slow-moving thunderstorms in a local area or by heavy rains associated with hurricanes and tropical storms. However, flash flooding events may also occur from a dam or levee failure within minutes or hours of heavy amounts of rainfall, or from a sudden release of water held by a retention basin or other stormwater control facility. Although flash flooding occurs most often along mountain streams, it is also common in urbanized areas where much of the ground is covered by impervious surfaces.

Periodic flooding of lands adjacent to rivers, streams and shorelines (land known as floodplain) is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. The recurrence interval of a flood is defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence intervals, and floodplains are designated by the frequency of the flood that is large enough to cover them.

Location and Extent – Floods

Historically, floods are and continue to be one of the most frequent destructive and costly natural hazards facing the State of Texas, constituting 91% of the disaster damage in the State. Floods take place every year, and in all seasons within the State of Texas. Winter and early spring floods are caused by the seasonal rainfall pattern. Most summer floods, except for those associated with hurricanes and tropical storms, occur in later summer and autumn by super cell thunderstorms.

Texas on the average suffers approximately 400 floods annually, double the number of the second highest State. On the basis of present knowledge, the size, time, and place of floods cannot be predicted more than a few hours in advance. Since 1953, Texas has had 30 federal disaster declarations as a result of flooding events.

The 100-year floodplain associated with streams and their tributaries is presented in *Figure 2.9*. This 100-year frequency of flood has a 1% annual chance of occurrence or a recurrence interval of 0.01. FEMA requires that all jurisdictions regulate development within the 100-year floodplains. For flood insurance purposes, FEMA also determines flood elevations for the 500-year frequency flood event (0.2%) annual chance of occurrence). The 500-year flood event has been used within this plan to establish the maximum extent of this hazard for determining potential impact and possible mitigation actions.

Historical Occurrences – Floods

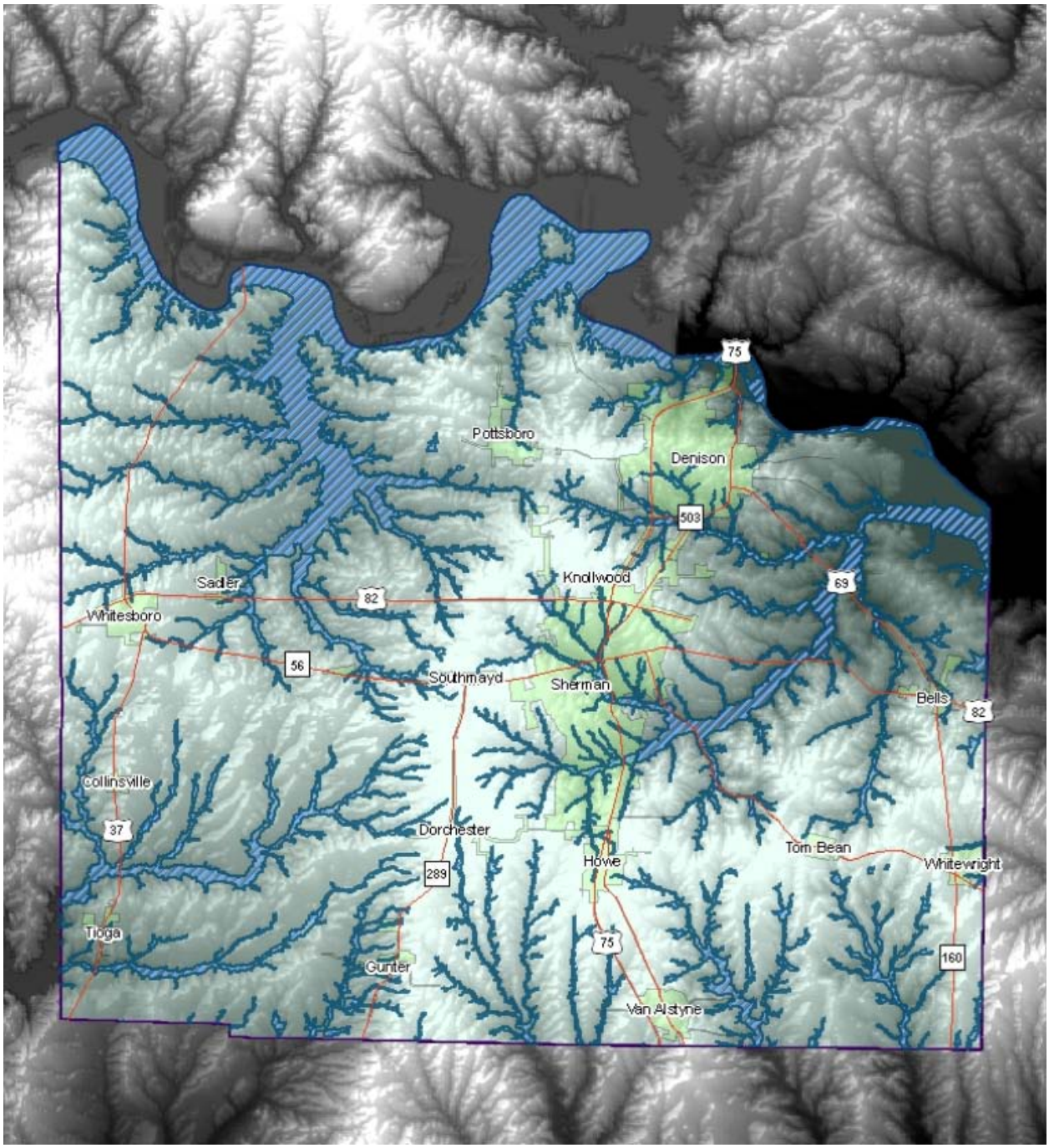


Figure 2-9 Grayson County 100-year Floodplain
Source: HAZUS-MH

According to the National Climatic Data Center, 51 recorded flood events have occurred in Grayson County from 1993 to 2009. Of these events three deaths and $21,215,000 has been recorded in property damage. Some notable events are described in the following paragraphs.

July 10, 2007
"Highway 11 at FM 1417, Highway 91 between Sherman and Denison, and several other roads were flooded. A high water rescue was required in Sherman, and Choctaw Creek was over its banks. High water was reported on Texoma Parkway under Highway 75, and on North Branch and Travis Streets. An auto store on Texoma Parkway suffered flood damage, as well as several cars. A compact upper level low-pressure system to the northwest created ripe conditions for thunderstorm development. A thunderstorm complex moved into North Texas on the morning of July 10, causing flash flooding across a few counties north of the metroplex. Storms later redeveloped along boundaries left over from that morning's thunderstorms. Flash flooding occurred again on the 11th as rain fell on saturated soils."

June 18, 2007
According to the Presidential Disaster Declaration (#1709), this event occurred in conjunction with severe storms. Detailed information was not available for this event. "Significant flooding occurred with cars and mobile homes moved by the force of the water. Numerous roads were closed across the county, including Highways 377 and 75, and more than 450 people were rescued from high water. One woman died in floodwaters as she drove on Texoma Parkway under the U.S. Highway 75 overpass. Another fatality occurred when a truck flooded at the intersection of FM 1417 and Highway 11. A bridge on Highway 11 south of Sherman suffered extensive damage. An upper level low lingered in the area for several days. An unstable atmosphere helped kick off several rounds of showers and storms. Boundaries helped focus rainfall totals over the same areas...leading to flash flooding."

January 3, 2005
"Flooding caused three bridges to be washed out around 8 AM. These bridges were at Tioga, Central Sherman, and on Old Luella Road. Numerous county roads were also washed out and in bad need of repair."

May 2, 1990
According to the Presidential Disaster Declaration (#863), this flooding event occurred in conjunction with severe storms and tornados. Detailed information was not available for this event.

June 8, 1989
According to the Presidential Disaster Declaration (#828), this flooding event occurred in conjunction with severe storms and tornados. Detailed information was not available for this event.

October 29, 1981
According to Presidential Disaster Declaration (#648), this flooding event occurred in conjunction with severe storms. Detailed information was not available for this event.

A complete list of these events is provided in Appendix B.

Probability of Occurrence – Floods

Due to stream and river basin topography and physiographic, precipitation and weather patterns, and recent soil moisture conditions, flood events will remain a very frequent occurrence in Grayson County. There is a high annual probability of future flood occurrences in Grayson County that pose significant risks to public health and damage to property and infrastructure.

2.13 DESCRIPTION – EARTHQUAKE

An earthquake is the motion or trembling of the ground produced by sudden displacement of rock in the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides or the collapse of caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons; and disrupt the social and economic functioning of the affected area.

Most earthquakes are caused by the release of stresses accumulated as a result of the rupture of rocks along opposing fault planes in the Earth's outer crust. These fault planes are typically found along borders of the Earth's 10 tectonic plates. The areas of greatest tectonic instability occur at the perimeters of the slowly moving plates, as these locations are subjected to the greatest strains from plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength, a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

According to the State of Texas Mitigation Plan the nature and geographical extent of earthquake hazard depends on the earthquake's size or magnitude. Each earthquake has one magnitude but different intensities, since earthquake damage becomes less severe away from the epicenter. The region nearest the epicenter has the highest intensity, so most of the damage done by an earthquake occurs there. While intensity relies mostly on factors like soil properties, in most cases earthquakes with larger magnitudes have higher maximum intensities.

Danger of earthquakes can be reduced by designing buildings such as dams, towers, very tall buildings, bridges, and highway overpasses with the understanding that an earthquake might occur. Citizens can prepare their homes by removing the possibility of falling objects in their homes causing damage.

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude, *Table 2.11*. Each unit increase in magnitude on the Richter Scale corresponds to a 10-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction). A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity and its correspondence to the Richter Scale is given in *Table 2.12.*

Table 2.11 Richter Scale

Richter Magnitude	Earthquake Effects
Less than 3.5 Generally not felt	Generally not felt, but recorded.
3.5-5.4	Often felt, but rarely causes damage.
Under 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0-7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: Federal Emergency Management Agency

Table 2.12 Modified Mercalli Intensity Scale for Earthquakes

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only on seismographs.	
II	Feeble	Some people feel it.	<4.2
III	Slight	Felt by people resting; like a truck rumbling by.	
IV	Moderate	Felt by people walking.	
V	Slightly Strong	Sleepers awake; church bells ring.	<4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves.	<5.4
VII	Very Strong	Mild alarm; walls crack; plaster falls.	<6.1
VIII	Destructive	Moving cars uncontrollable, masonry fractures, poorly constructed buildings damaged.	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open.	<6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread.	<7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards.	<8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves.	>8.1

Location and Extent – Earthquake

The greatest threat in the United States is along tectonic plate boundaries and seismic fault lines, located in the central and western states. However, Texas does face moderate risk to less frequent, less intense earthquake events. As shown in *Figure 2.10* below, there is a potential for earthquakes to pose a threat to Grayson County. Seismic activity for Grayson County is measured as 2 – 4 % (peak acceleration), which is the second lowest category shown within the United States.

Source: United States Geological Survey

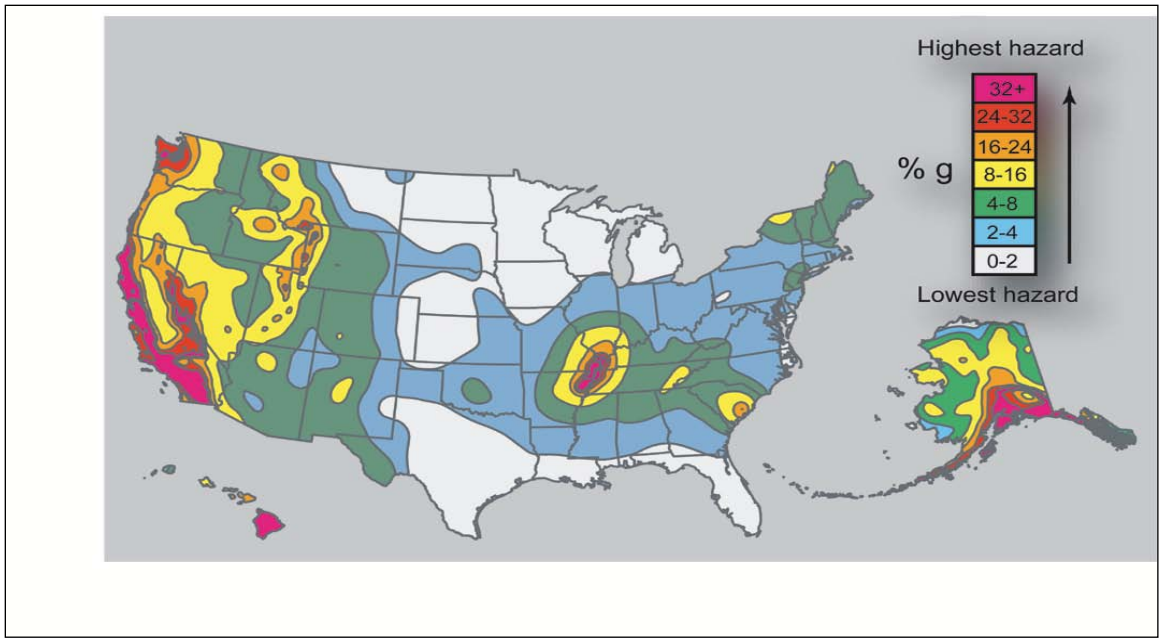


Figure 2-10 Peak Acceleration for Seismic Activity in the U.S

Figure 2.11, below, shows locations of earthquakes that have occurred in Texas or were felt by Texas residents with the year of each occurrence.

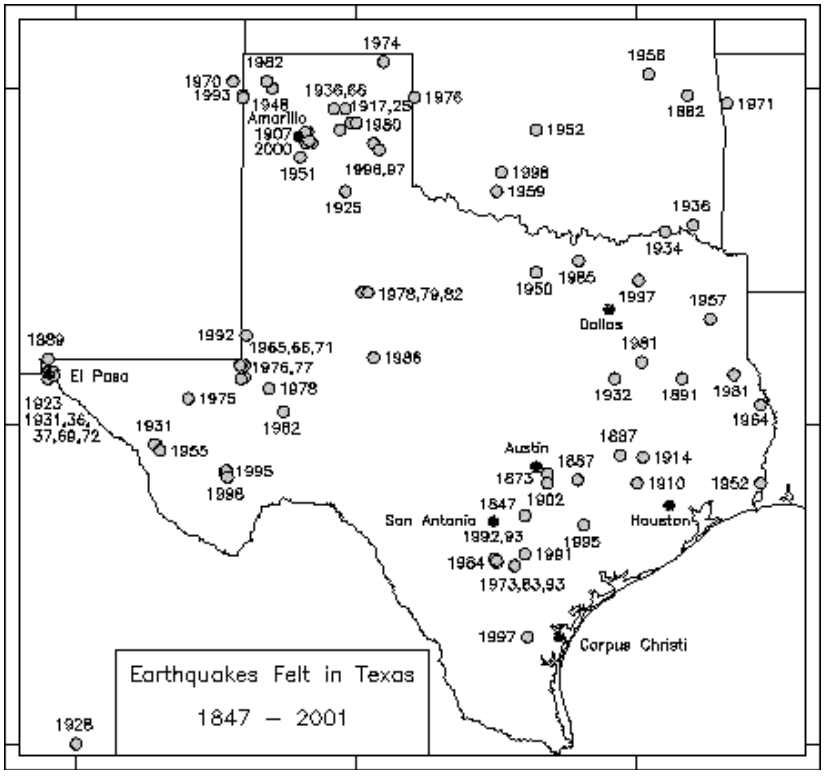


Figure 2-11 Locations of Earthquake in Texas
Source: The University of Texas at Austin Institute for Geophysics, Earthquake Seismology, http://www.ig.utexas.edu/research/projects/eq/compendium/earthquakes.htm

According to The University of Austin Institute for Geophysics (UTIG), Grayson County is at risk from very large, distant earthquakes occurring in Missouri-Tennessee or Oklahoma. There are very few earthquakes with epicenters within the Northeast Texas region in which Grayson County is located. UTIG estimates that hazardous earthquakes will probably only occur once per 500 years or less since only earthquakes with epicenters that are very close to poorly built structures will pose a risk. Consequently, a "strong" intensity earthquake with a Modified Mercalli Intensity Scale of VI has been assumed as the estimated maximum severity level for determining potential impact and possible mitigation actions for the planning area.

Historical Occurrences – Earthquake

According to UTIG, a magnitude 3.3 earthquake occurred in Cooke and Denton County near Pilot Point and Valley View on September 18, 1985. Cooke and Denton Counties border Grayson County to the west and southwest, respectively. The UTIG, Earthquake Seismology map (Figure 2.11) indicates that 3 earthquakes; 1950, 1985, 1997 occurred in the adjacent areas of Grayson County.

Probability of Occurrence – Earthquake

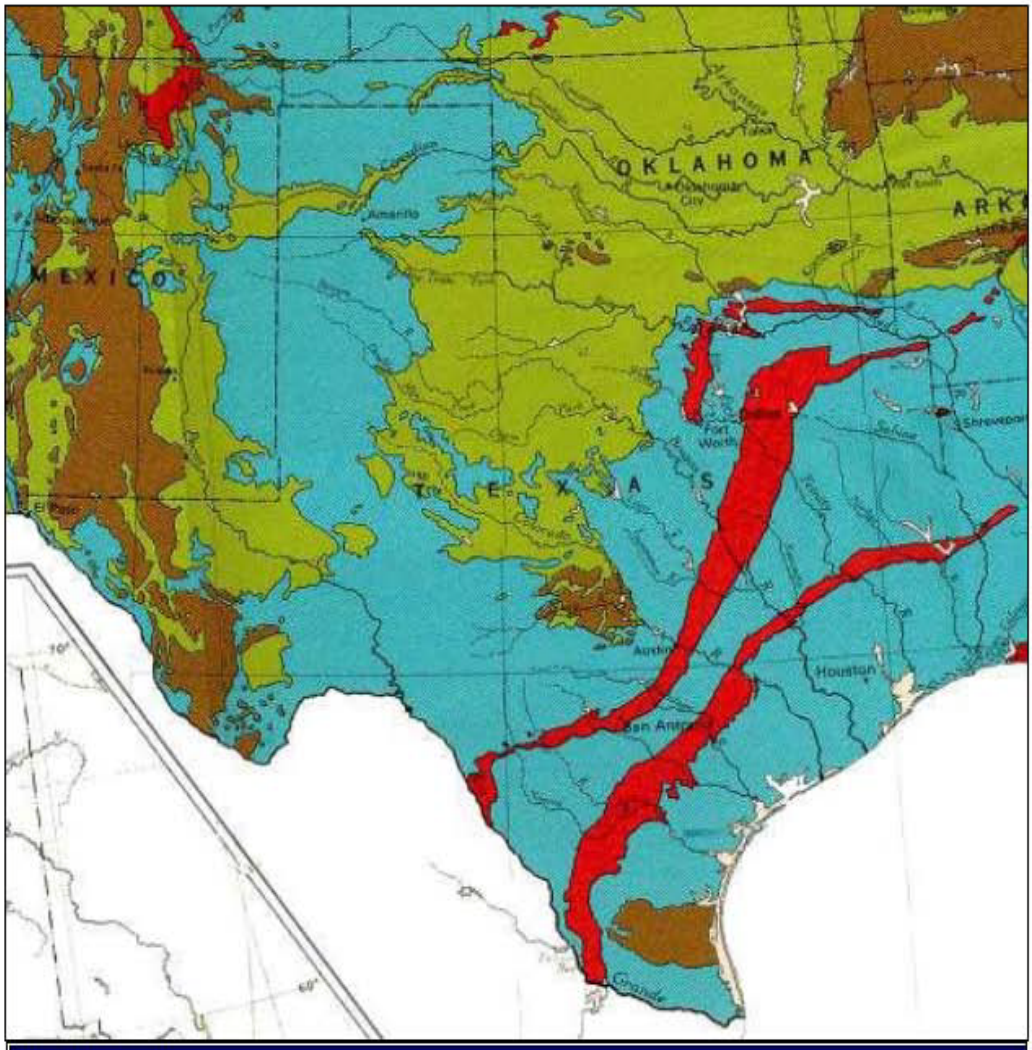
The annual probability of occurrence for future earthquake events affecting Grayson County is low to moderate (between 1 – 10%). Although earthquakes have historically occurred, the low severity and infrequency of past events does not present a significant threat to the county. According to the State of Texas Mitigation Plan, the earthquake hazard in Texas is small compared to other hazards attributable from other natural phenomena but is still present.

2.14 DESCRIPTION – EXPANSIVE SOILS

Expansive soils are defined as soils and soft rock that tend to swell or shrink due to changes in moisture content. 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. In Texas, most expansive soils are located in the Coastal Gulf areas from Beaumont down to Brownsville, as these areas receive the most moisture and are also vulnerable to droughts, which can cause the soils to expand and contract.

Location and Extent – Expansive Soils

The map below, *Figure 2.12* is based upon "Swelling Clays Map of the Conterminous United States." Land areas were assigned to map soil categories based upon the type of bedrock that exists beneath them as shown on a geologic map.



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 western most states only)

Figure 2-12 Swelling Clays Map of the Conterminous United States
Source: U.S. Geological Survey; Swelling Clays Map of the Conterminous U.S.

Texas is a State severely challenged with building failures caused by expansive soils. On the map above, soils coded pink or blue generally present challenges in this regard. Three quarters of the State of Texas is coded within that region. Grayson County is located in an area which contains either "abundant" or "significant – but generally less than 50%" of clay having a high swelling potential.

According to a 1982 Federal Emergency Management Agency report, expansive soils have caused billions of dollars of damage to U.S. buildings, roads, pipelines, and other structures. Today, damage from expansive soils is costlier than damage caused by earthquakes, floods, tornadoes, and hurricanes combined.

Expansive soils (bentonite, smectite, or other reactive clays) expand when the soil particles attract water, and can shrink when the clay dries. Expansive soil can grow to as much as 15 times its original size, thus causing severe damage. Sidewalks, roads, and residential and commercial buildings may be lifted causing cracks and distortion. It is differential expansion that causes damage.

If the entire area under a foundation or road maintained the same moisture content, the entire structure would rise uniformly, and there would be no damage. Residential construction generally has more problems than commercial, but both experience significant losses. The foundation type most prevalent in Texas is slab on grade, which is the most susceptible to damage from expansive clays.

According the State of Texas the percentage of insurance claims made in Texas involving foundations in 2005 is up to 14%. The great increase in damages in Texas caused by problems with expansive soils can be traced to the rise in residential slab-on-grade construction that began to accelerate in the 1960s. Prior to that time, most residential construction in Texas was pier and beam, with wood siding or other non-masonry covering.

Historical Occurrences – Expansive Soils

Additional information regarding these events was not available at the present time, but will be an objective in the five year planning cycle update and is included as an action item for Grayson County. Because of the widespread prevalence of expansive soils in Grayson County, most buildings and construction standards now include provisions to reduce damages and problems from this hazard; however, residential and commercial building claims are still likely to be common, especially for older structures with slab on grade, roadways, pipelines, and other similar infrastructure are also at risk in Grayson County.

Probability of Occurrence – Expansive Soils

Grayson County is located in an area that contains two defined soil types, both with abundant clay having high swelling potential. Grayson County likely incurs some level of annual damages to buildings, homes and infrastructure as a result of these expansive soils that are prevalent throughout the county.

The estimated maximum severity level for expansive soils used in this planning process for determining potential input and possible mitigation actions is a shrink-swell potential of 15 times its original size and for an area of 50% of the County.

2.15 DESCRIPTION – LANDSLIDE

A landslide is the downward and outward movement of slope-forming soil, rock and vegetation, which is driven by gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snowmelt, steepening of slopes due to construction or erosion, earthquakes, volcanic eruptions and changes in groundwater levels. Landslides occur when the force of gravity pulling down the slope exceeds the strength of the earth materials that comprise the soil and hold it in place.

There are several types of landslides: rock falls, rock topple, slides, slumps and debris flows. Rock falls are rapid movements of bedrock, which result in bouncing or rolling. A topple is a section or block of rock that rotates or tilts before falling to the slope below. Slides are movements of soil or rock along a distinct surface of rupture, which separates the slide material from the more stable underlying material. Slumps are landslides that typically occur on smaller slopes when loosely consolidated materials or rock layers move a short distance down a slope, typically in a rotational fashion. Debris flows, sometimes referred to as mudslides, mudflows, lahars or debris avalanches, are fast-moving rivers of rock, earth and other debris saturated with water.

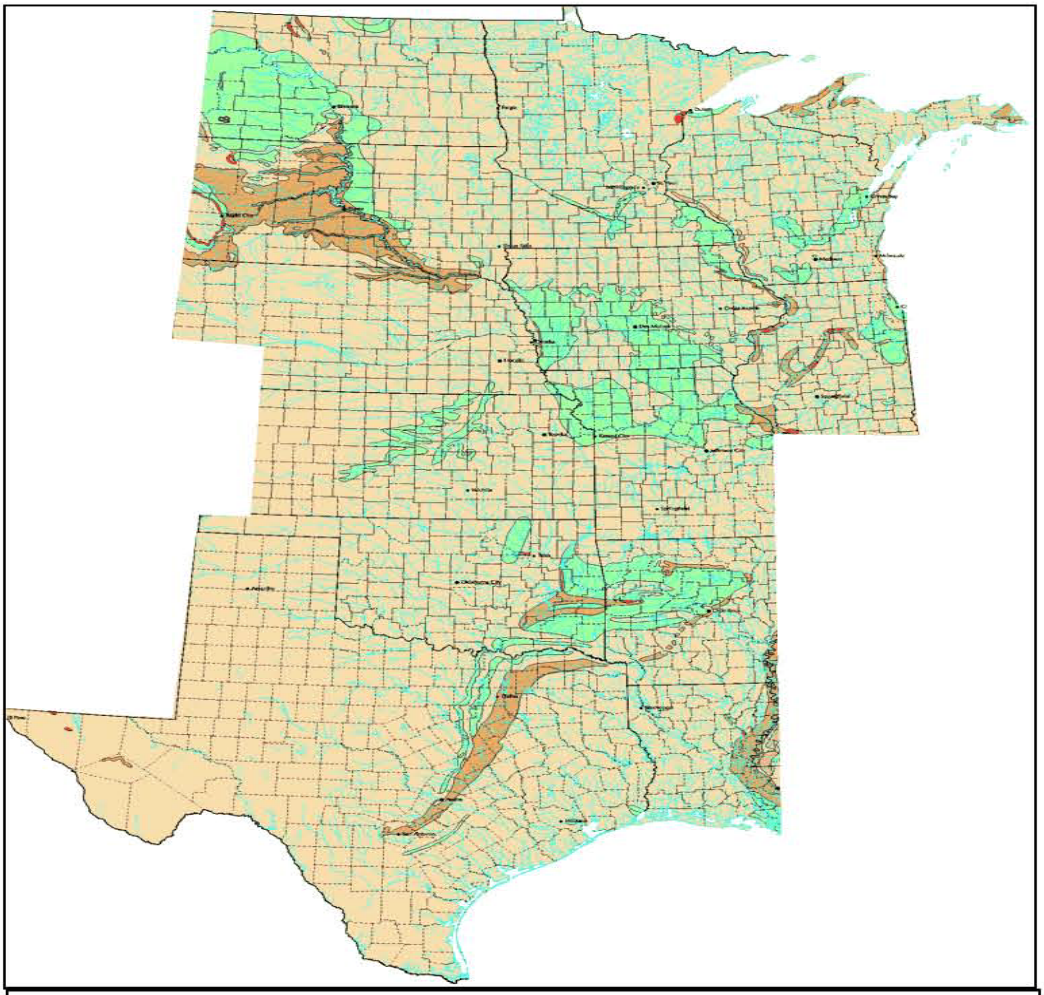
Landslides are typically associated with periods of heavy rainfall or rapid snowmelt and tend to worsen the effects of flooding that often accompany these events. Slopes are also more likely to fail if vegetative cover is low and/or soil water content is high. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Slopes greater than 10 degrees are more likely to slide, as are slopes where the height from the top of the slope to its toe is greater than 40 feet.

Location and Extent – Landslide

In the United States, it is estimated that landslides cause up to $2 billion in damages and from 25 to 50 deaths annually. Globally, landslides cause billions of dollars in damage and thousands of deaths and injuries each year.

According to the USGS Landslide Hazards Program, portions of Grayson County are located in an area where landslide incidence is low (less than 1.5% of area involved), but where susceptibility is moderate *(Figure 2.13).*

The specific areas of Grayson County that have sufficient topographic relief to be susceptible to potential landslides are very limited and are generally not present within populated urban areas; therefore, only the Grayson County unincorporated areas are expected to have moderate susceptibility. Likewise, the extent of damages possible from this hazard is very low. Additional information regarding these events is not available at the present time, but collection and evaluation of additional data has been included as an objective in the five year planning cycle update.



Landslide Incidence	
	Low (less than 1.5% of area involved)
	Moderate (1.5%-15% of area involved)
	High (greater than 15% of area involved)
Landslide Susceptibility / Incidence	
	Moderate susceptibility/low incidence
	High susceptibility/low incidence
	High susceptibility/moderate incidence

Figure 2-13 Landslide Incidence Map
Source: USGS

Probability of Occurrence – Landslide

Due to the topographic characteristics of Grayson County, and since Grayson County is located within a zone characterized with a relatively low incidence and moderate susceptibility for landslide, the likelihood of such an event in Grayson County is very low. Specific and detailed data regarding this hazard is currently unavailable at this time. Obtaining any previous historical data and estimating the future probability of recurrence are included as action items in order to eliminate this data deficiency for the unincorporated area of Grayson County.

2.16 DESCRIPTION – LAND SUBSIDENCE

According to the State of Texas Mitigation Plan, land subsidence is defined as the loss of surface elevation due to the removal of subsurface support. It can range from broad, regional lowering of the land surface, to localized collapses. Land subsidence extent is measured by the number of feet of land loss, or sinks.

Land subsidence occurs when large amounts of ground water have been withdrawn from certain types of rocks, such as fine-grained sediments. Because the water is partly responsible for holding the ground up, the rock gets compacted. When the water is withdrawn, the rocks fall in on themselves.

Location and Extent – Land Subsidence

Subsidence is a global problem and, in the United States, more than 17,000 square miles in 45 States, have been directly affected by subsidence. More than 80 % of the identified subsidence in the Nation has occurred because of exploitation of underground water. The increasing development of land and water resources threatens to exacerbate existing land-subsidence problems and initiate new ones. In many areas of the arid Southwest, and in more humid areas underlain by soluble rocks such as limestone, gypsum (or salt) land subsidence is an often-overlooked environmental consequence of our land- and water-use practices.

Location of land subsidence in Texas would most likely be along the Texas Gulf Coast counties where the removal of subsurface support (such as groundwater) could cause the loss of surface elevation.

According to the USGS compaction of soils in some aquifer systems can accompany excessive ground-water pumping, which is by far the single largest cause of subsidence. Excessive pumping of such aquifer systems has resulted in permanent subsidence and related ground failures. In some systems, when large amounts of water are pumped, the subsoil compacts, thus reducing in size and number the open pore spaces in the soil that previously held water. This can result in a permanent reduction in the total storage capacity of the aquifer system. *Figure 2.14* shows the location of major unconsolidated aquifer systems in the United States. Grayson County is not located near any of these aquifer systems.

Additional information regarding these events is not available at the present time, but an action item to address this data deficiency has been included as an objective in the five year planning cycle update.

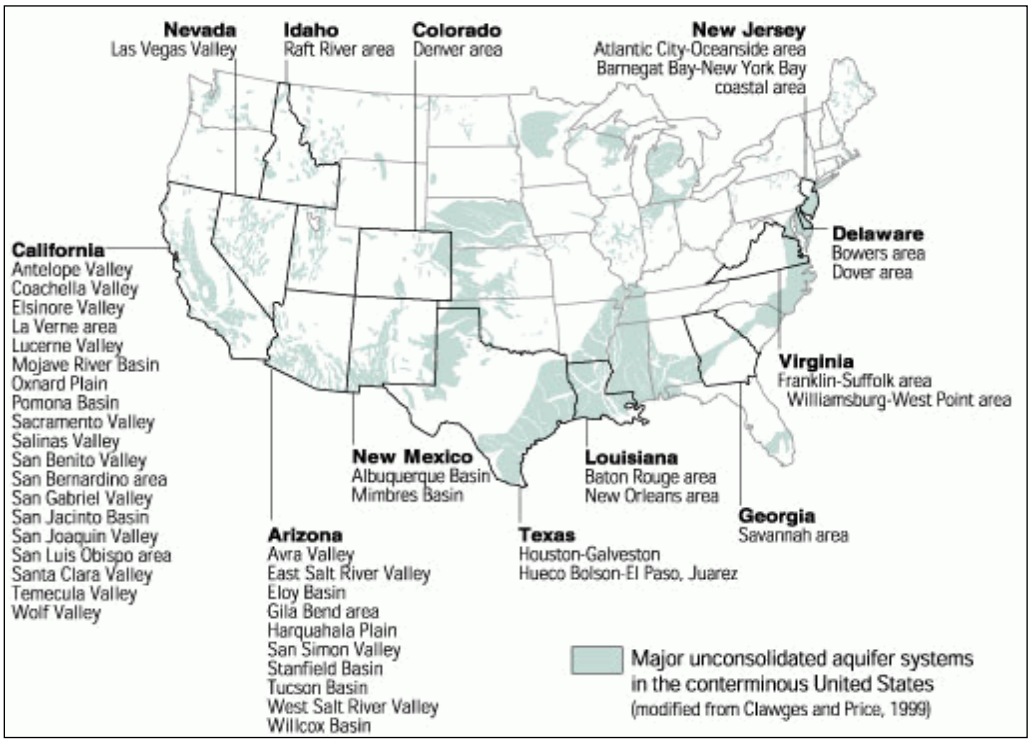


Figure 2-14 Aquifer Systems in the United States
Source: USGS

Probability and Extent of Occurrence – Land Subsidence

According to USGS, Grayson County is not located near or around an unconsolidated aquifer system; the probability of this hazard affecting Grayson County is not likely but could occur and is thought to have an annual probability of occurrence of less than 1%. If this hazard does occur, it has been assumed that it will occur in a broad regional lowering of the land surface of less than one foot. Consequently, the Hazard Risk classification for this hazard is deemed to be too low to include as a priority hazard for this plan; however, obtaining both historical data and future probability information have been added as action items in order to address this data deficiency.

2.17 DESCRIPTION – TSUNAMI

A tsunami is a series of ocean waves generated in marine and coastal regions by sudden displacements in the sea floor, landslides, volcanic activity, and meteorological activity. As the tsunami wave moves closer to shore, it can transform from a wave a few inches high to a fast moving, turbulent wave several meters high. Major tsunamis are caused by large (greater than 7 on the Rich Scale), shallow focus (< 30km depth in the earth) earthquakes cause major tsunamis. The average distribution of causes of tsunamis is presented in *Figure 2.15.*

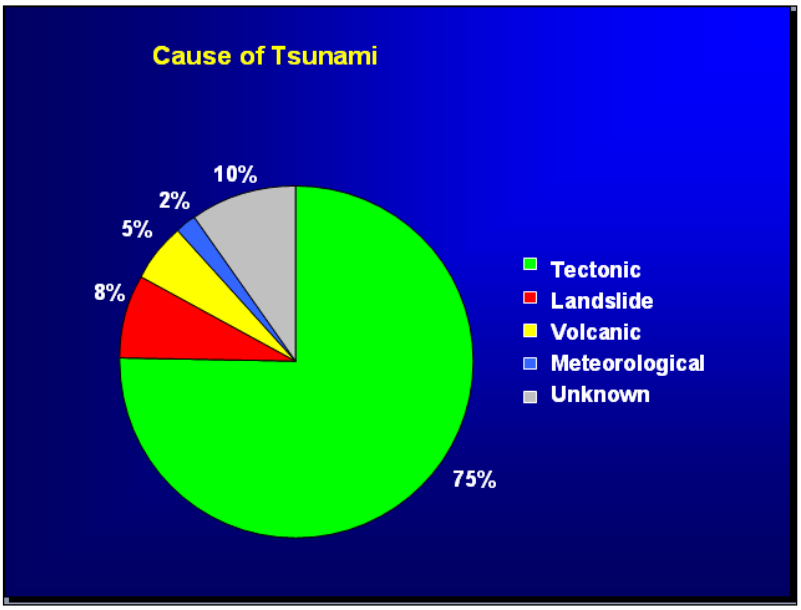


Figure 2-15 Distribution of Causes of Tsunamis
Source: Institute of Computational Mathematics and Mathematical Geophysics; Tsunami Laboratory

Location and Extent – Tsunami

Figure 2.16 provides the probable worldwide distribution of tsunami events. As observed in the figure, tsunamis mostly occur in the Pacific Ocean and always in coastal zones. Due to Grayson County's geographic location, tsunamis are not considered a threat to the region and are not mentioned in the State of Texas Mitigation Plan.

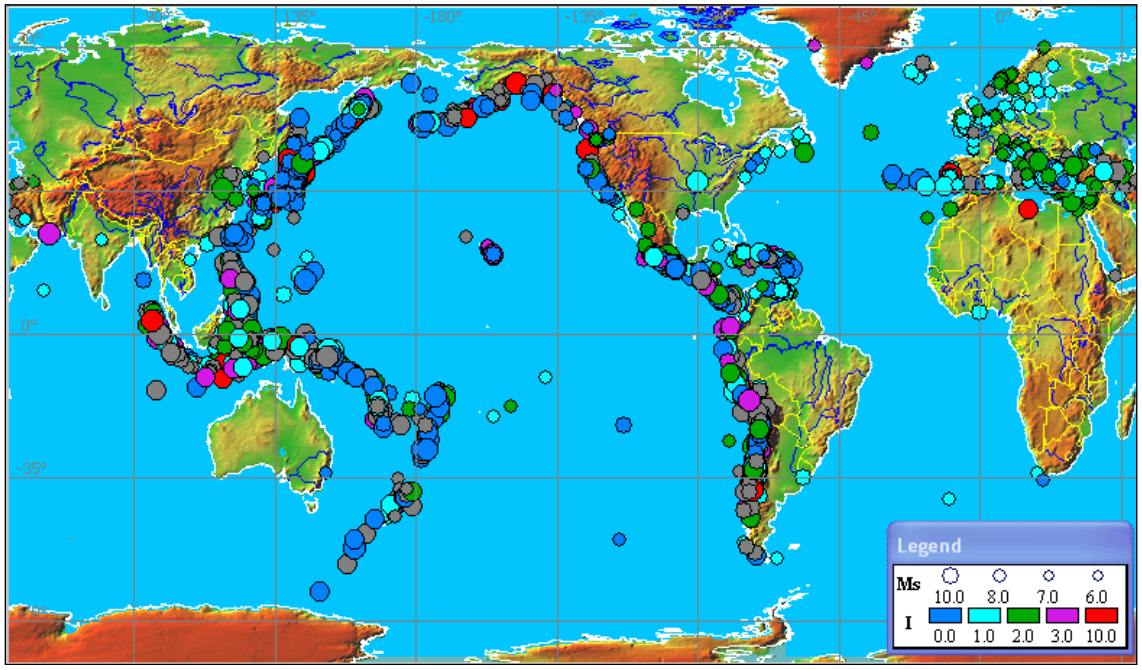


Figure 2-16 Tsunami Events
Source: Institute of Computational Mathematics and Mathematical Geophysics; Tsunami Laboratory

Tsunamis can cause the loss of human life and the destruction of property along the coastline. The effect a tsunami has on a community can be mitigated through community preparedness, timely warnings, and effective response. Warning systems can monitor earthquake activity but cannot predict the impact of the tsunami at a particular coastal location.

Probability of Occurrence – Tsunami

Tsunamis occur along coastal regions, mostly in the Pacific Ocean. The probability of a tsunami affecting Grayson County is zero; consequently, this hazard is not considered further within this Plan.

2.18 DESCRIPTION – VOLCANO

Volcanoes form when pieces of the earth's crust move apart or collide with one another, allowing molten rock, ashes and gases to escape from below the crust. They can also be caused by mantle plumes. Volcanoes are typically mountains or features that resemble mountains.

Location and Extent – Volcano

Sixty percent of the earth's volcanoes are located at crustal plate boundaries. The explosive ejection of molten rock and rock fragments can endanger the lives of people and property. Volcanic particles can be flung as far as 20 miles high and many miles away from the volcano. Volcanic eruptions can cause tsunamis, a significant hazard in itself. Volcanic ash can also pose a serious threat to aviation. According to *Figure 2.17* Grayson County is not located in a region affected by volcanic activity, and is not mentioned in the State of Texas Mitigation Plan.

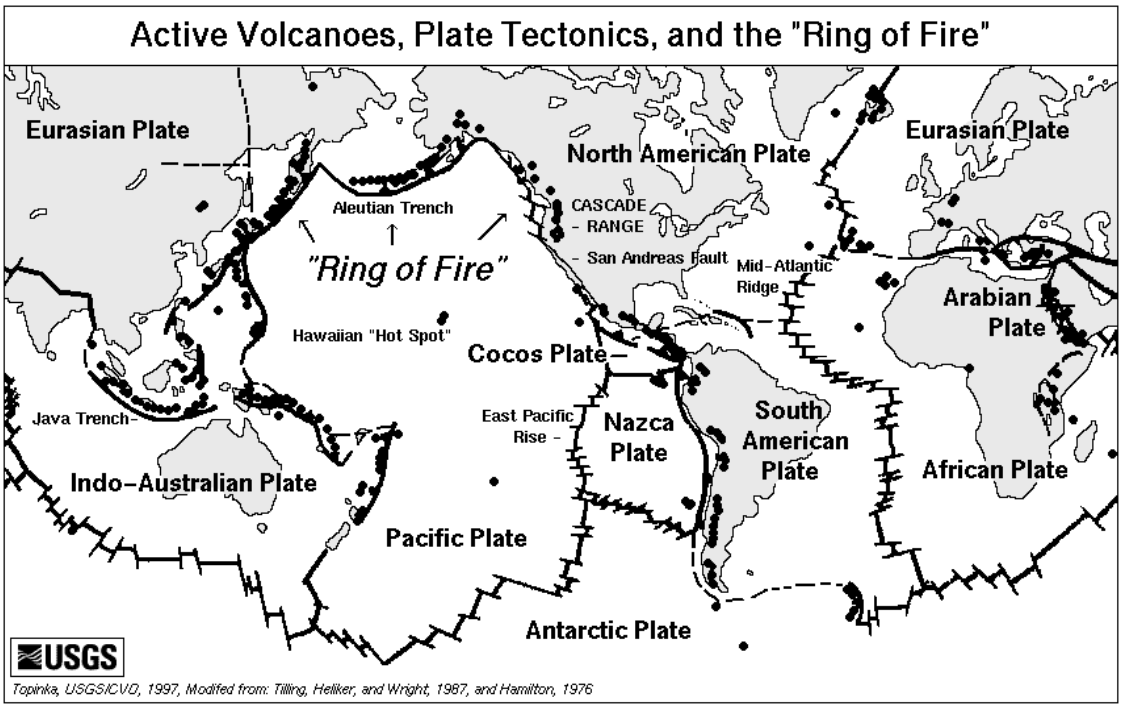


Figure 2-17 Active Volcanoes, Plate Tectonics, and the "Ring of Fire"
Source: United States Geological Survey (USGS)

Probability of Occurrence – Volcano

As shown in *Figure 2.17* Grayson County is not located in a region affected by volcanic activity and probability is considered to be zero; consequently, this hazard is not considered further within this Plan.

2.19 DESCRIPTION – WILDFIRE

A wildfire is any fire occurring in a wildland area (e.g., grassland, forest, brush land) except for fire under prescription. Wildfires are part of the natural management of forest, grassland and brush land ecosystems, but may also be caused by human factors. Nationally, over 80 % of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

There are three classes of wildland fires: surface fires, ground fires, and crown fires. A surface fire is the most common of these three classes and burns along the floor of a forest, moving slowly and killing or damaging trees. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees.

Wildland fires are usually signaled by dense smoke that fills the area for miles around. Wildfire probability depends on local weather conditions, outdoor activities such as camping, debris burning and construction, and the degree of public cooperation with fire prevention measures. Drought conditions and other natural hazards (tornadoes, hurricanes, etc.) increase the probability of wildfires by producing fuel in both urban and rural settings. Forest damage from hurricanes and tornadoes may also block interior access roads and firebreaks, pull down overhead power lines, or damage pavement and underground utilities.

Wildfires can cause significant damage to property and threatens the lives of people who are unable to evacuate wildfire-prone areas. Many individual homes and cabins, subdivisions, resorts, recreational areas, organizational camps, businesses and industries are located within high wildfire hazard areas. Further, the increasing demand for outdoor recreation places more people in wildlands during holidays, weekends and vacation periods. Unfortunately, wildland residents and visitors are rarely educated or prepared for wildfire events that can sweep through the brush and timber and destroy property within minutes.

Wildfire hazards can be mitigated by protecting buildings, clearing dry vegetation, removing combustibles near the location, and other preventative measures. Human life can be spared by proper evacuation.

Location and Extent – Wildfire

Wildfire poses a major risk for Texas each year. Forest brush and grass fires are the greatest fire danger threats. The total Statewide costs for the wildfires of 1996, 1998, 1999, 2000 and 2006 are approximately $88,486,604. Rapid population growth and unrestrained building in Urban Wildland Interface in the Hill Country creates the potential for a major catastrophe. The potential for wildland fires is increased during certain times of the year with dry conditions in various parts of the United States

Grayson County is located in an area susceptible to wildfires. *Figure 2.18* below shows the locations across the United States that have experienced wildfires greater than 250 acres,

between 1980 and 2003. The undeveloped, grassland areas located throughout Grayson County cause the entire area to be prone to wildfires.

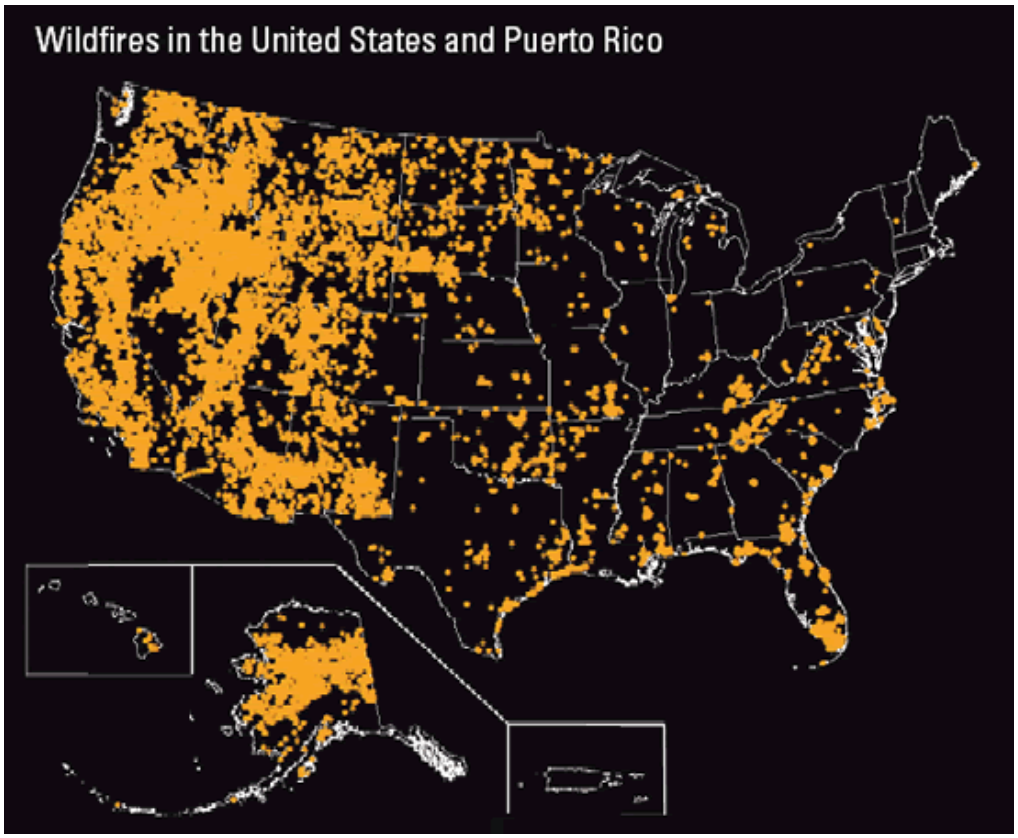


Figure 2-18 Wildfires in the United States and Puerto Rico
Source United States Geological Survey, Locations that experienced wildfires greater than 250 acres between 1980 and 2003

Historical Occurrences – Wildfire

According to National Climatic Data Center, there has been one wildfire recorded in Grayson County since 1950. The wildfire resulted in $1,000,000 in property damage with no injury or loss of life. The counties affected within North Central Texas include Grayson, Hamilton, Parker and Wise. A summary of the incidents as reported by National Climatic Data Center is provided below. However, emergency management officials of Grayson County believe that wildfires are under-reported to the NCDC and to the State of Texas. Maintenance of accurate historical wildfire occurrences is now underway by Grayson County Office of Emergency Management.

January 29, 2008
"Fires fueled by sustained winds around 40 MPH fanned a fire near Reno. A business housed in a mobile home sustained about $100,000 worth of damage. A pickup truck, hundreds of tires, and various other equipment were destroyed. A total of 18 structures were lost with nearly 3,500 acres burned. Hundreds of acres of hay were also lost. There

were dozens of reports of damage due to strong winds as a powerful low pressure system and cold front moved through the state."

Reported fire call data from January 2009 to December 2009 was requested from the individual fire departments within Grayson County. *Table 2.13* consists of a summary of calls for the departments who provided data.

Table 2.13 Summary of Reported Fire Calls

Fire Department	Wildland Fires	Acres	Vehicle Calls	Haz-Mat Calls	Structural Fires	EMS Calls	Search Rescue Calls	Other Calls	Total Calls
Denison Fire Department	63	364	30	39	49	1836	11	792	**2820**
Gunter Fire Department	36	1,050	17	15	19	165	5	63	**320**
Locust Fire Department	11	3,500	6	0	8	135	0	14	**174**
North Texas Regional Airport Fire Department (Denison)	36	300	7	13	30	75	1	122	**284**
Pottsboro Fire Department	6	193	3	3	2	96	3	51	**164**
Preston Valley Emergency Services	21	50	36	0	18	283	1	98	**457**
Sherman Fire Department	111	17	40	212	55	4098	8	1070	**5594**
Southmayd Fire Department	5	300	4	3	1	39	0	12	**64**
Whitesboro Fire Department	50	500	46	16	5	704	15	151	**987**
Whitewright Fire Department	40	8,000	25	0	19	70	0	15	**169**
Total	**379**	**14,274**	**214**	**301**	**206**	**7,501**	**44**	**2388**	**11,033**

Source: Data was provided by the respective fire departments.

Probability and Extent of Occurrence – Wildfire

Given the vast amount of grassland and undeveloped land, the probability of future wildfires occurring in Grayson County is high. In 2009 alone, reports of over 350 wildland fires were recorded by individual fire departments within Grayson County. Based on past reporting fire calls, some areas in Grayson County may be more prone to others such as Whitewright, Denison, Pottsboro, Sadler, and Van Alstyne. For purposes of estimating the level of severity and planning mitigation actions, a wildfire of 2000 acres burned along the urban/wildland interface has been used.

2.20 CONCLUSION OF HAZARDS

Hazard profiles presented in this section were developed using the best available data and considered principally a qualitative assessment as recommended by Federal Emergency Management Agency in its guidance document, *Understanding Your Risks: Identifying Hazards and Estimating Losses (Federal Emergency Management Agency Publication 386-2).* This section relies heavily on historical data, anecdotal data, stakeholder input, and experienced professional judgment regarding observed and/or anticipated hazard impacts. *Table 2.14* summarizes a preliminary assessment of the relevance of each hazard for Grayson County and the basis for this determination.

Table 2.14 Hazard Assessment

Natural Hazards	Significant to Grayson County (Yes or No)	Basis of Determination	Details
ATMOSPHERIC			
Avalanche	NO	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of US Forest Service National Avalanche Center web site.	There is no risk of avalanche events in Grayson County. The topography and climate in Grayson County would not support conditions needed for an avalanche to occur.
Extreme Temperature	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan. Review of National Oceanic Atmospheric Administration National Climatic Data Center Storm Events Database.	Extreme temperature events are discussed in The State of Texas Mitigation Plan. National Climatic Data Center reports six extreme temperature events for Grayson County between April 1997 and September 2000 (five extreme heat events, and one extreme cold event). There were no recorded property damages in connection to the events; 53 fatalities were reported.
Extreme Windstorm	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan. Review of National Oceanic Atmospheric Administration National Climatic Data Center Storm Events Database.	Extreme windstorms events are discussed in The State of Texas Mitigation Plan. National Climatic Data Center reports 235 high wind events for Grayson County between August 1957 and February 2009. These events have resulted in no recorded deaths, nine injuries and a reported $1.93 million in property damage. Grayson County is located in a climate region that is highly susceptible to numerous types of extreme wind

Natural Hazards	Significant to Grayson County (Yes or No)	Basis of Determination	Details
			events. Grayson County is located within Zone VI and is susceptible to wind speeds of 250 mph.
Hailstorm	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan Review of National Oceanic Atmospheric Administration and the National Climatic Data Center Storm Events Database.	Hailstorm events are discussed in The State of Texas Mitigation Plan. National Climatic Data Center reports 213 severe hailstorm events for Grayson County between April 1955 and May 2008. For these events there are no recorded deaths or injuries, but has a recorded property damages of $30.375 million. Since 1980, the United States has averaged 3,000 hailstorms a year, with four states accounting for 42% of the total: Texas (500), Oklahoma (400), Kansas (400), and Nebraska (135).
Coastal Storms Hurricane / Tropical Storm	NO	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan Review of National Oceanic Atmospheric Administration National Climatic Data Center Storm Events Database	Costal Storms (Hurricane / Tropical Storms) events are discussed in The State of Texas Mitigation Plan. National Climatic Data Center reports one severe tropical depression events for Grayson County in September of 2008. There were no recorded deaths or injuries in connection to this event, and a recorded property damage of only $5,000.
Lightning	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of National Oceanic Atmospheric Administration National Climatic Data Center Storm Events Database. U.S. National Lighting Detection Network.	National Climatic Data Center reports nine severe lightning events for Grayson County between September 1955 and August 2008. There are no recorded deaths or injuries in connection to these events, but recorded property damages of $280,000. Grayson County is located in a region of the country that is highly susceptible to lighting strikes.
Severe Winter Storm	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan Review of National Oceanic	Severe winter storm events are discussed in The State of Texas Mitigation Plan. National Climatic Data Center reports 22 severe winter storm events in Grayson County between February 1994 and January

Natural Hazards	Significant to Grayson County (Yes or No)	Basis of Determination	Details
		Atmospheric Administration National Climatic Data Center Storm Events Database	2009. There are no recorded deaths or injuries in connection to these events, but there are recorded property damages of $65.07 million. The Texas Panhandle and North Central Texas around Dallas and Texarkana are most vulnerable to severe winter storms.
Tornado	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan Review of National Oceanic Atmospheric Administration National Climatic Data Center Storm Events Database. Review of National Oceanic Atmospheric Administration; Federal Emergency Management Agency	Tornado events are discussed in The State of Texas Mitigation Plan. National Climatic Data Center reports 22 severe tornado events in Grayson County between April 1952 and December 2008. For these events, there were two recorded deaths, 49 injuries, and recorded property damages of $6.197 million. Texas averages 123 tornadoes annually, 88% are F-0 or F-1 and only 3% are F-3 or F-4 that causes 65% of the deaths.
HYDROLOGIC			
Coastal Erosion Coastal Retreat / Coastal Subsidence	NO	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan	Coastal Erosion (Coastal Retreat / Coastal Subsidence) events are discussed in The State of Texas Mitigation Plan. No coastline (beach, shoreline, or dunes) in Grayson County.
Dam Failure & Levee Failure	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan Review of U.S. Army Corps of Engineers National Inventory of Dams database. HAZUS-MH® database.	According to The State of Texas Mitigation Plan, there are 7,546 dams in the State of Texas, of which 106 are located in Grayson County. The State of Texas Mitigation Plan states that there are an increasing number of these high-hazard structures, not because higher hazard dams are being built, but because more development is occurring downstream.
Drought	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan Review of National Oceanic	Drought events are discussed in The State of Texas Mitigation Plan. National Climatic Data Center reports 24 drought events in Grayson County between August 1996 and February 2009. For these events, there were no

Natural Hazards	Significant to Grayson County (Yes or No)	Basis of Determination	Details
		Atmospheric Administration National Climatic Data Center Storm Events Database.	recorded deaths or injuries, but recorded property damage of $100.500 million and $2.581 billion in crop damage.
Flood	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment Review of The State of Texas Mitigation Plan Review of National Oceanic Atmospheric Administration National Climatic Data Center Storm Events Database	Flooding is discussed in the State of Texas Mitigation Plan as a hazard of concern and indicated that it is the most frequent destructive and costly natural hazard the State of Texas, constituting 91% of the disaster damage in the State. National Climatic Data Center reports 51 flood events in Grayson County between May 1993 and May 2008. For these events, there were three recorded deaths, and a recorded property damage of $21.215 million.
GEOLOGIC			
Earthquake	NO	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan United States Geological Survey. The University of Texas at Austin Institute for Geophysics.	Earthquake events are discussed in The State of Texas Mitigation Plan. Texas does face moderate risk to less frequent, less intense earthquake events. There are very few earthquakes with epicenters within the Northeast Texas region in which Grayson County is located, but past earthquakes have been recorded in surrounding counties.
Expansive Soils	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan Swelling Clays Map of the Conterminous United States	Expansive soils are discussed in The State of Texas Mitigation Plan. The percentage of insurance claims made in Texas involving foundations in 2005 is up to 14%.
Landslide	NO	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. USGS Landslide Hazards Program	According to the USGS Landslide Hazards Program, Grayson County in located in an area where landslide incidence is low (less than 1.5% of area involved), and where landslide susceptibility / incidence is moderate susceptibility/low incidence.
Land Subsidence	NO	Review of Federal Emergency Management Agency's Multi-	Land Subsidence events are discussed in The State of Texas Mitigation Plan.

Natural Hazards	Significant to Grayson County (Yes or No)	Basis of Determination	Details
		Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan USGS; Land Subsidence.	Location of land subsidence in Texas would most likely be along the Texas Gulf Coast counties where the removal of subsurface support (such as groundwater) could cause the loss of surface elevation, and possibility of occurrence is low.
Tsunami	NO	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Tsunami Laboratory.	A tsunami is a series of ocean waves generated in marine and coastal regions by sudden displacements in the sea floor, landslides, volcanic activity, and meteorological activity. The location of Grayson County would not support conditions for a tsunami to occur.
Volcano	NO	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. United States Geological Survey (USGS).	According to The United States Geological Survey, Grayson County is not located in a region affected by volcanic activity.
OTHER			
Wildfire	YES	Review of Federal Emergency Management Agency's Multi-Hazard Identification and Risk Assessment. Review of The State of Texas Mitigation Plan Review of National Oceanic Atmospheric Administration National Climatic Data Center Storm Events Database Review of Texas Forest Service.	Wildfire events are discussed in The State of Texas Mitigation Plan. National Climatic Data Center reports one wildfire event in Grayson County in January of 2008. This event has no recorded deaths or injuries, but has a recorded property damage of $1.0 million.

2.21 THE PRIORITY RISK INDEX

A Priority Risk Index (PRI) was developed with the purpose of categorizing potential hazards for Grayson County and ranks each hazard as high, moderate, low, or no risk. The hazard classification generated through the use of the PRI allows for the prioritization of those high hazard risks for mitigation planning purposes, and more specifically, the identification of hazard mitigation opportunities for Grayson County jurisdictions to consider as part of their proposed mitigation strategy.

The PRI is used to assist Grayson County in gaining consensus on the determination of those hazards that pose the most significant threat to Grayson County based on a variety of factors. The PRI is not scientifically based, but is rather meant to be utilized as an objective and systematic planning tool for classifying and prioritizing hazard risks in Grayson County based on standardized criteria. The PRI results in numerical values that allow identified hazards to be ranked against one another. The sum of all four categories equals the final PRI value, as shown below:

PRI Value = (Probability x .30) + (Life Impact x .35) + (Property Impact x .25) + (Spatial Extent x .10)
The higher the PRI value, the greater the hazards risk. These values were obtained by assigning varying degrees of risk to four categories for each hazard: Probability, Life Impact, Property Impact, and Spatial Extent *(Table 2.15).* Each category has been assigned an Index Value (0 to 3) and a Weighing Factor (0 – 100%). These values may be adjusted during future plan updates. In order to evaluate the risk of each hazard, the assigned Index Value for each category is multiplied by the weighing factor. Then, the PRI for each hazard is calculated by adding the product obtained in each category. According to the weighing scheme applied for Grayson County, the highest possible PRI value is 3.0. The PRI calculations are presented in *Table 2.16*.

Table 2.15 Priority Risk Index for Grayson County

Assigned Weighing Factor	PRI Category	Degree of Risk		
		Level	Criteria	Index Value
30 %	Probability	Unlikely	Less than 1% annual probability	0
		Possible	Between 1 and 10% annual probability	1
		Likely	Between 10 and 100% annual probability	2
		Highly Likely	100% annual probability	3
35%	Life Impact	Minor	Very few injuries, if at all none	0
		Limited	Minor injuries	1
		Critical	Multiple deaths/injuries	2

Assigned Weighing Factor	PRI Category	Degree of Risk		
		Level	Criteria	Index Value
		Catastrophic	High number of deaths/injuries	3
25%	Property Impact	Minor	Only minor property damage and minimal disruption of life. Temporary shutdown of critical facilities.	0
		Limited	More than 10% of property in affected area damaged/destroyed. Complete shutdown of critical facilities for more than one day.	1
		Critical	More than 25% of property in affected area damaged/destroyed. Complete shutdown of critical facilities for more than one week.	2
		Catastrophic	More than 50% of property in affected area damaged/destroyed. Complete shutdown of critical facilities for 30 days or more.	3
10%	Spatial Extent	Negligible	Less than 1% of area affected	0
		Small	Between 1 and 10% of area affected	1
		Moderate	Between 10 and 50% of area affected	2
		Large	Between 50 and 100% of area affected	3

Table 2.16 Summary of PRI Results for Grayson County

Hazard	Category / Degree of Risk				
	Probability	Life Impact	Property Impact	Spatial Extent	PRI Score
Weighing Factor	30%	35%	25%	10%	
Atmospheric					
Avalanche	Unlikely (0)	Minor (0)	Minor (0)	Negligible (0)	0
Extreme Temperature	Highly Likely (3)	Critical (2)	Limited (1)	Large (3)	2.15
Extreme Windstorm	Highly Likely (3)	Critical (2)	Critical (2)	Large (3)	2.40
Hailstorm	Highly Likely (3)	Limited (1)	Catastrophic (3)	Moderate (2)	2.20

Hazard	Category / Degree of Risk				
	Probability	Life Impact	Property Impact	Spatial Extent	PRI Score
Weighing Factor	30%	35%	25%	10%	
Coastal Storms (Hurricane / Tropical Storm)	Unlikely (0)	Minor (0)	Minor (0)	Negligible (0)	0
Lightning	Highly Likely (3)	Limited (1)	Limited (1)	Moderate(2)	1.70
Severe Winter Storm	Likely (2)	Critical (2)	Catastrophic (3)	Large (3)	2.35
Tornado	Highly Likely (3)	Catastrophic (3)	Catastrophic (3)	Large (3)	3.00
Hydrologic					
Coastal Erosion	Unlikely (0)	Minor (0)	Minor (0)	Negligible (0)	0
Dam Failure & Levee Failure	Likely (2)	Limited (1)	Catastrophic (3)	Small (1)	1.80
Drought	Highly Likely (3)	Minor (0)	Catastrophic (3)	Large (3)	1.95
Flood	Highly Likely (3)	Critical (2)	Catastrophic (3)	Large (3)	2.65
Geologic					
Earthquake	Unlikely (0)	Minor (0)	Limited (1)	Large (3)	0.55
Expansive Soils	Likely (2)	Minor (0)	Catastrophic (3)	Small (1)	1.45
Landslide	Unlikely (0)	Minor (0)	Limited (1)	Negligible (0)	0.25
Land Subsidence	Unlikely (0)	Minor (0)	Limited (1)	Small (1)	0.35
Tsunami	Unlikely (0)	Minor (0)	Minor (0)	Negligible (0)	0
Volcano	Unlikely (0)	Minor (0)	Minor (0)	Negligible (0)	0
Other					
Wildfire	Likely (2)	Limited (1)	Catastrophic (3)	Moderate (2)	1.90

The conclusions drawn from the hazard profiling process for Grayson County, resulted in the classification of risk for each identified hazard according to four categories: High Risk, Moderate Risk, Low Risk, and No Risk *(Table 2.17).* For purposes of these classifications, risk is expressed in relative terms according to the probability of occurrence and estimated impact that a hazard will have on human life and property in Grayson County.

Table 2.17 Hazard Risk for Grayson County

Risk Level	Hazard	PRI Score
High Risk (PRI 2.0 – 3.0)	Tornado	3.00
	Flood	2.65
	Extreme Wind Storm	2.40
	Severe Winter Storm	2.35
	Hailstorm	2.20
	Extreme Temperature	2.15
Moderate Risk (PRI 1.0 -1.95)	Drought	1.95
	Wildfire	1.90
	Dam & Levee Failure	1.80
	Lightning	1.70
	Expansive Soils	1.45
Low Risk (PRI 0.50 – 0.95)	Earthquake	0.55
No Risk (PRI 0 – 0.49)	Land Subsidence	0.35
	Landslide	0.25
	Avalanche	0.00
	Coastal Erosion	0.00
	Coastal Storm (Hurricane/Trop. Storm	0.00
	Tsunami	0.00
	Volcano	0.00

A quantitative analysis to estimate potential dollar losses for hazard which directly impacts Grayson County, has been performed separately at the local jurisdictional level, and is described in the Vulnerability Assessment Section. It should be noted that although the PRI classifies some hazards as posing low risk, their occurrence of varying or unprecedented magnitudes is still possible in some cases. Therefore, their classification will continue to be evaluated during future plan updates.

3 VULNERABILITY ASSESSMENT

This section of the Hazard Mitigation Plan provides a vulnerability assessment for the twelve natural hazards that, based on the Priority Risk Index calculations, are considered to pose a high, moderate, or low risk to Grayson County. The hazards considered to pose a high risk are: Tornado, Flood, Extreme Wind Storm, Severe Winter Storm, Hailstorm, and Extreme Temperature. The hazards considered to pose a moderate risk are: Drought, Wildfire, Dam & Levee Failure, Lightning, and Expansive Soils. Earthquake is considered to pose a low risk. No further analysis has been conducted on the remaining seven natural hazards classified to pose no risk for Grayson County, including Land Subsidence, Landslide, Avalanche, Coastal Erosion, Coastal Storm (Hurricane/Tropical Storm), Tsunami, and Volcano.

According to *Requirement 201.6(c)(2)(ii) "The risk assessment shall include a description of the jurisdiction's vulnerability to the hazards that can affect the jurisdiction. This description shall include an overall summary of each hazard and its impact on the community."* In compliance with *Requirement 201.6(c)(2)(iii),* the vulnerability assessment was conducted for each jurisdiction as needed to reflect unique or varied risks within the County. This objective was met by analyzing the data on an individual basis to assess each jurisdiction's risk.

3.1 IDENTIFICATION OF ASSETS

An inventory of Grayson County's geo-referenced assets was created in order to identify and characterize property and population potentially at risk to the identified hazards. By understanding the type and number of assets that exist and where they are located in relation to known hazard areas, the relative risk and vulnerability for such assets can be assessed. For this assessment, five categories of assets were evaluated using Geographic Information System and statistical analysis. The five categories of vulnerable assets include:

- Population: Includes the number of people residing in Grayson County as delineated by U.S. Census 2000 block data provided by the Texas Hazard Mitigation Package.
- Improved property: Includes all developed properties according to local parcel Grayson Central Appraisal District. The information has been expressed in terms of the total assessed value of improvements that may be exposed to the identified hazards.
- Emergency facilities: Includes fire stations, police stations and hospitals, provided by HAZUS-MH®, Grayson County Emergency Management Coordinator, and participating jurisdictions.
- Critical facilities: Includes schools and historic places provided by HAZUS-MH®, Grayson County Emergency Management Coordinator, and participating jurisdictions. These are non-emergency facilities, but still provide critical services and functions for vulnerable sectors of the population.
- Critical infrastructure: Includes airports, natural gas facilities, wastewater facilities, potable water treatment facilities, wastewater treatment facilities, dams, and bridges. Data for all critical facilities was obtained from HAZUS-MH®, Grayson County Emergency Management Coordinator, and participating jurisdictions.

The following tables provide a breakdown by municipal jurisdiction of the geo-referenced assets that were used for the vulnerability assessment. Maps showing the location of these assets within the individual jurisdictions are also provided at the end of this section.

Population

According to the U.S. Census 2000 block data provided by the Texas Hazard Mitigation Package, the total population of Grayson County in 2000 was 110,595 people, with 42,849 households. The count breakdown by municipal jurisdiction is provided in *Table 3.1*.

Table 3.1 Grayson County Population Counts

Jurisdiction	Population			Households		
	Population	% of County Total	Population Density (Sq. Mile)	Household	% of County Total	Household Density (Sq. Mile)
Grayson County*	46,168	41.8	54.6	17,581	41.0	20.8
Bells	398	0.4	185.6	171	0.4	79.8
Collinsville	752	0.7	1,262.0	295	0.8	495.1
Denison	20,356	18.4	892.7	8,259	19.0	362.2
Dorchester	65	0.1	43.3	23	0.1	15.3
Gunter	826	0.7	442.0	178	0.4	95.3
Howe	1,755	1.6	438.4	650	2.0	162.4
Knollwood	282	0.3	3,581.0	102	0.2	1,295.3
Pottsboro	781	0.7	272.2	293	0.7	102.1
Sadler	189	0.2	227.9	79	0.2	95.3
Sherman	31,439	28.0	815.3	12,273	29.0	318.3
Southmayd	479	0.4	269.1	167	0.4	93.8
Tioga	461	0.4	363.8	190	0.4	149.9
Tom Bean	362	0.3	357.0	153	0.4	150.9
Van Alstyne	2,060	2.0	615.0	790	2.0	235.9
Whitesboro	2,732	3.0	887.8	1,106	3.0	359.4
Whitewright	1,490	1.0	817.1	539	1.0	295.6
Total	**110,595**	**100.0**	**118.5**	**42,849**	**100.0**	**45.9**

Source: Texas Hazard Mitigation Package Population (Block) 2000
* *Grayson County unincorporated areas*

Table 3.2 summarizes population counts and population chance (absolute and percent predications for Grayson County.

Table 3.2 Population Predictions

County	Population 2000 Census	Population 2005 Estimate	Population 2010 Estimate	Absolute Change 2000-2010	Percent (%) Change 2000-2010
Grayson County	110,595	114,081	117,732	7,137	6.45 %

Source: Texas Hazard Mitigation Package Population (County) 2005 Estimate, 2010 Estimate

Property

There are an estimated 74,825 thousand parcels in Grayson County *(Figures 3.1-3.17, all located at the end of this section)*, with an approximate $7.1 billion in total assessed value. *Table 3.3* lists the total number and percentage of parcels by jurisdiction.

Table 3.3 Parcel Counts and Improvements Value

Jurisdiction	Number of Parcels	% of County Total	Total Assessed Value of Improvements (Buildings)[1]
Grayson County*	37,695	50.0	$2,400,531,269
Bells	560	1.0	$65,056,000
Collinsville	630	1.0	$64,963,000
Denison	12,395	17.0	$1,499,457,000
Dorchester	81	0.1	$4,227,000
Gunter	541	1.0	$62,325,000
Howe	1,042	1.0	$140,165,000
Knollwood	5	0.1	$8,029,000
Pottsboro	845	1.0	$83,735,000
Sadler	178	0.2	$17,653,000
Sherman	15,060	20.0	$2,252,008,000
Southmayd	463	1.0	$37,443,000
Tioga	463	1.0	$54,851,000
Tom Bean	422	1.0	$55,983,000
Van Alstyne	1,545	2.0	$164,444,000
Whitesboro	1,870	3.0	$227,218,000
Whitewright	1,030	1.0	$114,731
Total	**74,825**	**100.0**	**$7,138,203,000**

Source: Grayson Central Appraisal District and Federal Emergency Management Agency HAZUS-MH®

* *Grayson County unincorporated areas*

1 *Includes public buildings (residential, commercial, industrial, agricultural, religion, government, education)*

Emergency Facilities

There are 36 identified emergency facilities in Grayson County, including 22 fire stations, 14 police stations, and four hospitals *(Figure 3.18). Table 3.4* presents the distribution of emergency facilities by jurisdiction. Geographic coordinates were used to determine the location of each facility.

Table 3.4 Emergency Facilities

Jurisdiction	Fire Stations	Police Stations	Hospitals
Grayson County*	2	1	0
Bells	1	1	0
Collinsville	0	1	0
Denison	5	1	2
Dorchester	0	0	0
Gunter	1	1	0
Howe	1	1	0
Knollwood	0	0	0
Pottsboro	3	1	0
Sadler	0	0	0
Southmayd	0	1	0
Sherman	5	1	2
Tioga	0	1	0
Tom Bean	1	1	0
Van Alstyne	1	1	0
Whitesboro	0	1	0
Whitewright	2	1	0
Total	**22**	**14**	**4**

Source: Federal Emergency Management Agency HAZUS-MH® and participating jurisdictions

— *No Recorded Information*

* *Grayson County unincorporated areas*

Critical Facilities

There are 61 critical facilities, which are considered non-emergency in Grayson County *(Figure 3.19).* The critical facilities include 59 schools and two historical property sites (*Table 3.5*). Geographic coordinates (i.e., latitude and longitude) were used to determine the location of each facility.

Table 3.5 Critical Facilities

Jurisdiction	Schools	Historical Property
Grayson County*	11	0
Bells	3	0
Collinsville	2	0
Denison	13	0
Dorchester	0	0
Gunter	0	0
Howe	2	0
Knollwood	0	0
Pottsboro	3	0
Sadler	0	0
Sherman	15	0
Southmayd	1	0
Tioga	0	0
Tom Bean	3	0
Van Alstyne	0	1
Whitesboro	3	0
Whitewright	3	1
Total	**59**	**2**

Source: Grayson Central Appraisal District

— *No Recorded Information*

* *Grayson County unincorporated areas*

Critical Infrastructure

There are 605 identified critical infrastructure facilities in Grayson County *(Figure 3.20-3.21),* including two airports, one natural gas facility, 16 water treatment facilities, 37 wastewater treatment facilities, 106 dams, and 443 railway/highway bridges (*Table 3.6*).

Table 3.6 Critical Infrastructure

Jurisdiction	Airports	Natural Gas Facilities	Wastewater Treatment Facilities	Potable Water Treatment Facilities	Dams	Railway/ Highway Bridges
Grayson County*	0	0	12	8	100	312
Bells	0	0	0	3	0	3
Collinsville	0	0	1	1	0	0
Denison	1	0	0	1	2	39
Dorchester	0	0	0	2	0	0
Gunter	0	0	1	1	0	1
Howe	0	0	0	3	0	4
Knollwood	0	0	0	0	0	0
Pottsboro	0	0	0	0	0	0
Sadler	0	0	0	4	0	2
Sherman	1	1	0	0	3	69
Southmayd	0	0	0	1	0	1
Tioga	0	0	0	2	1	0
Tom Bean	0	0	1	1	0	0
Van Alstyne	0	0	0	0	0	3
Whitesboro	0	0	0	4	0	6
Whitewright	0	0	1	6	0	3
Total	**2**	**1**	**16**	**37**	**106**	**443**

Source: Grayson Central Appraisal District—: No Recorded Information

* *Grayson County unincorporated areas*

3.2 METHODOLOGY

Based on the type of information available for analysis, Grayson County's multi-jurisdictional vulnerability assessment was conducted using three distinct methodologies, a Geographic Information System-based analysis, a statistical risk assessment analysis, and a qualitative analysis. Each approach provides estimates for the potential impact of hazards by using a common, systematic framework for evaluation, of historical occurrence information provided by National Climatic Data Center, the Texas Hazard Mitigation Package and Federal Emergency Management Agency HAZUS-MH®. The results of the vulnerability assessment are provided by jurisdiction for each hazard analyzed.

Of the 12 hazards evaluated for Grayson County, four were analyzed using a Geographic Information System-based analysis, three using a statistical risk assessment methodology, and the remaining three hazards using a qualitative analysis. The qualitative analysis was limited to five of the hazards due to lack of information, the inability to define specific areas of risk, and/or inexistence of historical records. Additional information regarding these events is unattainable at the present time, but obtaining it has been included as an objective in the five-year planning cycle update, should the information become available. *Table 3.7* shows the methodology used for each hazard.

Table 3.7 Analysis Used for Vulnerability Assessment

Hazard	Geographic Information System-based Analysis	Statistical Analysis	Qualitative Analysis
Extreme Temperature		√	
Extreme Windstorm		√	
Hailstorm	√		
Lightning		√	
Server Winter Storm		√	
Tornado		√	
Dam Failure & Levee Failure			√
Drought	√		
Flood	√		
Earthquake			√
Expansive Soils			√
Wildfire	√		

3.2.1 Geographic Information System Based Analysis

For the Geographic Information System-based assessment, digital data was collected from local, state, and national sources. ESRI® ArcMap™ 9.2 was used to assess risk utilizing digital data, which included local tax records for individual parcels and geo-referenced point locations for buildings and critical facilities.

The objective of the Geographic Information System-based analysis was to determine the estimated vulnerability of the five categories of assets to the identified hazards for Grayson County using best available geospatial data. Local databases made available through Grayson County such as local tax assessor records, parcel boundaries, building footprints and critical and emergency facilities data, were used in combination with digital hazard data obtained from the Texas Hazard Mitigation Package and HAZUS-MH®. The results of the analysis provided an estimated number of people, as well as the numbers and values of buildings and critical facilities determined to be potentially at risk to those hazards with delineable geographic hazard boundaries.

For some of the hazards, the Geographic Information System analysis was supplemented with a statistical analysis conducted on the historical data obtained from National Climatic Data Center and the Texas Hazard Mitigation Package. The data included both personal and property losses from hazard events that occurred in Grayson County from 1950 to 2008. Dollar losses were adjusted to present value assuming an annual 6% inflation value. Annualized personal and property losses were calculated by dividing the total losses by the number of years for which data was available (i.e. 58 years).

3.2.2 Statistical Risk Assessment

A statistical risk assessment uses statistical and mathematical tools to predict hazard frequency and hazard estimated impacts. Data collected from National Climatic Data Center storm events database (recorded historic hazard events), census block data from the U.S. Census 2000 block data provided by the Texas Hazard Mitigation Package and HAZUS-MH® were used to assess vulnerability of the five vulnerable categories of assets: population, improved property, critical facilities, critical infrastructure, and emergency facilities.

The statistical analysis was conducted using the historical data obtained from National Climatic Data Center. The data included both personal and property losses from hazard events that occurred in Grayson County from 1950 to 2008. Dollar losses were adjusted to present value assuming an annual 6% inflation value. Annualized personal and property losses were calculated by dividing the total losses by the number of years for which data was available (i.e. 58 years).

3.2.3 Qualitative Analysis

In compliance to *Requirement 201.6(c)(2)(ii)* a qualitative analysis was made for five of the hazards representing low risk to Grayson County. While historical and geographical information regarding these events is unattainable at the present time, conducting a quantitative analysis for these hazards will be an objective in the five-year planning cycle update, should information become available.

3.3 HAILSTORM

Hail	
Population	According to National Climatic Data Center (NCDC), no recorded injuries or fatalities have been recorded for hailstorm events. There are no personal losses expected from hailstorm events.
Improved Property	According to National Climatic Data Center (NCDC), a loss of $253,629 per year can be expected in property loss due to hailstorm damage, and all improved property is exposed to this hazard. Although some crops are susceptible to hail hazards, available historical data for Grayson County indicates that there are no expected crop losses from this event.
Emergency Facilities	Because of the unpredictability of the geographical location of hailstorms, all emergency facilities in Grayson County are exposed to this hazard.
Critical Facilities	Because of the unpredictability of the geographical location of hailstorms, all critical facilities in Grayson County are exposed to this hazard.
Critical Infrastructure	Because of the unpredictability of the geographical location of hailstorms, all critical infrastructures in Grayson County are exposed to this hazard.

As described in Section 2, damage from hail events is determined by the intensity of the storm, which, based on the hail diameter, ranges from hard hail to super hailstorm. These events are unpredictable, and all areas of Grayson County can be affected. All five categories of assets are exposed to this hazard and could potentially be impacted. However, the most vulnerable assets are those related to property and infrastructure, particularly roofs and structures. Damages from hail can potentially translate into significant insurance claims and expenses.

Based on the available information, vulnerability to hail was assessed using two techniques: (1) to comply with *Requirement 201.6(c)(2)(ii)(B*), historical loss data obtained from the National Climatic Data Center was used to predict expected monetary and human losses from the event; (2) in fulfillment of Element A of *Requirement 201.6(c)(2)(ii)(A*), geographical hazard areas identified for hail and the nature of the impacts expected from hail were used to identify the assets, including existing structures, vulnerable to this hazard event. The vulnerability to future structures was not conducted at this time due to unattainable data. Therefore, compliance with Element B of *Requirement 201.6(c)(2)(ii)(A,* describin*g* vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities will be an objective in the five-year planning cycle to be completed by Grayson County, should required information become available.

Table 3.8 presents Grayson County's recorded historical losses due to hailstorm events as provided in the hazard events database obtained from the National Climatic Data Center. Based on the starting location of the hailstorm event, these events were geo-referenced using ESRI®

ArcMap™ 9.2 *(Figure 3.22).* The resulting layer was overlaid with the jurisdiction boundary layer to determine the property and personal losses in each jurisdiction.

Table 3.8 Historical Annualized Losses Due to Hail Events (1950-2008)

Jurisdiction	Number of Events	Years	Magnitude	Fatalities	Injuries	Property Damage	Annualized Expected Property Losses	Crop Damage
Grayson County*	130	1955-2003	0in to 4.5in	0	0	$525,264	$9,056	—
Bells	—	—	—	—	—	—	—	—
Collinsville	—	—	—	—	—	—	—	—
Denison	19	1983-2003	0.75in to 1.75in	0	0	0	0	—
Dorchester	—	—	—	—	—	—	—	—
Gunter	—	—	—	—	—	—	—	—
Howe	4	1981-2001	0.75in to 1.75in	0	0	0	0	—
Knollwood	—	—	—	—	—	—	—	—
Pottsboro	—	—	—	—	—	—	—	—
Sadler	2	1990-2001	1.75in	0	0	0	0	—
[1]Sherman	4	1982-2003	1.75in to 2.75in	0	0	$14,185,191[1]	$244,572	—
Southmayd	—	—	—	—	—	—	—	—
Tioga	4	1985-2003	0.75in to 1.75in	0	0	0	0	—
Tom Bean	6	1990-1999	0.75in to 3in	0	0	0	0	—
Van Alstyne	8	1984-2003	0.75in to 1.75in	0	0	0	0	—
Whitesboro	—	—	—	—	—	—	—	—
Whitewright	2	1976-1990	1in to 1.75in	0	0	0	0	—
Total	**179**	**1955-2003**	**0in to 4.5in**	**0**	**0**	**$14,710,455**	**$253,629**	**—**

Source: Texas Hazard Mitigation Package and National Climatic Data Center

* *Grayson County unincorporated areas*

— *No Recorded Information*

[1] *Storm Event recorded for Sherman on April 6, 2006 producing baseball-sized hail and four tornados.*

As described in Section 3.2.1, calculations of annualized losses due to hail events were conducted using historical data obtained from the National Climatic Data Center (*Table 3.8*). The annualized loss value can be interpreted as the impact expected from hail in terms of annualized human losses and human injuries, and annualized property losses. As observed in *Table 3.8*, Grayson County can expect a total property loss of $253,629 each year as a result of hail, with no injuries, deaths, or crop losses expected from this event.

The geographical occurrence of hailstorm events cannot be predicted; therefore, the area of potential impacts corresponds to all of Grayson County's territory. Therefore, all improved property, emergency and critical facilities, and critical structures are exposed to this hazard,

including 17 fire stations, 15 police stations, four hospitals, 59 schools, and two historical properties. As described above, roofs and structures are more vulnerable to this hazard. Therefore, it is expected that building improvements would be most affected.

In compliance to *Requirement 201.6(c)(2)(ii),* vulnerability to hail and impacts to assets expected from hail events can be summarized as follows:

- Population: According to National Climatic Data Center (NCDC), no recorded injuries or fatalities have been recorded for hailstorm events. All the population of Grayson County is exposed to this hazard, but there are no personal losses expected from hailstorm events.
- Improved Property: Based on historical data, a loss of $253,629 per year can be expected in property loss due to hailstorm damage. Because of the unpredictability of the geographical location of hailstorms, all improved property in Grayson County is exposed to this hazard. Although some crops are susceptible to hail hazards, available historical data for Grayson County indicates that there are no expected crop losses from this event.
- Emergency Facilities: Because of the unpredictability of the geographical location of hailstorms, all emergency facilities in Grayson County are exposed to this hazard.
- Critical Facilities: Because of the unpredictability of the geographical location of hailstorms, all critical facilities in Grayson County are exposed to this hazard.
- Critical Infrastructure: Because of the unpredictability of the geographical location of hailstorms, all critical infrastructure in Grayson County is exposed to this hazard.

Information needed to fulfill *Requirement 201.6(c)(2)(ii*)(C), which addresses land uses and development trends, was unattainable during the preparation of this Hazard Mitigation Plan. Compliance with this requirement will be an objective in the five-year planning cycle, should the necessary information become available.

3.4 DROUGHT

Drought	
Population	According to National Climatic Data Center (NCDC), no recorded injuries or fatalities have been recorded for drought events. There are no personal losses expected from drought events.
Improved Property	According to National Climatic Data Center (NCDC), a loss of $2,063,743 per year can be expected in property loss due to damage from drought. Available historical data indicates that the expected losses from drought correspond to crop losses in the amount of $53,745,624 per year, mostly experienced in water shortages and crop losses on agricultural lands.
Emergency Facilities	Because of the nature of this hazard, there are no losses or direct impacts expected on emergency facilities due to drought events.
Critical Facilities	Because of the nature of this hazard, there are no losses or direct impacts expected on critical facilities due to drought events.
Critical Infrastructure	Because of the nature of this hazard, there are no losses or direct impacts expected on critical infrastructure due to drought events.

Because drought impacts large areas that cross-jurisdictional boundaries, all of the improved property and population in Grayson County are considered to be exposed to this hazard. However, drought impacts are mostly experienced in water shortages and crop losses on agricultural lands, with no impact on buildings.

Since crop losses are expected to be the most vulnerable assets for this hazard, agricultural land acreage was acquired from the USGS land cover classification data to estimate the relative area of Grayson County that would be affected by this event. *Table 3.9* below provides the distribution of agricultural land for each jurisdiction in Grayson County. Grayson County has a total of 426,733 acres of agricultural lands, which represents approximately 68% of Grayson County territory, with the vast majority located in the unincorporated areas.

Table 3.9 Agricultural Land in Grayson County

Jurisdiction	Total Acres	Agricultural Land Acres	Percentage (%) of Total Acres
Grayson County*	570,100	397,032	63
Bells	1,372	995	0.16
Collinsville	381	120	0.02
Denison	14,594	3,343	1
Dorchester	960	891	0.14
Gunter	1,196	949	0.15
Howe	2,562	2,154	0.34
Knollwood	50	29	0.07
Pottsboro	1,836	1,442	0.23
Sadler	531	327	0.05
Sherman	24,680	14,172	2
Southmayd	1,139	940	0.15
Tioga	811	641	0.10
Tom Bean	649	440	0.07
Van Alstyne	2,144	1,504	0.24
Whitesboro	1,970	1,138	0.18
Whitewright	1,167	611	0.10
Total	**626,147**	**426,733**	**68 %**

Source: Texas Hazard Mitigation Package and U.S. Geological Survey

* *Grayson County unincorporated areas*

— *No Recorded Information*

Based on the available information, vulnerability to drought was assessed using two techniques: (1) to comply with *Requirement 201.6(c)(2)(ii)(B*), historical loss data obtained from the Texas Hazard Mitigation Package was used to predict expected monetary and human losses from the event; (2) in fulfillment of Element A of *Requirement 201.6(c)(2)(ii)(A*), geographical hazard areas identified for drought and the nature of the impacts expected from drought events were used to identify the assets, including existing structures, vulnerable to this hazard. The vulnerability to future structures was not conducted at this time due to unattainable data. Therefore, compliance with Element B of *Requirement 201.6(c)(2)(ii)(A)*, describing vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities will be an objective in the five-year planning cycle, should necessary information become attainable.

Table 3.10 presents Grayson County's recorded historical losses due to drought events as provided in the hazard events database obtained from the National Climatic Data Center, and the Texas Hazard Mitigation Package. The drought events layer was overlaid with the jurisdiction boundary layer to determine the number of drought events occurring within each jurisdiction. Property and personal losses in each expected in each jurisdiction are presented in *Table 3.10.*

Table 3.10 Historical Annualized Losses Due to Drought (1950-2008)

Jurisdiction	Date	Fatalities	Injuries	Property Damage (Present Value)	Annualized Expected Property Losses	Crop Damage Including (Present Value)	Annualized Expected Crop Loss	Annualized Expected Crop Loss per Acre
Grayson County Territory (including jurisdictions)	8/1/1996	0	0	$0	$0	$0	$0	$0
	7/1/1998	0	0	$0	$0	$0	$0	$0
	8/1/2000	0	0	$0	$0	$0	$0	$0
	9/1/2000	0	0	$0	$0	$0	$0	$0
	5/1/2005	0	0	$0	$0	$75,748,618	$1,306,011	$3.00
	6/1/2005	0	0	$0	$0	$75,748,618	$1,306,011	$3.00
	7/1/2005	0	0	$0	$0	$75,748,618	$1,306,011	$3.00
	8/1/2005	0	0	$0	$0	$75,748,618	$1,306,011	$3.00
	9/1/2005	0	0	$0	$0	$75,748,618	$1,306,011	$3.00
	10/1/2005	0	0	$0	$0	$75,748,618	$1,306,011	$3.00
	11/1/2005	0	0	$0	$0	$151,497,235	$2,612,021	$6.00
	12/1/2005	0	0	$0	$0	$151,497,235	$2,612,021	$6.00
	1/1/2006	0	0	$0	$0	$1,191,016,000	$20,534,759	$48.00
	2/1/2006	0	0	$0	$0	$357,304,800	$6,160,428	$14.00
	3/1/2006	0	0	$0	$0	$238,203,200	$4,106,952	$10.00
	4/1/2006	0	0	$119,101,600	$2,053,476	$0	$0	$0
	5/1/2006	0	0	$0	$0	$119,101,600	$2,053,476	$5.00
	6/6/2006	0	0	$0	$0	$119,101,600	$2,053,476	$5.00
	7/1/2006	0	0	$0	$0	$119,101,600	$2,053,476	$5.00
	8/1/2006	0	0	$0	$0	$119,101,600	$2,053,476	$5.00
	9/1/2006	0	0	$0	$0	$95,281,280	$1,642,781	$4.00
	10/1/2006	0	0	$595,508	$10,267	$595,508	$10,267	$0.02
	11/1/2006	0	0	$0	$0	$952,813	$16,428	$0.04
Total	**1996-2006**	**0**	**0**	**$119,697,108**	**$2,063,743**	**$3,117,246,177**	**$53,745,624**	**$126.00**

Source: National Climatic Data Center

— *No Recorded Information*

As described on Section 3.2.1, calculations of annualized losses due to drought events were conducted using historical data obtained from the National Climatic Data Center (*Table 3.10*).

The annualized loss value can be interpreted as the impact expected from drought in terms of annualized human losses and human injuries, and annualized property losses. As observed in *Table 3.10*, Grayson County can expect approximately an annual $2,063,743 in property losses, and $53,745,624 of crop losses each year as a result of drought, with no injuries or deaths expected from this event.

Since the geographical occurrence of drought is typically regional, the area of potential impacts corresponds to all Grayson County's territory. However, due to the nature of this event, property losses are more likely related to crop damage. Buildings and infrastructure are not expected to be directly impacted by drought events. Therefore, improved property, emergency and critical facilities, and critical structures are not exposed to this hazard.

In compliance to *Requirement 201.6(c)(2)(ii)*, vulnerability to drought and impacts to assets expected from drought events can be summarized as follows:

- Population: According to National Climatic Data Center (NCDC), no recorded injuries or fatalities have been recorded for drought events. There are no personal losses expected from drought events. All the population of Grayson County is exposed to this hazard, but there are no personal losses expected from drought events.
- Improved Property: According to National Climatic Data Center (NCDC), a loss of $2,063,743 per year can be expected in property loss due to damage from drought. Available historical data indicates that the expected losses from drought correspond to crop losses in the amount of $53,745,624 per year, mostly experienced in water shortages and crop losses on agricultural lands.
- Emergency Facilities: Because of the nature of this hazard, there are no losses or direct impacts expected on emergency facilities due to drought events.
- Critical Facilities: Because of the nature of this hazard, there are no losses or direct impacts expected on critical facilities due to drought events.
- Critical Infrastructure: Because of the nature of this hazard, there are no losses or direct impacts expected on critical infrastructure due to drought events.

Information needed to fulfill *Requirement 201.6(c)(2)(ii*)(C), which addresses land uses and development trends, was unattainable during the preparation of this Hazard Mitigation Plan. Compliance with this requirement will be an objective in the five-year planning cycle, should required information become available.

3.5 FLOOD

Flooding	
Population	Flooding produces an expected annualized fatalities count of 0.052 persons per year and zero injuries per year. Approximately 37% of the population of Grayson County is located within the 100-year floodplain.
Improved Property	A loss of $425,000 per year can be expected in property loss due to flooding, and 54% of the total assessed value of improvements in Grayson County is at risk from the 100-year storm event.
Emergency Facilities	There are no emergency facilities at imminent risk from the 100-year storm event.
Critical Facilities	There are no critical facilities located within the 100-year storm event.
Critical Infrastructure	52% of railways/highways and bridges, 36% of dams, 6% of water treatment works, 14% waste water treatment facilities, and 3% hazardous material facilities (Sherman Wire Co. East Plant, Sherman, Texas) are at risk from the 100-year storm event. Many of these structures are designed to traverse or be located within the floodplain due to unavoidable circumstances. Additionally, treated wastewater is typically discharged towards streams, which makes portions of wastewater treatment facilities likely to be located within the floodplain.

Floods impact large areas and cross-jurisdictional boundaries. All five categories of assets are considered vulnerable and can be exposed to this hazard. Based on the available information, vulnerability to flooding was assessed using two techniques: (1) to comply with *Requirement 201.6(c)(2)(ii)(B*), historical loss data obtained from National Climatic Data Center was used to predict expected monetary and human losses from the event; (2) in fulfillment of Element A of *Requirement 201.6(c)(2)(ii)(A*), geographical data was used to identify the assets, including existing structures, vulnerable to flooding. The vulnerability to future structures was not assessed at this time due to unattainable data. Therefore, compliance with Element B of *Requirement 201.6(c)(2)(ii)(A),* describing vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities will be an objective in the five-year planning cycle, should required data become attainable.

Table 3.11 presents Grayson County's recorded historical losses due to flooding as provided in the hazard events database obtained by National Climatic Data Center. Although specific data is provided by jurisdiction, the figures presented may reflect the place where the event was more relevant or where it started. For example, the Event Record Details provided by National Climatic Data Center for the flood event recorded in Collinsville refers to the flooding event that started in Collinsville on June 18, 2007, which impacted all Grayson County, including unincorporated areas.

Table 3.11 Historical Annualized Losses Due to Flood Events (1950-2008)

Jurisdiction	Fatalities	Number of Events	Annualized Expected Fatalities	Injuries	Property Damage	Annualized Expected Property Losses	Crop Damage ($)
Grayson County*	0	6	0	0	$246,076	$4,242	$0
Bells	0	2	0	0	$0	$0	$0
Collinsville	2	3	0.034	0	$22,472,000	$387,448	$0
Denison	0	10	0	0	$1,629,728	$28,098	$0
Dorchester	—	0	—	—	—	—	—
Gunter	—	0	—	—	—	—	—
Howe	0	3	0	0	$0	$0	$0
Knollwood	—	0	—	—	—	—	—
Pottsboro	0	1	0	0	$0	$0	$0
Sadler	—	0	—	—	—	—	—
Sherman	1	14	0.017	0	$271,149	$4,674	$0
Southmayd	0	0	—	—	—	—	—
Tioga	0	3	0	0	$12,702	$219	$0
Tom Bean	0	1	0	0	$0	$0	$0
Van Alstyne	0	3	0	0	$5,618	$96	$0
Whitesboro	0	1	0	0	$0	$0	$0
Whitewright	0	4	0	0	$12,702	$219	$0
Total	**3**	**51**	**0.052**	**0**	**$24,649,975**	**$425,000**	**$0**

Source: National Climatic Data Center

* *Grayson County unincorporated areas*

— *No Recorded Information*

As described in Section 3.2.1, calculations of annualized losses due to flooding events were conducted using historical data obtained from National Climatic Data Center (*Table 3.11*). The annualized loss value can be interpreted as the impact expected from flooding in terms of annualized human losses and human injuries, and annualized property losses. As observed in *Table 3.11*, Grayson County can expect a total property loss of $425,000 each year as a result of flooding, with no injuries, no crop losses, and an expected number of 0.052 fatalities per year.

In order to assess flood risk and vulnerability of the identified assets, a Geographic Information System-based analysis was conducted to estimate exposure to flood events using Federal Emergency Management Agency's digital 100-year floodplain in combination with Grayson Central Appraisal District property records and the geo-referenced assets provided by HAZUS-

MH® *(Figures 3.23-3.39).* The 100-year floodplain data layer for this analysis is a subset of FAFDS Nationwide Floodmap Database as of May 2007[1].

By overlaying the geo-referenced assets and the floodplain, layers using Geographic Information System, the number of emergency facilities, critical facilities, and critical infrastructure located within the 100-year floodplain was calculated *(Figures 3.40-3.42).* Although, having a facility located within the floodplain does not necessarily imply that would be impacted by the 100-year storm event (e.g., the building could be flood-proofed, or the buildings may be constructed above the 100-year elevation), it provides with a good approximation of potential impacts from flooding.

According to the analysis conducted, no emergency or critical facilities are located within the 100-year floodplain. Critical infrastructure located within the 100-year floodplain is presented in *Table 3.12*

Table 3.12 Critical Infrastructure Located in 100-year Federal Emergency Management Agency Floodplain

Jurisdiction	Critical Infrastructure												
	Railway/ Highway Bridges		Airports	Dams		Water Treatment Facilities		Waste-Water Treatment Facilities		Natural Gas	Hazardous Material		Radioactive Waste
	Total	Percentage (%)	Total	Total	Percentage (%)	Total	Percentage (%)	Total	Percentage (%)	Total	Total	Percentage (%)	Radioactive Waste
Grayson County*	198	63	0	37	37	1	8	4	50	0	0	0	0
Bells	2	67	0	0	0	0	0	0	0	0	0	0	0
Collinsville	0	0	0	0	0	0	0	0	0	0	0	0	0
Denison	7	18	0	1	50	0	0	0	0	0	0	0	0
Dorchester	0	0	0	0	0	0	0	0	0	0	0	0	0
Gunter	1	100	0	0	0	0	0	0	0	0	0	0	0
Howe	2	50	0	0	0	0	0	0	0	0	0	0	0
Knollwood	0	0	0	0	0	0	0	0	0	0	0	0	0
Pottsboro	0	0	0	0	0	0	0	0	0	0	0	0	0
Sadler	0	0	0	0	0	0	0	0	0	0	0	0	0
Sherman	20	29	0	0	0	0	0	0	0	0	1	5	0
Southmayd	0	0	0	0	0	0	0	0	0	0	0	0	0

[1]The 100-year floodplain data does not include updated Digital Flood Insurance Rate Maps released after May 2007. The effective Flood Insurance Study (FIS) for Grayson County was revised in July 17, 1995. Except for two FIRM maps for Van Alstyne Town, he effective dates of the FIRMs maps Grayson County date back to 1992 and 1995. Therefore, the data used for this analysis corresponds to the most up-to-date flood mapping information available.

Jurisdiction	Critical Infrastructure												
	Railway/ Highway Bridges		Airports	Dams		Water Treatment Facilities		Waste-Water Treatment Facilities		Natural Gas	Hazardous Material		Radioactive Waste
	Total	Percentage (%)	Total	Total	Percentage (%)	Total	Percentage (%)	Total	Percentage (%)	Total	Total	Percentage (%)	Radioactive Waste
Tioga	0	0	0	0	0	0	0	0	0	0	0	0	0
Tom Bean	0	0	0	0	0	0	0	0	0	0	0	0	0
Van Alstyne	0	0	0	0	0	0	0	0	0	0	0	0	0
Whitesboro	1	17	0	0	0	0	0	0	0	0	0	0	0
Whitewright	0	0	0	0	0	0	0	1	17	0	0	0	0
Total	**231**	**52**	**0**	**38**	**36**	**1**	**6**	**5**	**14**	**0**	**1**	**3**	**0**

Source: Federal Emergency Management Agency HAZUS-MH® and Texas Hazard Mitigation Package

* *Grayson County unincorporated areas*

— *No Recorded Information*

As noted in *Table 3.12*, the total and percentage of critical infrastructure located within the 100-year floodplain corresponds to approximately 52% of railway/highway bridges, 36% of dams, 6 % of water treatment works, 14% wastewater treatment works, and 3% of hazardous material sites. The hazardous material site corresponds to the Sherman Wire Co. (East Plant), located at 1300 E. Pacific, Sherman, Texas. The percent of railway/highway bridges located within the floodplain is high, however, many of these structures are designed to traverse or be located within the floodplain due to unavoidable circumstances. Additionally, treated wastewater is typically discharged towards streams, which makes portions of wastewater treatment facilities likely to be located within the floodplain. However, some of the critical facilities located within the 100-year floodplain may be subject to impacts from flooding.

Vulnerability to flooding can also be measured by assessing the number of people and buildings exposed to flood events. *Table 3.13* shows Population and Improved Property at risk from flooding events.

The determination of population vulnerability was calculated by adding the total population for those 2000 Census blocks that had at least some portion located within the 100-year floodplain. The determination of property value at-risk (exposure) was calculated adding the total assessed building values for only those parcels that were confirmed to have at least one building located within the 100-year floodplain.

Table 3.13 Population and Buildings potentially located with the 100-year floodplain

Jurisdiction	Population at Risk from 100-year Floodplain	Percentage of Population at Risk From 100-year Floodplain	Buildings at Risk from 100-year Floodplain	Percentage of Total Assessed Value of Improvements (Buildings & Contents) At Risk From 100-year Floodplain
Grayson County*	22,390	63	$2,180,961,000	95
Bells	276	25	$20,345,000	31
Collinsville	0	0	$0	0
Denison	4,271	19	$413,980,000	27
Dorchester	2	3	$204,000	4
Gunter	373	33	$23,104,000	37
Howe	904	37	$52,319,000	37
Knollwood	0	0	$0	0
Pottsboro	255	18	$17,126,000	20
Sadler	238	62	$14,388,000	81
Sherman	10,843	31	$976,281,000	43
Southmayd	96	13	$4,599,000	12
Tioga	134	19	$8,734,000	15
Tom Bean	119	13	$7,089,000	12
Van Alstyne	45	2	$2,202,000	1
Whitesboro	872	24	$72,650,000	31
Whitewright	349	20	$30,980,000	27
Total	**41,167**	**37**	**$3,824,962,000**	**54**

Source: Federal Emergency Management Agency HAZUS-MH® , Texas Hazard Mitigation Package, and National Climatic Data Center

* *Grayson County unincorporated areas—: No Recorded Information*

As it can be observed in *Table 3.13*, approximately 37% of the population of Grayson County, and 54% of its buildings, are exposed to impacts from flooding events.

Since Grayson County is composed by large areas used for cropland, an analysis was conducted to determine the vulnerability of the land to flooding relative to the type of land cover (*Table 3.14*). The calculations were made using Geographic Information System. The USGS land cover shapefile was clipped with the 100-year floodplain to calculate the area (acreage) of each land cover type potentially affected by flooding. Reservoirs, streams, and channels were excluded from the calculations.

Table 3.14 Land Cover Types and Acreage located within the 100-year Floodplain

Land Cover Type	Total Areas For Grayson County (Acres)	Total Area Affected By 100-year Flood (Acres)	Percentage of Area Affected By 100-year Flood (%)
Commercial and Services	3,751	458	12
Cropland and pasture	466,723	38,461	8
Deciduous forest land	74,249	18,506	25
Herbaceous Rangeland	6,476	114	2
Industrial	1,235	366	30
Mixed rangeland	8,442	1,445	17
Mixed urban or built-up land	234	11	5
Nonforested wetland	927	927	100
Orchards, groves, vineyards, nurseries..	347	27	8
Other urban or built-up land	1,778	313	18
Residential	16,719	560	3
Shrub-brush land rangeland	12,582	1,124	9
Strip mines, quarries and gravel pits	706	120	17
Transitional areas	1,776	119	7
Transportation, communications and services	4,223	268	6
Total	**600,168**	**62,819**	**11**

Source: USGS

As observed, in average only approximately 11% of the total area of Grayson County is located within the 100-year floodplain. Note, that a higher percentage than the average of the total industrial land (30%) and the urban/built-up land (18%) is located within the floodplain. Approximately 83% of the land cover located within the 100-year floodplain is developed (including cropland). The remaining 17% is undisturbed rangelands, forests, or wetlands.

In compliance to *Requirement 201.6(c)(2)(ii),* Grayson County's vulnerability from flooding and impacts to assets expected from flooding can be summarized as follows:

- Population: Based on historical data, flooding produces an expected annualized fatalities count of 0.052 persons per year, and zero injuries per year. In total, 37% of the population of Grayson County is located within the 100-year floodplain.

- Improved Property: Based on historical data, a loss of $425,000 per year can be expected in property loss due to flooding, with no expected crop losses. Based on geographic information and assuming that a facility within the 100-year floodplain is exposed to impact, 54% of the total assessed value of improvements in Grayson is at risk from the 100-year storm event.
- Emergency Facilities: Based on geographic information and assuming that a facility within the 100-year floodplain is exposed to impact, there are no emergency facilities at imminent risk from the 100-year storm event.
- Critical Facilities: Based on geographic information and assuming that a facility within the 100-year floodplain is exposed to impact, there are no critical facilities at imminent risk from the 100-year storm event.
- Critical Infrastructure: Based on geographic information and assuming that a critical infrastructure within the 100-year floodplain is exposed to impact 52% of railways/highways and bridges, 36% of dams, 6% of water treatment works, 14% waste water treatment facilities, and 3% hazardous material facilities (Sherman Wire Co. East Plant, Sherman, Texas) are at risk from the 100-year storm event. Note that the amount of railway/highway bridges is high, because of the likelihood of these to be located within the floodplain. Additionally, treated wastewater is typically discharged towards streams, which makes portions of wastewater treatment facilities likely to be located within the floodplain.

Information needed to fulfill *Requirement 201.6(c)(2)(ii)(C),* which addresses land uses and development trends, was unattainable during the preparation of this Hazard Mitigation Plan. Compliance with this requirement will be an objective in the five-year planning cycle, should necessary information becomes available.

Repetitive Loss

As per Requirement 201.6(c)(2)(ii) "The risk assessments in all plans approved after October 1, 2008 must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods." Repetitive Loss Property information provides with the properties that had submitted insurance claims due to flooding damage to buildings and its contents. The information provided by Federal Emergency Management Agency included 48 repetitive loss properties in Grayson County as of March 31, 2009 (Table 3.15).

Address information available for 46 out of the 48 repetitive loss properties recorded allowed those properties to be geo-referenced using ESRI® ArcMap™ 9.2. The probability of future repetitive losses on those properties was estimated using Geographic Information System by overlying the geo-referenced properties with the 100-year floodplain layer. *Table 3.15* summarizes with the number of properties located within the 100-year floodplain as obtained using this approach.

Table 3.15 Repetitive Loss Properties located within the 100-year Floodplain

Jurisdiction	Total Number of Repetitive Loss Properties	Properties within 100-year Floodplain			Total Number of Repetitive Loss Properties within 100-year Floodplain	Percent of Repetitive Loss Properties within 100-year Floodplain
		Single Family	Other Residential	Non Residential		
Grayson County*	7	4	1	2	7	100
Bells	—	—	—	—	—	—
Collinsville	—	—	—	—	—	—
Denison	—	—	—	—	—	—
Dorchester	—	—	—	—	—	—
Gunter	1	1	—	—	—	—
Howe	1	1	—	—	—	—
Knollwood	—	—	—	—	—	—
Pottsboro	—	—	—	—	—	—
Sadler	—	—	—	—	—	—
Sherman	39	11	9	6	26	67
Southmayd	—	—	—	—	—	—
Tioga	—	—	—	—	—	—
Tom Bean	—	—	—	—	—	—
Van Alstyne	—	—	—	—	—	—
Whitesboro	—	—	—	—	—	—
Whitewright	—	—	—	—	—	—
Total	**48**	**15**	**10**	**8**	**33**	**69**

Source: Federal Emergency Management Agency

* *Grayson County unincorporated areas*

— *No Recorded Information*

As noted in *Table 3.15* most of the repetitive loss properties are located in the City of Sherman, with only approximately 67% of those properties located within the 100-year floodplain. Unincorporated areas of Grayson County present records of seven properties, all located within the floodplain area. The cities of Gunter and Howe had one recorded repetitive loss property each, both located outside the floodplain. As expected, in general the majority of the properties are located within the 100-year floodplain, which can be interpreted as having a greater

probability of future losses resulting from flood events. In compliance with *Requirement 201.6(c)(2)(ii),*Table 3.19 provides the type (residential, commercial, institutional, etc.) and numbers of repetitive loss properties located in the identified flood hazard zones within Grayson County.

Table 3.16 shows the repetitive loss property statistics for the 48 properties recorded in Grayson County classified by jurisdiction. The numbers provided can be used to estimate the vulnerability to repetitive loss properties in terms of dollar losses.

Table 3.16 Repetitive Loss Property Statistics

Jurisdiction	Single Family				Other Residential				Non Residential				Total			
	Years	Properties	Number of Losses	Payments	Years	Properties	Number of Losses	Payments	Years	Properties	Number of Losses	Payments	Years	Properties	Number of Losses	Payments
Grayson County*	1981-2007	2	4	$131,550	1987-2007	1	8	$1,422,428	1982-2007	4	14	$265,290	1981-2007	7	16	$1,819,268
Bells	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Collinsville	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Denison	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dorchester	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gunter	2007	1	2	$30,241	—	—	—	—	—	0	—	—	2007	1	2	$30,241
Howe	2006-2007	1	2	$5,616	—	—	—	—	—	0	—	—	2006-2007	1	2	$5,616
Knollwood	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pottsboro	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sadler	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sherman	1981-2007	16	47	$473,377	1981-2007	13	40	$862,933	1981-2007	10	37	$708,108	1981-2007	39	97	$2,044,418
Southmayd	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tioga	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tom Bean	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Van Alstyne	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Whitesboro	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Whitewright	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	**—**	**20**	**55**	**$640,784**	**—**	**14**	**48**	**$2,285,361**	**—**	**14**	**51**	**$973,398**	**—**	**48**	**117**	**$3,899,543**

Source: Federal Emergency Management Agency and Texas Hazard Mitigation Package

* *Grayson County un-incorporated areas*

— *No Recorded Information*

The dollar amounts in the tables represent the payments made for insurance claims due to flood damage to buildings and contents. As can be observed in *Table 3.16* and, consistent with having the greatest number of repetitive loss properties, the City of Sherman has the greatest value

dollar of claims, with mostly residential properties damaged (29 out of the 39 properties recorded). It is followed by the unincorporated areas of Grayson County, with approximately the same number of residential and non-residential claims. Note that, although the unincorporated areas of Grayson County approximately one-fifth the number of repetitive loss properties compared to that of the City of Sherman, the dollar loss value is relatively close for both. This may be due to the type of facilities that were affected in each. Finally, the dollar value for the cities of Gunter and Howe is negligible compared to the overall total repetitive loss value for Grayson County.

Although, both repetitive loss information (*Tables 3.15 and 3.16*) and the historical annualized losses expected from flooding (*Table 3.11*) represent actual historical information, the data cannot be compared or correlated to each other. The repetitive loss information presents insurance claims on properties and buildings, whereas the historical annualized losses represent property losses in the community due to flood events.

3.6 WILDFIRES

Wildfires	
Population	Based on geographical data, approximately 20% of Grayson County is vulnerable to wildfires, with Denison and the unincorporated areas contributing with the majority of the exposed population.
Improved Property	Based on geographical data, a loss of $1,870,909,000 worth of buildings and its contents is exposed to wildfires. This corresponds to a 26% of the overall property improvement values across Grayson County.
Emergency Facilities	Based on geographic information there are three fire stations (Denison Fire Department, 700 W. Chestnut Street, Denison Fire Department, 108 W. Main Street, and Locust Volunteer Fire Department Anglers Est. in Pottsboro), and one police station (Denison Police Department) at risk from wildfire events.
Critical Facilities	Based on geographic information there are six schools at risk from wildfire events. (Grayson County JJAEP, Lamar Elementary, Pathway High School, Houston Elementary, B McDaniel Middle School, Terrell Elementary)
Critical Infrastructure	Based on geographic information there are 26 bridges, six dams, one wastewater treatment facility, and one water treatment facility at risk from wildfire events.

By definition, wildfires are fires occurring in a wildland area (e.g., grassland, forest, brush land) except for fire under prescription. Therefore, impacts from this hazard are related to wildland areas and what is known as Wildland Urban Interface (WUI), which are defined as the area where structures and other human development meet or intermingle with undeveloped wildland. The WUI creates an environment in which fire can move readily between structural and vegetation fuels. The expansion of these areas has increased the likelihood that wildfires will threaten structures and people.

Wildfires can cause significant damage to property and threatens the lives of people who are unable to evacuate WUI areas. All five categories of assets located in these wildfire-prone areas are considered vulnerable and can be exposed to this hazard.

WUI is composed for what is known as Interface and Intermix communities. In both Interface and Intermix communities, housing must meet or exceed a minimum density of one structure per 40 acres (16 ha). Intermix communities are places where housing and vegetation intermingle; vegetation is continuous, with more than 50% vegetation coverage. Interface communities are areas with housing in the vicinity of contiguous vegetation, with less than 50 percent vegetation, and located within 1.5 mi of an area (made up of one or more contiguous Census blocks) over 1,325 acres (500 ha) that is more than 75% vegetated.

WUI data was obtained from the University of Wisconsin's SILVAS laboratory. The data provides with WUI polygon boundaries for WUI-Interface Communities and WUI-Intermix Communities.

ESRI® ArcMap™ 9.2 was used to calculate the area of low, medium, and high density Interface and Intermix communities within each major city boundary *(Figure 3.43).* Definition of low, medium, and high-density Interface Intermix communities is presented in *Table 3.17.*

Table 3.17 Density Distribution for WUI Communities

WUI-Interface community	
Low Density Interface	Housing density >= 6.177635 and < 49.42108 Vegetation <= 50%, within 2.414 km of an area with >= 75% Vegetation
Medium Density Interface	Housing density >= 49.42108 and < 741.3162 Vegetation <= 50%, within 2.414 km of an area with >= 75% Vegetation
High Density Interface	Housing density >= 741.3162 Vegetation <= 50%, within 2.414 km of an area with >= 75% Vegetation
WUI-Intermix community	
Low Density Intermix	Areas with housing density >= 6.177635 and < 49.42108 Vegetation > 50%.
Medium Density Intermix	Housing density= 49.42108 and < 741.3162 Vegetation > 50%
High Density Intermix	Housing density >= 741.3162 Vegetation > 50%

Source: University of Wisconsin-SILVIS LAB

Table 3.18 provides the acreage and relative distribution (percentage, %) of WUI area for each of Grayson County's jurisdictions. As observed in *Table 3.18*, only 1% of Grayson County's area corresponds to Interface community, and 7% to Intermix community. In addition, those areas are in its vast majority composed by low-density populated areas.

The WUI polygons were used to define the hazard areas subjected to impacts from wildfires. In fulfillment of Element A of *Requirement 201.6(c)(ii)(A),* these hazard areas were used to identify critical facilities, emergency facilities, and critical infrastructure vulnerable to this hazard.

In order to assess wildfire risk and vulnerability of the identified assets, a Geographic Information System-based analysis was conducted to estimate exposure to this event using the WUI polygons in combination with Grayson Central Appraisal District property records and the geo-referenced assets provided by HAZUS-MH®.

The vulnerability of emergency facilities, critical facilities, and critical infrastructure was calculated by adding the total number of facilities and infrastructure located within the low/medium/high density WUI Interface and Intermix communities. These calculations are presented in *Tables 3.19, 3.20, 3.21,* and *3.22*. As observed in those tables, 6 schools, 3 fire

stations, 1 police station, 26 bridges, six dams, one wastewater facility, and one water facilities are located within WUI areas.

After further review, overlaying aerials provided by Aerials Express DataDoors Desktop 2008, three emergency facilities located in the WUI Interface/Intermix communities have a low probability of being vulnerable to wildfires. These emergency facilities are located in urban areas of Denison and include two fire stations located at 700 W Chestnut St., and 108 W. Main St.; and one police station located at 108 W. Main St.

Table 3.18 Distribution of WUI Interface and Intermix Communities in Grayson County

Jurisdiction	Area (Sq. Mile)	WUI-Interface Community					WUI-Intermix Community				
		Low Density (Sq. Mile)	Medium Density (Sq. Mile)	High Density (Sq. Mile)	Total (Sq. Mile)	Percentage of Total Area (%)	Low Density (Sq. Mile)	Medium Density (Sq. Mile)	High Density (Sq. Mile)	Total (Sq. Mile)	Percentage (%) of Total Area
Grayson County*	845.9	4.80	1.413	0.04	6.20	1	55	5.80	0.01	61	7
Bells	2.1	—	—	—	0	0	—	0.13	—	0.13	6
Collinsville	0.6	—	—	—	0	0	—		—	0	0
Denison	22.8	.05	1.40	0.60	2	9	2	1.84	0.01	3.91	17
Dorchester	1.5	—	—	—	0	0	—	—	—	0	0
Gunter	1.9	—	—	—	0	0	—	—	—	0	0
Howe	4.0	—	—	—	0	0	—	—	—	0	0
Knollwood	0.79	—	—	—	0	0	—	—	—	0.01	4
Pottsboro	2.9	—	—	—	0	0	—	0.04	—	0.04	2
Sadler	0.83	—	—	—	0	0	—	0.02	—	0.01	0.28
Sherman	38.6	—	—	—	0	0	0.34	0.20	0.01	0.56	2
Southmayd	1.8	—	—	—	0	0	—	—	—	0	0
Tioga	1.3	—	—	—	0	0	—	—	—	0	0
Tom Bean	1.0	—	—	—	0	0	—	—	—	0	0
Van Alstyne	3.4	—	—	—	0	0	—	0.01	—	0.01	0.18
Whitesboro	3.1	—	—	—	0	0	0.01		0.01	0.01	0.41
Whitewright	1.8	—	—	—	0	0	—	—	—	0	0
Total	**934.3**	**4.8**	**2.8**	**0.64**	**8.2**	**1**	**57.4**	**8**	**0.04**	**66**	**7**

Source: University of Wisconsin-SILVIS LAB

* *Grayson County unincorporated areas*

— *No Recorded Information*

Table 3.19 Critical Facilities within Wildland Urban Interface

Jurisdiction	Schools	
	Schools Located within Low/Medium/High Density Interface or Intermix Communities	Percentage (%) of Schools within WUI Communities
Grayson County*	0	0
Bells	0	0
Collinsville	0	0
Denison	6	46
Dorchester	0	0
Gunter	0	0
Howe	0	0
Knollwood	0	0
Pottsboro	0	0
Sadler	0	0
Sherman	0	0
Southmayd	0	0
Tioga	0	0
Tom Bean	0	0
Van Alstyne	0	0
Whitesboro	0	0
Whitewright	0	0
Total	**6**	**10**

Source: University of Wisconsin-SILVIS LAB

* *Grayson County unincorporated areas*

— *No Recorded Information*

Table 3.20 Emergency Facilities within Wildland Urban Interface

Jurisdiction	Hospitals		Fire Stations		Police Stations	
	Facilities Located within Low/Medium/High Density Interface or Intermix Communities	Percentage (%) of Facilities within WUI Communities	Facilities Located within Low/Medium/High Density Interface or Intermix Communities	Percentage (%) of Facilities within WUI Communities	Facilities Located within Low/Medium/High Density Interface or Intermix Communities	Percentage (%) of Facilities within WUI Communities
Grayson County*	0	0	1	14	0	0
Bells	0	0	0	0	0	0
Collinsville	0	0	0	0	0	0
Denison	0	0	2	50	1	100
Dorchester	0	0	0	0	0	0
Gunter	0	0	0	0	0	0
Howe	0	0	0	0	0	0
Knollwood	0	0	0	0	0	0
Pottsboro	0	0	0	0	0	0
Sadler	0	0	0	0	0	0
Sherman	0	0	0	0	0	0
Southmayd	0	0	0	0	0	0
Tioga	0	0	0	0	0	0
Tom Bean	0	0	0	0	0	0
Van Alstyne	0	0	0	0	0	0
Whitesboro	0	0	0	0	0	0
Whitewright	0	0	0	0	0	0
Total	**0**	**0**	**3**	**18**	**1**	**7**

Source: University of Wisconsin-SILVIS LAB

* *Grayson County unincorporated areas*

— *No Recorded Information*

Table 3.21 Critical Infrastructure within Wildland Urban Interface

Jurisdiction	Bridges		Natural Gas		Airports		Dams		Wastewater Facilities		Water Facilities	
	Infrastructure Located within Low/ Medium/High Density Interface or Intermix Communities	Percentage (%) of Facilities within WUI Communities	Infrastructure Located within Low/Medium/High Density Interface or Intermix Communities	Percentage (%) of Facilities within WUI Communities	Infrastructure Located within Low/ Medium/High Density Interface or Intermix Communities	Percentage (%) of Facilities within WUI Communities	Infrastructure Located within Low/ Medium/High Density Interface or Intermix Communities	Percentage (%) of Facilities within WUI Communities	Infrastructure Located within Low/ Medium/High Density Interface or Intermix Communities	Percentage (%) of Facilities within WUI Communities	Infrastructure Located within Low/ Medium/High Density Interface or Intermix Communities	Percentage (%) of Facilities within WUI Communities
Grayson County*	20	7	0	0	0	0	6	6	1	8	1	20
Bells	0	0	0	0	0	0	0	0	0	0	0	0
Collinsville	0	0	0	0	0	0	0	0	0	0	0	0
Denison	5	14	0	0	0	0	0	0	0	0	0	0
Dorchester	0	0	0	0	0	0	0	0	0	0	0	0
Gunter	0	0	0	0	0	0	0	0	0	0	0	0
Howe	0	0	0	0	0	0	0	0	0	0	0	0
Knollwood	0	0	0	0	0	0	0	0	0	0	0	0
Pottsboro	0	0	0	0	0	0	0	0	0	0	0	0
Sadler	0	0	0	0	0	0	0	0	0	0	0	0
Sherman	1	100	0	0	0	0	0	0	0	0	0	0
Southmayd	0	0	0	0	0	0	0	0	0	0	0	0
Tioga	0	0	0	0	0	0	0	0	0	0	0	0
Tom Bean	0	0	0	0	0	0	0	0	0	0	0	0
Van Alstyne	0	0	0	0	0	0	0	0	0	0	0	0
Whitesboro	0	0	0	0	0	0	0	0	0	0	0	0
Whitewright	0	0	0	0	0	0	0	0	0	0	0	0
Total	**26**	**6**	**0**	**0**	**0**	**0**	**6**	**6**	**1**	**6**	**1**	**3**

Source: University of Wisconsin-SILVIS LAB

* *Grayson County unincorporated areas* —: *No Recorded Information*

The determination of population vulnerability to wildfires was calculated by overlaying the population data from the 2000 U.S. Census Block shapefile to the WUI polygon data, and adding the total population within each of the low/medium/high density WUI Interface and Intermix communities. The determination of assessed value at-risk (exposure) to wildfires was calculated by overlaying the improved property shapefile to the WUI polygons, and adding the total

assessed building values within each of the low/medium/high density WUI Interface and Intermix communities (*Table 3.23*).

Table 3.22 Population and Assessed Value of Improvements

Jurisdiction	Population at Risk	Percentage (%) of Population at Risk	Total Assessed Value of Improvements (Buildings & Contents) at Risk	Percentage (%) of Assessed Value of Improvements (Buildings & Contents) at Risk
Grayson County*	11,264	32	$956,478,000	42
Bells	—	0	—	0
Collinsville	—	0	—	0
Denison	10,235	46	$880,048,000	59
Dorchester	—	0	—	0
Gunter	—	0	—	0
Howe	—	0	—	0
Knollwood	62	22	$2,466,000	31
Pottsboro	23	2	$1,081,000	1
Sadler	4	1	$149,000	1
Sherman	357	1	$26,717,000	1
Southmayd	—	0	—	0
Tioga	—	0	—	0
Tom Bean	—	0	—	0
Van Alstyne	—	0	—	0
Whitesboro	32	1	$3,970,000	2
Whitewright	—	0	—	0
Total	**21,977**	**20**	**$1,870,909,000**	**26**

Source: University of Wisconsin-SILVIS LAB and Texas Hazard Mitigation Package

* *Grayson County unincorporated areas*

— *No Recorded Information*

As observed in *Table 3.23*, only approximately 20% of Grayson County is vulnerable to wildfires, with Denison and unincorporated areas contributing with the majority of the exposed population. Based on geographical location, a total of $1,870,909,000 worth of property value composed by buildings and its contents are vulnerable to this hazard. This corresponds to a 26% of the overall property improvement values across Grayson County. This number is relatively high considering that only 1% of Grayson County's area corresponds to Interface community, and 7% to Intermix community. The reason might be that, once the wildfires occur, the devastating impacts are significant.

In compliance to *Requirement 201.6(c)(2)(ii),* Grayson County's vulnerability to wildfire and impacts to assets expected from this event can be summarized as follows:

- Population: Based on geographical data, approximately 20% of Grayson County is vulnerable to wildfires, with Denison and unincorporated areas contributing with the majority of the exposed population.
- Improved Property: Based on geographical data, a loss of $1,870,909,000 worth of buildings and its contents is exposed to wildfires. This corresponds to a 26% of the overall property improvement values across Grayson County.
- Emergency Facilities: Based on geographic information and assuming that the facilities located within the WUI polygons is exposed to impact from wildfire, there are three fire stations and one police station at risk from wildfire events. The emergency facilities exposed to this hazard are: Denison Fire Department, located at 700 W. Chestnut Street; Denison Fire Department, at 108 W. Main Street; Locust Volunteer Fire Department Anglers Est. in Pottsboro; and Denison Police Department.
- Critical Facilities: Based on geographic information and assuming that the facilities located within the WUI polygons is exposed to impacts from wildfire, there are six schools at risk from wildfire events. The schools correspond to Grayson County JJAEP, Lamar Elementary, Pathway High School, Houston Elementary, B McDaniel Middle School, and Terrell Elementary.
- Critical Infrastructure: Based on geographic information and assuming that the infrastructure located within the WUI polygons is exposed to impacts from fire, there are 26 bridges, six dams, one wastewater and one water facilities at risk from wildfire events.

Information needed to fulfill *Requirement 201.6(c)(2)(ii)(C)*, which addresses land uses and development trends, was unattainable during the preparation of this Hazard Mitigation Plan. Compliance with this requirement will be an objective in the five-year planning cycle, should such data become available.

3.7 EXTREME TEMPERATURE

Extreme Temperatures	
Population	According to National Climatic Data Center (NCDC), extreme temperatures events produced an average of 0.91 fatalities per year, with no recorded injuries. Grayson County and it is population is exposed to this hazard.
Improved Property	According to National Climatic Data Center (NCDC), and the negligible impact of extreme temperatures to developed areas, the improved property in Grayson County is not exposed to this hazard.
Emergency Facilities	According to National Climatic Data Center (NCDC), and the negligible impact of extreme temperatures to buildings, the emergency facilities in Grayson County are not exposed to this hazard.
Critical Facilities	According to National Climatic Data Center (NCDC), and the negligible impact of extreme temperatures to buildings, the critical facilities in Grayson County are not exposed to this hazard.
Critical Infrastructure	According to National Climatic Data Center (NCDC), and the negligible impact of extreme temperatures to critical infrastructure, exposure to this hazard is considered minimal in Grayson County

Extreme temperatures impact large areas and cross-jurisdictional boundaries; therefore, all Grayson County is exposed to this hazard. Improved property, emergency facilities, critical infrastructure, and critical facilities are not considered vulnerable to extreme heat or cold events; therefore, estimated vulnerability to these assets is anticipated to be minimal. However, population is significantly vulnerable to extreme temperatures.

Based on the available information, vulnerability to extreme temperatures was assessed using two techniques: (1) to comply with *Requirement 201.6(c)(2)(ii)(B*), historical loss data obtained from the National Climatic Data Center was used to predict expected monetary and human losses from the event; (2) in fulfillment of *Requirement 201.6(c)(2)(ii)(A*), geographical hazard areas identified for extreme temperature and the nature of the impacts expected from this hazard event were used to identify the vulnerable assets.

Table 3.24 presents Grayson County's recorded historical losses due to extreme temperature events as provided in the hazard events database obtained from the National Climatic Data Center. The annualized losses due to extreme events were calculated using the methodology described in Section 3.2.2.

Table 3.23 Extreme Temperature Historical Occurrences Between 1950 and 2008

Jurisdiction	Date	Type	Fatalities	Annualized Expected Fatalities	Injuries	Property Damage	Crop Damage
Grayson County Territory (Including jurisdictions)	04/12/1997	Extreme Cold	0	0	0	$0	$0
	07/01/1998	Excessive Heat	32	0.55	0	$0	$0
	08/01/1999	Excessive Heat	3	0.05	0	$0	$0
	07/01/2000	Excessive Heat	8	0.14	0	$0	$0
	08/01/2000	Excessive Heat	5	0.09	0	$0	$0
	09/01/2000	Excessive Heat	5	0.09	0	$0	$0
Total	**1997 to 2000**		**53**	**0.91**	**0**	**$0**	**$0**

Source: National Climatic Data Center
: No Recorded Information

The annualized loss value can be interpreted as the impact expected from extreme temperatures in terms of annualized human losses and human injuries, and annualized property losses. As observed in *Table 3.24*, Grayson County can expect 0.91 fatalities per year with no injuries, and no property or crop losses expected from extreme temperatures.

The occurrence of extreme temperature is regional; therefore, the area of potential impacts corresponds to all Grayson County's territory. However, according to the recorded historical information, extreme temperatures do not have a significant impact on property value. Although, extreme cold temperatures can impact buildings (e.g. rupture of frozen pipes), the expected loss is negligible in comparison to the improvement value, and the impact is subject to inexpensive and rapid repairs. In terms of infrastructure, extreme cold events could cause temporary closure or cease of operation of some critical infrastructures. However, those closures are expected to be only temporary and of very limited frequency in Grayson County. Therefore, the improved property, emergency and critical facilities, and critical structures are not expected to be significantly impacted from this hazard.

In compliance to *Requirement 201.6(c)(2)(ii)*, vulnerability to extreme temperature and impacts to assets expected from hail events can be summarized as follows:

- Population: Based on historical data, extreme temperatures can expected to produce an average of 0.91 fatalities per year, and no injuries. All the population of Grayson County is exposed to this hazard.
- Improved Property: Based on historical data and the negligible impact of extreme temperatures to developed areas, the improved property in Grayson County is not exposed to this hazard.

- Emergency Facilities: Based on historical data and the negligible impact of extreme temperatures to buildings, the existing and future emergency facilities in Grayson County are not exposed to this hazard.
- Critical Facilities: Based on historical data and the negligible impact of extreme temperatures to buildings, the existing and future critical facilities in Grayson County are not exposed to this hazard.
- Critical Infrastructure: Based on historical data and the negligible impact of extreme temperatures to existing and future critical infrastructure, exposure to this hazard is considered minimal in Grayson County.

Information needed to fulfill *Requirement 201.6(c)(2)(ii)(C)*, which addresses land uses and development trends, was unattainable during the preparation of this Hazard Mitigation Plan. Compliance with this requirement will be an objective in the five-year planning cycle, should required information become available.

3.8 EXTREME WINDSTORM

Extreme Windstorm	
Population	According to National Climatic Data Center (NCDC), extreme windstorm events can be expected to produce an average of 0.2 injuries per year, with no recorded deaths. All the population of Grayson County is exposed to this hazard.
Improved Property	According to National Climatic Data Center (NCDC), an average loss of $51,962 per year in property losses is expected from windstorm events in Grayson County. No crop losses are expected from this hazard in Grayson County.
Emergency Facilities	Because of the expected geographical widespread nature of windstorms, all emergency facilities in Grayson County are exposed to this hazard.
Critical Facilities	Because of the expected geographical widespread nature of windstorms, all critical facilities in Grayson County are exposed to this hazard.
Critical Infrastructure	Because of the expected geographical widespread nature of windstorms, all critical infrastructures in Grayson County are exposed to this hazard.

Extreme windstorm events impact large areas and cross-jurisdictional boundaries; therefore, all Grayson County is exposed to this hazard. Improved property, emergency facilities, critical infrastructure, and critical facilities, and population are considered vulnerable to this hazard.

Based on the available information, vulnerability to extreme windstorms was assessed using two techniques: (1) to comply with *Requirement 201.6(c)(2)(ii)(B*), historical loss data obtained from the National Climatic Data Center was used to predict expected monetary and human losses from the event; (2) in fulfillment of *Requirement 201.6(c)(2)(ii)(A*), geographical hazard areas identified for extreme windstorms and the nature of the impacts expected from this hazard event were used to identify the vulnerable assets.

Table 3.25 presents Grayson County's recorded historical losses due to extreme windstorm events as provided in the hazard events database obtained from the National Climatic Data Center and the Texas Hazard Mitigation Package.

Table 3.24 Extreme Wind Historical Occurrences Between 1950 and 2008

Jurisdiction	Number of Events	Years	Magnitude (Knots)	Fatalities	Injuries	Annualized Expected Injuries	Property Damage (Present Value)	Crop Damage	Annualized Expected Property Losses
Grayson County*	129	1957-2008	0 to 90	0	7	0.121	$1,667,509	$0	$28,750.16
Bells	1	2003	52	0	0	0	$7,093	$0	$122.29
Collinsville	3	1994-2005	0 to 50	0	0	0	$69,397	$0	$1,196.50
Denison	18	1994-2008	0 to 61	0	1	0.017	$238,571	$0	$4,113.29
Dorchester	—	—	—	—	—	—	—	—	—
Gunter	4	1996-2007	0 to 78	0	0	0	$144,766	$0	$2,495.97
Howe	7	1996-2008	0 to 65	0	0	0	$33,001	$0	$568.98
Knollwood	—	—	—	—	—	—	—	—	—
Pottsboro	13	1994-2007	0 to 61	0	1	0.017	$159,894	$0	$2,756.79
Sadler	2	1996-2008	50 to 52	0	0	0	$5,300	$0	$91.38
Sherman	29	1994-2007	0 to 65	0	0	0	$370,473	$0	$6,387.47
Southmayd	2	2006-2007	50 to 61	0	0	0	$28,090	$0	$484.31
Tioga	5	2001-2008	0 to 52	0	0	0	$56,753	$0	$978.50
Tom Bean	—	—	—	—	—	—	—	—	—
Van Alstyne	9	1995-2008	0 to 58	0	0	0	$49,813	$0	$858.84
Whitesboro	11	1994-2007	0 to 65	0	0	0	$183,115	$0	$3,157.16
Whitewright	2	1995-1997	—	0	0	0	—	$0	$0
Total	**235**	**1957-2008**	**0 to 90**	**0**	**9**	**0.155**	**$3,013,775**	**$0**	**$51,962**

Source: Texas Hazard Mitigation Package and National Climatic Data Center

* *Grayson County unincorporated areas*

— *No Recorded Information*

The annualized losses due to extreme windstorm events were calculated using the methodology described in Section 3.2.2. The annualized loss value can be interpreted as the impact expected from extreme wind in terms of annualized human losses and human injuries, and annualized property losses. As observed in *Table 3.24*, Grayson County can expect in average 0.2 injuries per year, $51,962 per year in property losses, with no deaths and no losses in crop production from extreme windstorm events.

The occurrence of extreme windstorms is regional; therefore, the area of potential impacts corresponds to all Grayson County's territory. According to the recorded historical information, extreme windstorms impact property. Currently, there is no information available with respect to the type structures that had been historically damaged by windstorm events. However, because of the regional character of this hazard event, all improved property, emergency and critical facilities, and critical structures are exposed to this hazard.

In compliance to *Requirement 201.6(c)(2)(ii)*, vulnerability to extreme windstorm and impacts to assets expected from this event can be summarized as follows:

- Population: Based on historical data, extreme windstorm events can be expected to produce an average of 0.2 injuries per year, and no deaths. All the population of Grayson County is exposed to this hazard.
- Improved Property: Based on historical data, an average loss of $51,962 per year in property losses are expected from windstorm events in Grayson County. No crop losses are expected from this hazard in Grayson County.
- Emergency Facilities: Because of the expected geographical widespread nature of windstorms, all existing and future emergency facilities in Grayson County are exposed to this hazard.
- Critical Facilities: Because of the expected geographical widespread nature of windstorms, all existing and future emergency facilities in Grayson County are exposed to this hazard.
- Critical Infrastructure: Because of the expected geographical widespread nature of windstorms, all existing and future critical infrastructures in Grayson County are exposed to this hazard.

Information needed to fulfill *Requirement 201.6(c)(2)(ii)(C)*, which addresses land uses and development trends, was unattainable during the preparation of this Hazard Mitigation Plan. Compliance with this requirement will be an objective in the five-year planning cycle, should required information become available.

3.9 LIGHTNING

Lightning	
Population	According to National Climatic Data Center (NCDC), lightning events can be expected to cause no deaths and no injuries in Grayson County. All the population of Grayson County is exposed to this hazard.
Improved Property	According to National Climatic Data Center (NCDC), an average loss of $4,828 per year in property losses is expected from lightning events in Grayson County. No crop losses are expected from this hazard in Grayson County.
Emergency Facilities	Because of the expected geographical widespread nature of lightning, all emergency facilities in Grayson County are exposed to this hazard.
Critical Facilities	Because of the expected geographical widespread nature of lightning, all critical facilities in Grayson County are exposed to this hazard.
Critical Infrastructure	Because of the expected geographical widespread nature of lightning, all critical infrastructures in Grayson County are exposed to this hazard.

Because the location at which a lightning events cannot be predicted, all existing and future buildings, critical facilities, critical infrastructure, emergency facilities, improved property, and population are considered to be exposed to this hazard.

Based on the available information, vulnerability to lightning was assessed using two techniques: (1) to comply with *Requirement 201.6(c)(2)(ii)(B*), historical loss data obtained from the National Climatic Data Center was used to predict expected monetary and human losses from the event; (2) in fulfillment of *Requirement 201.6(c)(2)(ii)(A*), geographical hazard areas identified for lightning and the nature of the impacts expected from this hazard event were used to identify the vulnerable assets.

Table 3.26 presents Grayson County's recorded historical losses due to lightning events as provided in the hazard events database obtained from the National Climatic Data Center.

Table 3.25 Historical Lightning Occurrences Between 1950 and 2008

Jurisdiction	Number of Events	Years	Fatality	Injuries	Property Damage (Present Value)	Crop Damage (Present Value)	Annualized Expected Property Losses
Grayson County*	0	—	—	—	—	—	—
Bells	0	—	—	—	—	—	—
Collinsville	2	2001-2006	0	0	$155,000	$0	$2,672
Denison	1	2006	0	0	$20,000	$0	$344
Dorchester	0	—	—	—	—	—	—
Gunter	0	—	—	—	—	—	—
Howe	1	2005	0	0	$5,000	$0	$86
Knollwood	0	—	—	—	—	—	—
Pottsboro	0	—	—	—	—	—	—
Sadler	1	1996	0	0	$10,000	$0	$172
Sherman	2	1995-2001	0	0	$5,000	$0	$86
Southmayd	1	2004	0	0	$25,000	$0	$431
Tioga	0	—	—	—	—	—	—
Tom Bean	0	—	—	—	—	—	—
Van Alstyne	1	1998	0	0	$60,000	$0	$1,034
Whitesboro	0	—	—	—	—	—	—
Whitewright	0	—	—	—	—	—	—
Total	**9**		**0**	**0**	**$280,000**	**$0**	**$4,828**

Source: Texas Hazard Mitigation Package, National Climatic Data Center, and Grayson Central Appraisal District

* *Grayson County unincorporated areas*

— *No Recorded Information*

The annualized losses due to lightning events were calculated using the methodology described in Section 3.2.2. The annualized loss value can be interpreted as the impact expected from lightning in terms of annualized human losses and human injuries, and annualized property losses. As observed in *Table 3.26*, Grayson County can expect in average an annual $4,828 in property losses, with no deaths, no injuries, and no losses in crop production from lightning events.

The geographical occurrence of lightning events cannot be predicted; therefore, the area of potential impacts corresponds to all Grayson County's territory. According to the recorded historical information, extreme windstorms impact property. Because of the regional character of this hazard event, all improved property, emergency and critical facilities, and critical structures are exposed to this hazard.

In compliance to *Requirement 201.6(c)(2)(ii)*, vulnerability to extreme windstorm and impacts to assets expected from this event can be summarized as follows:

- Population: Based on historical data, extreme windstorm events can be expected to cause no deaths and no injuries in Grayson County. All the population of Grayson County is exposed to this hazard.
- Improved Property: Based on historical data, an average loss of $4,828 per year in property losses are expected from lightning events in Grayson County. No crop losses are expected from this hazard in Grayson County.
- Emergency Facilities: Because of the expected geographical widespread nature of lightning, all existing and future emergency facilities in Grayson County are exposed to this hazard.
- Critical Facilities: Because of the expected geographical widespread nature of lightning, all existing and future critical facilities in Grayson County are exposed to this hazard.
- Critical Infrastructure: Because of the expected geographical widespread nature of lightning, all existing and future critical infrastructures in Grayson County are exposed to this hazard.

Information needed to fulfill *Requirement 201.6(c)(2)(ii)(C,* which addresses land uses and development trends was unattainable during the preparation of this Hazard Mitigation Plan. Compliance with this requirement will be an objective in the five-year planning cycle, should required information become available.

3.10 SEVERE WINTER STORM

Severe Winter Storm	
Population	According to National Climatic Data Center (NCDC), severe winter storm events can be expected to cause an average of 0.17 deaths per year, with no injuries recorded. All the population of Grayson County is exposed to this hazard.
Improved Property	According to National Climatic Data Center (NCDC), an average loss of $2,433,438 per year in property losses is expected to result from severe winter storm events. No crop losses are expected from this hazard in Grayson County.
Emergency Facilities	Because of the expected geographical widespread nature of severe winter storms, all emergency facilities in Grayson County are exposed to this hazard.
Critical Facilities	Because of the expected geographical widespread nature of severe winter storms, all critical facilities in Grayson County are exposed to this hazard.
Critical Infrastructure	Because of the expected geographical widespread nature of severe winter storms, all critical infrastructures in Grayson County are exposed to this hazard.

Because winter storm events are large and can affect extensive areas of a county, all existing and future buildings, critical facilities, critical infrastructure, emergency facilities, improved property, and population are considered to be exposed to this hazard.

Based on the available information, vulnerability to severe winter storms was assessed using two techniques: (1) to comply with *Requirement 201.6(c)(2)(ii)(B*), historical loss data obtained from the National Climatic Data Center was used to predict expected monetary and human losses from the event; (2) in fulfillment of *Requirement 201.6(c)(2)(ii)(A*), geographical hazard areas identified for severe winter storms and the nature of the impacts expected from this hazard event were used to identify the vulnerable assets.

Table 3.27 presents Grayson County's recorded historical losses due to severe winter storm events as provided in the hazard events database obtained from the National Climatic Data Center.

Table 3.26 Severe Winter Storm Historical Occurrences Between 1950 and 2008

Jurisdiction	Date	Fatalities	Annualized Expected Fatalities	Injuries	Property Damage (Present Value)	Crop Damage	Annualized Expected Property Losses
Grayson County Territory (including jurisdictions)	02/09/1994	0	0	0	$119,827,910	$0	$2,065,998.44
	11/24/1996	0	0	0	$0	$0	$0
	12/22/1998	6	0.10	0	$0	$0	$0
	01/25/2000	4	0.07	0	$0	$0	$0
	12/12/2000	0	0	0	$0	$0	$0
	12/25/2000	0	0	0	$0	$0	$0
	12/31/2000	0	0	0	$0	$0	$0
	01/01/2001	0	0	0	$0	$0	$0
	11/27/2001	0	0	0	$0	$0	$0
	02/05/2002	0	0	0	$0	$0	$0
	03/02/2002	0	0	0	$0	$0	$0
	02/24/2003	0	0	0	$21,277,787	$0	$366,858.39
	02/14/2004	0	0	0	$0	$0	$0
	12/22/2004	0	0	0	$0	$0	$0
	12/07/2005	0	0	0	$0	$0	$0
	11/30/2006	0	0	0	$0	$0	$0
	01/13/2007	0	0	0	$33,708	$0	$581.17
	03/03/2008	0	0	0	$0	$0	$0
	03/06/2008	0	0	0	$0	$0	$0
	12/15/2008	0	0	0	$0	$0	$0
	12/23/2008	0	0	0	$0	—	$0
Total		**10**	**0.17**	0	**$141,139,404**	$0	**$2,433,438**

Source: Texas Hazard Mitigation Package, National Climatic Data Center, and Grayson Central Appraisal District

— *No Recorded Information*

The annualized losses due to severe winter storm events were calculated using the methodology described in Section 3.2.2. The annualized loss value can be interpreted as the impact expected from severe winter storm in terms of annualized human losses and human injuries, and annualized property losses. As observed in *Table 3.27*, Grayson County can expect in average an annual $2,433,438 in property losses and 0.17 deaths per year, with no injuries and no losses in crop production from severe winter storm events.

The geographical occurrence of winter storm events is widespread; therefore, the area of potential impacts corresponds to all Grayson County's territory. According to the recorded historical information, extreme winter storm events impact property. Because of the regional character of this hazard event, all improved property, emergency and critical facilities, and critical structures are exposed to this hazard.

In compliance to *Requirement 201.6(c)(2)(ii),* vulnerability to extreme windstorm and impacts to assets expected from this event can be summarized as follows:

- Population: Based on historical data, severe winter storm events can be expected to cause an average of 0.17 deaths per year, and no injuries in Grayson County. All the population of Grayson County is exposed to this hazard.
- Improved Property: Based on historical data, an average loss of $2,433,438 per year in property losses are expected to result from severe winter storm events in Grayson County. No crop losses are expected from this hazard in Grayson County.
- Emergency Facilities: Because of the expected geographical widespread nature of severe winter storms, all existing and future emergency facilities in Grayson County are exposed to this hazard.
- Critical Facilities: Because of the expected geographical widespread nature of severe winter storms, all existing and future critical facilities in Grayson County are exposed to this hazard.
- Critical Infrastructure: Because of the expected geographical widespread nature of severe winter storms, all existing and future critical infrastructures in Grayson County are exposed to this hazard.

Information needed to fulfill *Requirement 201.6(c)(2)(ii),* which addresses land uses and development trends was unattainable during the preparation of this Hazard Mitigation Plan. Compliance with this requirement will be an objective in the five-year planning cycle, should required information become available.

3.11 TORNADO

Tornado	
Population	According to National Climatic Data Center (NCDC), tornado events can be expected to cause an average of 0.03 deaths and 0.85 injuries per year in Grayson County. All the population of Grayson County is exposed and vulnerable to this hazard.
Improved Property	According to National Climatic Data Center (NCDC), an average loss of $1,413,244 per year in property losses is expected to result from severe winter storm events. No crop losses are expected from this hazard in Grayson County.
Emergency Facilities	Because of the impossibility to predict the geographical area of impact for tornados, all emergency facilities in Grayson County are exposed to this hazard.
Critical Facilities	Because of the impossibility to predict the geographical area of impact for tornados, all critical facilities in Grayson County are exposed to this hazard.
Critical Infrastructure	Because of the impossibility to predict the geographical area of impact for tornados, all critical infrastructures in Grayson County are exposed to this hazard.

The areas of impact from tornado events cannot be predicted, and they can affect extensive areas of a county. All existing and future buildings, critical facilities, critical infrastructure, emergency facilities, improved property, and population are considered to be exposed to this hazard.

Based on the available information, vulnerability to tornados was assessed using two techniques: (1) to comply with *Requirement 201.6(c)(2)(ii)(B*), historical loss data obtained from the National Climatic Data Center, and the Texas Hazard Mitigation Plan was used to predict expected monetary and human losses from the event; (2) in fulfillment of *Requirement 201.6(c)(2)(ii)(A*), geographical hazard areas identified for tornados and the nature of the impacts expected from this hazard event were used to identify the vulnerable assets *(Figure 3.44).*

Table 3.28 presents Grayson County's recorded historical losses due to tornado events as provided in the hazard events database obtained from the National Climatic Data Center.

Table 3.27 Historical Tornado Occurrences between 1950 and 2008

Jurisdiction	Number of Events	Years	Magnitude (Fujita Scale)	Fatalities	Annualized Expected Fatalities	Injuries	Annualized Expected Injuries	Property Damage (Present Value)	Crop Damage (Present Value)	Annualized Expected Property Losses
Grayson County*	53	1952-2006	F0 to F3	2	0.034	44	0.759	$80,125,051	$0	$1,381,466
Bells	0	—	—	—	—	—	—	—	—	—
Collinsville	1	2008	F1	0	0	1	0.017	$424,000	$0	$7,310
Denison	2	1996-2008	F0 to F2	0	0	3	0.052	$799,266	$0	$13,780
Dorchester	0	—	—	—	—	—	—	—	—	—
Gunter	1	2006	F0	0	0	0	—	$0	$0	$0
Howe	0	—	—	—	—	—	—	—	—	—
Knollwood	0	—	—	—	—	—	—	—	—	—
Pottsboro	2	1994-1997	F0	0	0	0	—	$0	$0	$0
Sadler	1	1996	F0	0	0	0	—	$4,266	$0	$74
Sherman	3	1995-2006	F0	0	0	1	0.017	$615,569	$0	$10,613
Southmayd	0	—	—	—	—	—	—	—	—	—
Tioga	0	—	—	—	—	—	—	—	—	—
Tom Bean	0	—	—	—	—	—	—	—	—	—
Van Alstyne	0	—	—	—	—	—	—	—	—	—
Whitesboro	1	2008	F0	0	0	0	—	$0	$0	$0
Whitewright	0	—	—	—	—	—	—	—	—	—
Total	**64**	**1952 to 2008**	**F0 to F3**	**2**	**0.034**	**49**	**0.845**	**$81,968,152**	**—**	**$1,413,244**

Source: Texas Hazard Mitigation Package, National Climatic Data Center, and Grayson Central Appraisal District

* *Grayson County unincorporated areas*

— *No Recorded Information*

The annualized losses due to tornado events were calculated using the methodology described in Section 3.2.2. The annualized loss value can be interpreted as the impact expected from tornados in terms of annualized human losses and human injuries, and annualized property losses. As observed in *Table 3.27*, Grayson County can expect in average 0.03 deaths per year and 0.85 injuries per year. All the population of Grayson County is exposed to this hazard. Also, an expected average of $1,413,244 per year in property losses is expected from tornados, with most of the historical events occurring in the unincorporated areas of Grayson County. Finally, there are no expected crop losses as result of tornados events.

As stated before, the geographical area of impact for tornado events cannot be predicted, the area of potential impacts corresponds to all Grayson County's territory, and all improved property, emergency and critical facilities, and critical structures are exposed to this hazard. According to the recorded historical information, expected personal and property losses from tornado events are significant.

In compliance to *Requirement 201.6(c)(2)(ii)*, vulnerability to extreme windstorm and impacts to assets expected from this event can be summarized as follows:

- Population: Based on historical data, tornado events can be expected to cause an average of 0.03 deaths per year and 0.85 injuries per year in Grayson County. All the population of Grayson County is exposed to this hazard.
- Improved Property: Based on historical data, an average loss of $1,413,244 per year in property losses are expected to result from severe winter storm events in Grayson County. No crop losses are expected from this hazard in Grayson County.
- Emergency Facilities: Because of the impossibility to predict the geographical area of impact for tornados, all existing and future emergency facilities in Grayson County are exposed to this hazard.
- Critical Facilities: Because of the impossibility to predict the geographical area of impact for tornados, all existing and future critical facilities in Grayson County are exposed to this hazard.
- Critical Infrastructure: Because of the impossibility to predict the geographical area of impact for tornados, all existing and future critical infrastructures in Grayson County are exposed to this hazard.

Information needed to fulfill *Requirement 201.6(c)(2)(ii)(C)*, which addresses land uses and development trends was unattainable during the preparation of this Hazard Mitigation Plan. Compliance with this requirement will be an objective in the five-year planning cycle, should required information become available.

3.12 DAM AND LEVEE FAILURE

The probability of occurrence for dam and/or levee events in Grayson County is likely. However, due to unattainable information regarding this hazard, quantitative predictions are not available at the present time. All five categories, population, improved property, emergency facilities, critical facilities, and critical infrastructure are considered vulnerable to damage caused by dam and/or levee failure. According to the Priority Risk Index analysis presented in Section 2, any estimated losses associated with this hazard are anticipated to be of moderate risk across Grayson County.

Based on Federal Emergency Management Agency's HAZUS-MH®, a total of 106 dams are located in Grayson County (*Table 3.29).*

Table 3.28 Dams located in Grayson County and Participating Jurisdictions

Jurisdiction	Number of Dams	Dam Classification		
		High	Significant	Low
Grayson County*	100	5	4	91
Bells	0	0	0	0
Collinsville	0	0	0	0
Denison	2	1	0	1
Dorchester	0	0	0	0
Gunter	0	0	0	0
Howe	0	0	0	0
Knollwood	0	0	0	0
Pottsboro	0	0	0	0
Sadler	0	0	0	0
Sherman	3	3	0	0
Southmayd	0	0	0	0
Tioga	1	0	1	0
Tom Bean	0	0	0	0
Van Alstyne	0	0	0	0
Whitesboro	0	0	0	0
Whitewright	0	0	0	0
Total	**106**	**9**	**5**	**92**

Source: Federal Emergency Management Agency HAZUS-MH®

* *Grayson County unincorporated areas*

The Natural Resources Conservation Service provided a list *(Table 3.29)* of 15 high and significant hazard dams located in Grayson County (based on the NRCS classification criteria). Only three of these 15 dams are considered high or significant hazard dams in the FEMA HAZUS-MH Classification System. Fifteen of these dams have received federal funds from the Natural Resources Conservation Service to conduct an assessment to determine needs of dam rehabilitation. The Natural Resources Conservation Service considers these fifteen dams to be of high or significant hazard, thus the need for the assessment (T*able 3.29).*

Table 3.29 Natural Resources Conservation Service High Hazard Dams

Jurisdiction	National Inventory of Dams ID Number	Dam Name
Grayson County*	TX02051	Pilot Grove Creek WS NRCS Site 30
	TX02061	Choctaw Creek WS NRCS Site 16
	TX02077	Pilot Grove Creek WS NRCS Site9
	TX02080	Pilot Grove Creek WS NRCS Site 31A
	TX02084	Sister Grove Creek WS NRCS Site 36
	TX02087	Sister Grove Creek WS NRCS Site 32
	TX02092	Sister Grove Creek WS NRCS Site 23
	TX02093	Sister Grove Creek WS NRCS Site 24
	TX02096	Sister Grove Creek WS NRCS Site 21
	TX02113	East Fork Above Lavon WS NRCS Site 20A
	TX02114	East Fork Above Lavon WS NRCS Site 20
	TX02115	East Fork Above Lavon WS NRCS Site 19
	TX02116	East Fork Above Lavon WS NRCS Site 39
	TX02117	East Fork Above Lavon WS NRCS Site 18
	TX06919	Choctaw Creek WS NRCS Site 28

Source: Natural Resources Conservation Service
* *Grayson County unincorporated areas*

A further assessment of Loy Lake Dam, located in an unincorporated area of Grayson County, was prepared by the Texas Department of Water Resources. Loy Lake Dam is owned and operated by Grayson County for purposes of maintaining a recreational lake and County Park. Loy Lake Dam is classified as a high hazard dam by the state at the time of this assessment, but is now classified by FEMA as a significant hazard dam and is one of the 4 significant hazard dams located in the unincorporated area of Grayson County that make up the 5 dams shown in Grayson County. The assessment concluded that the dam is hydraulically inadequate, because it will not pass the probability maximum flood required by the *Recommended Guidelines for Safety Inspection of Dams*. As a result, the Soil Conservation Service proposed to rebuild the project as a floodwater-retarding site. The assessment provides some monitoring and warning actions recommendations including routine maintenance programs, periodic surveillance of seepage areas, and formal downstream flood/failure warning procedures.

The owners of all dams considered by the State of Texas dam safety regulations to be of significant or high hazard risk were required to prepare Emergency Action Plans and submit them to the State by January 1, 2011. These EAPs must designate the areas of potential inundation that would result from a breach or failure of the dam. During the next planning update of the Hazard Mitigation Plan, Grayson County will work with the State of Texas Commission on Environmental Quality (TCEQ) to review those EAPs and the inundation maps provided therein, in order to determine appropriate action items for Grayson County emergency officials. If the owners of any of these dams have not yet prepared the appropriate EAPs, Grayson County

will evaluate the proper steps that should be taken to bring those dams into compliance with the State's regulations.

In addition, based on the inundation maps, an estimate of the potential damages and repercussions of the potential dam failure events will be estimated.

3.13 EARTHQUAKE

Earthquake events are discussed in the State of Texas Mitigation Plan. Texas does face moderate risk to less frequent, less intense earthquake events. There are very few earthquakes with epicenters within the Northeast Texas region in which Grayson County is located, but past earthquakes have been recorded in surrounding counties. Therefore, the probability of occurrence for a damaging earthquake event in Grayson County is extremely low. Due to the lack of available information regarding this hazard, quantitative predictions are not available at the present time. All five categories, population, improved property, emergency facilities, critical facilities, and critical infrastructure are considered vulnerable to damage caused by an earthquake. As summarized in Table 2.14 and outlined according to the Priority Risk Index analysis presented within Table 2.16 in Section 2, any estimated losses associated from this hazard are anticipated to be of low magnitude across Grayson County and the extent of risk is considered to be very low

3.14 EXPANSIVE SOILS

The probability of occurrence for expansive soil events in Grayson County is at a moderate risk. Due to a lack of available information regarding this hazard, quantitative predictions were not made for this hazard at the present time, but it is assumed that up to 50% of the County's property is at risk for some damages due to expansive soil events.

Population is not considered vulnerable to damage caused by expansive soils; therefore, any estimated population losses associated with this hazard are anticipated to be minimal across Grayson County. Improved property, emergency facilities, critical facilities, and critical infrastructures are more vulnerable to this event. Grayson County is located in an area that contains abundant clay with high swelling potential. According to the Priority Risk Index analysis presented in Section 2, impacts from expansive soils have a moderate risk of creating a hazard causing extensive damage to highways, streets, and may other structures.

3.15 NO IMPACT HAZARDS

The Priority Risk Index classifies the hazards listed below as posing very low to no risk; however, the occurrence of these hazards to varying or unprecedented magnitudes is still possible in some cases. Therefore, their classification will continue to be evaluated during future plan updates and where appropriate, additional data will be collected, if available, during future updates in order to re-evaluate these hazards.

Landslide

According to the Priority Risk Index analysis presented in Section 2, landslides have an extremely low risk in Grayson County. The probability of occurrence for landslide events in Grayson County is unlikely and the life and property damages which would be expected are minor. The spatial extent of landslides was considered negligible. Due to unavailability of information regarding this hazard, quantitative predictions were not developed for this Plan.

Land Subsidence

Based on the Priority Risk Index analysis presented in Section 2, land subsidence has only an extremely low risk in Grayson County. The probability of occurrence for land subsidence events in Grayson County is unlikely and the life and property damages which would be expected are extremely minor. The spatial extent of land subsidence was considered to be very small. Due to unavailability of information regarding this hazard, quantitative predictions were not developed for this Plan.

Avalanche, Coastal Erosion, Coastal Storm, Tsunami, and Volcano

Based on the Priority Risk Index analysis presented in Section 2 for these five hazards, all have zero risk in Grayson County. The probability of occurrence for each of these hazards in Grayson County is highly unlikely and the life and property damages which would be expected are extremely minor. The spatial extent of land subsidence was considered to be negligible. No further analysis or consideration of these hazards is expected to be warranted in the future.

3.16 SUMMARY

Table 3.31 provides a summary of annualized losses for each nine hazard event for which the quantitative analysis (Geographic Information System and/or statistical) was conducted. *Table 3.32* summarizes the qualitative analysis conducted on the five hazard events. Wildfires are not listed due to lack of historical data related to annualized losses.

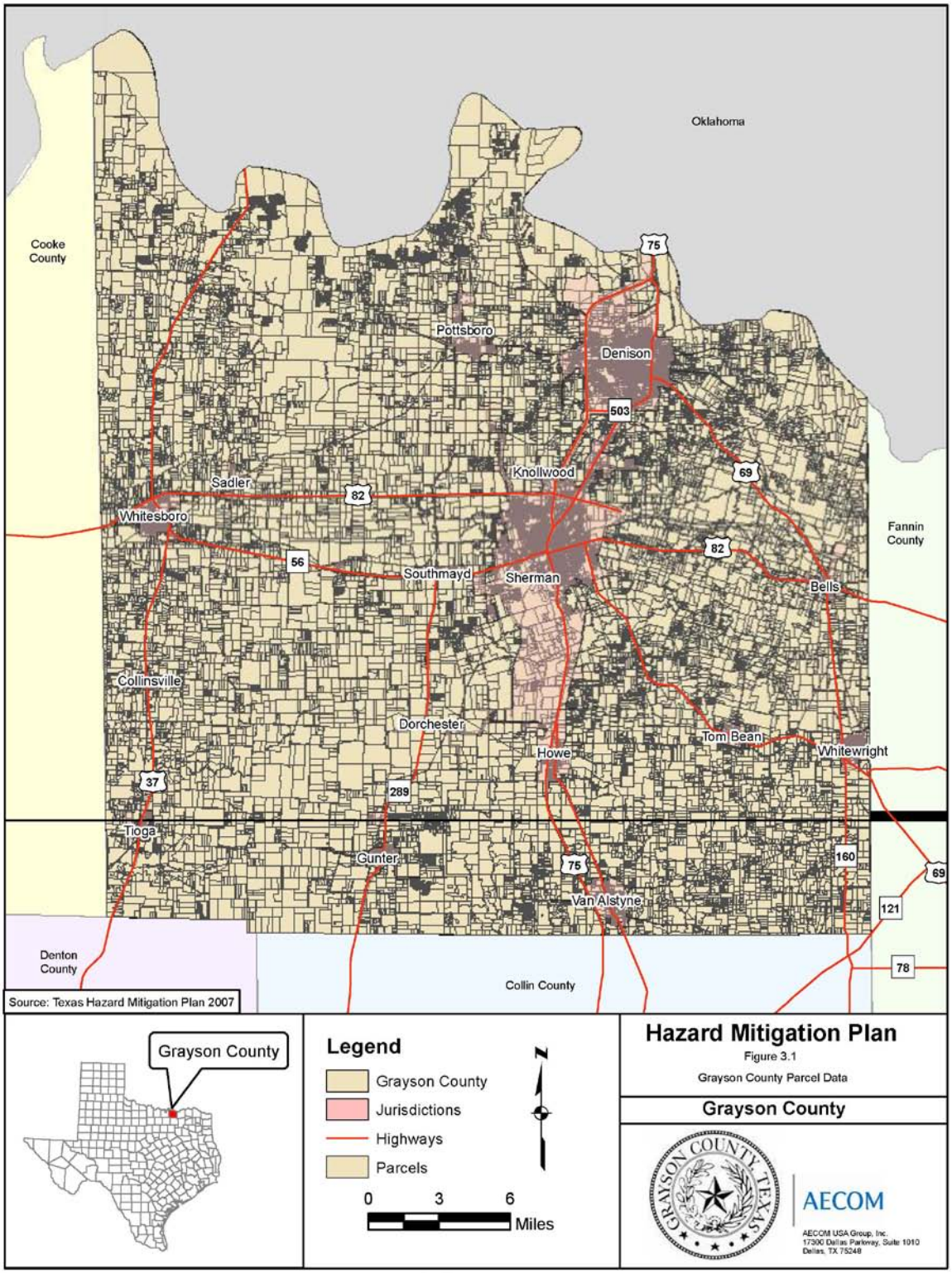
Table 3.30 Annualized Losses Expected from Hazards Analyzed using a Quantitative Analysis

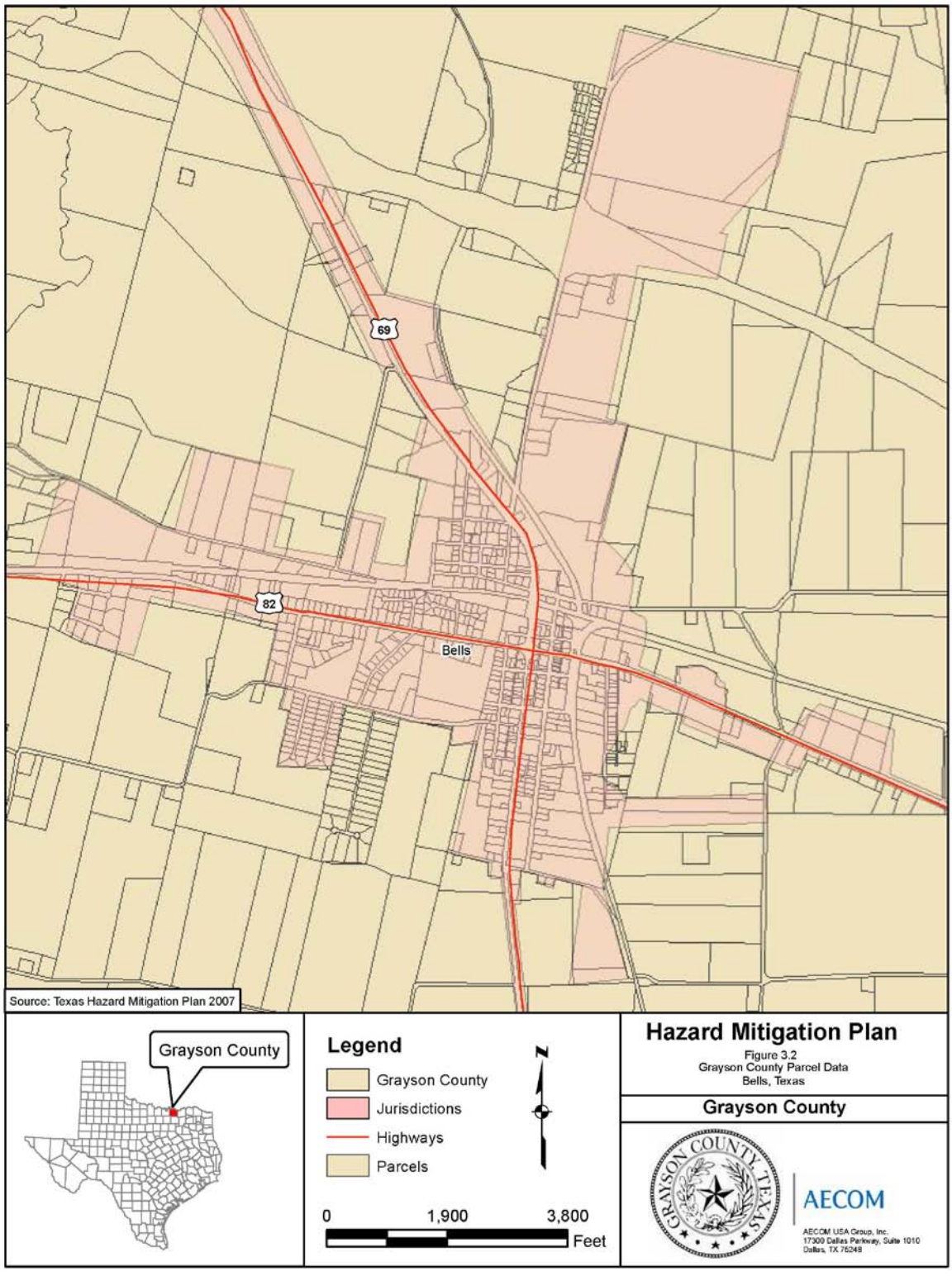
Hazards Event	Annualized Expected Fatalities	Annualized Expected Injuries	Annualized Expected Property Losses	Annualized Expected Crop Loss	Annualized Expected Crop Loss per Acre
Flood	—	—	$425,000	—	—
Hail	—	—	$253,629	—	—
Drought	—	—	$2,063,743	$53,745,624	$126
Extreme Temperature	0.91	—	$0.00	—	—
Extreme Wind	0.155	—	$51,962	—	—
Lightning		—	$4,828	—	—
Winter Storm	0.17	—	$2,433,438	—	—
Tornados	0.034	0.845	$1,413,244	—	—

— *No Recorded Information*

Table 3.31 Summary of Qualitative Analysis

Hazard Event	Probability of Occurrence According to the Priority Risk Index	Vulnerable Categories				
		Population	Property Damage	Emergency Facilities	Critical Facilities	Critical Infrastructures
Dam and Levee Failure	Moderate Risk	√	√	√	√	√
Earthquake	Low Risk	√	√	√	√	√
Expansive Soils	Moderate Risk		√	√	√	√
Landslide	Low Risk	√	√	√	√	√
Land	Moderate Risk		√	√	√	√


Oklahoma
Cooke County
Pottsboro
Denison
Knollwood
Sadler
Whitesboro
Fannin County
Southmayd
Sherman
Bells
Collinsville
Dorchester
Tom Bean
Whitewright
Howe
Tioga
Gunter
Van Alstyne
Denton County
Collin County
75
503
69
82
56
37
289
160
121
78
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0 3 6
Miles
Hazard Mitigation Plan
Figure 3.1
Grayson County Parcel Data
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


69
82
Bells
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
1,900
3,800
Feet
Hazard Mitigation Plan
Figure 3.2
Grayson County Parcel Data
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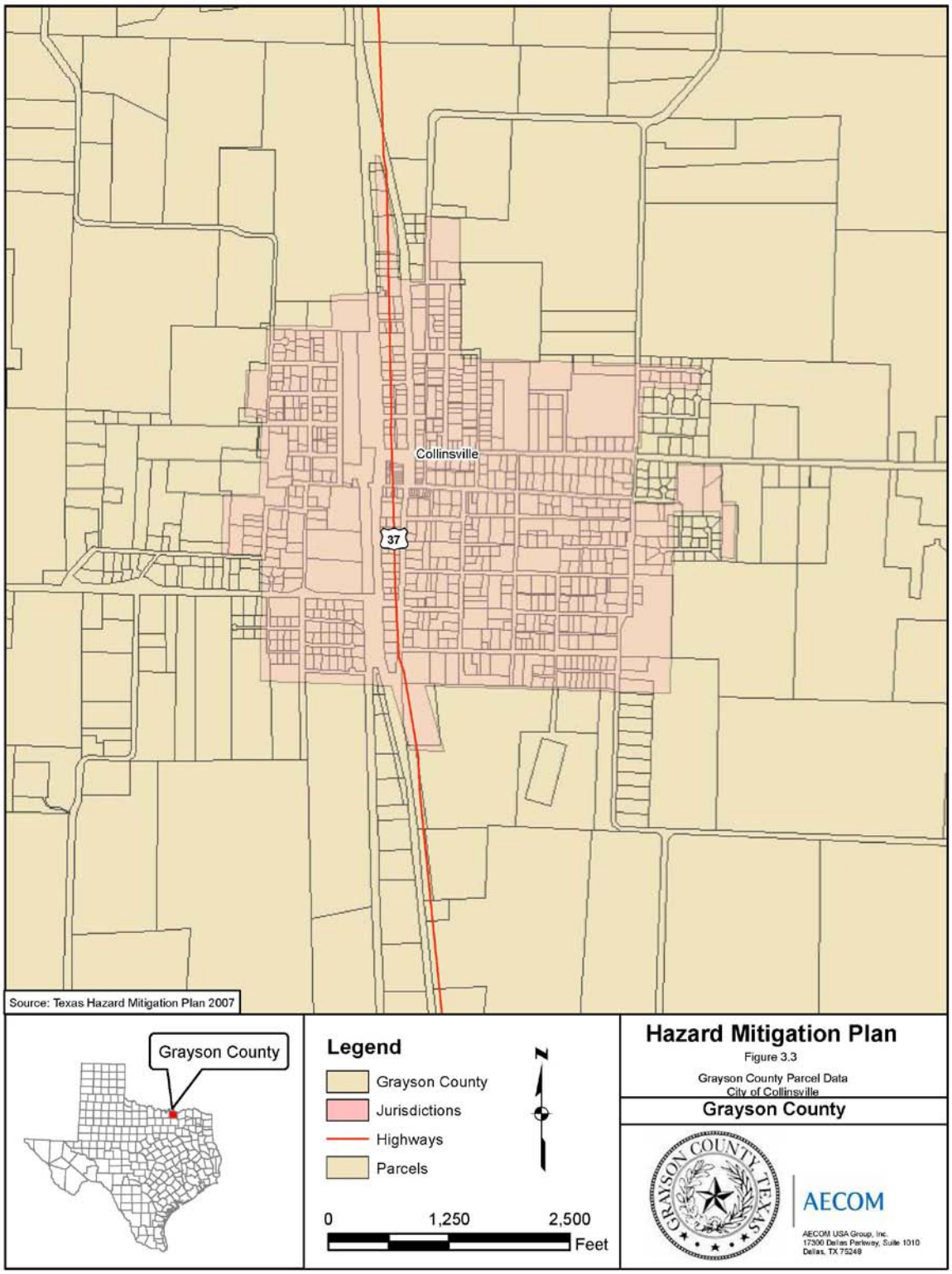
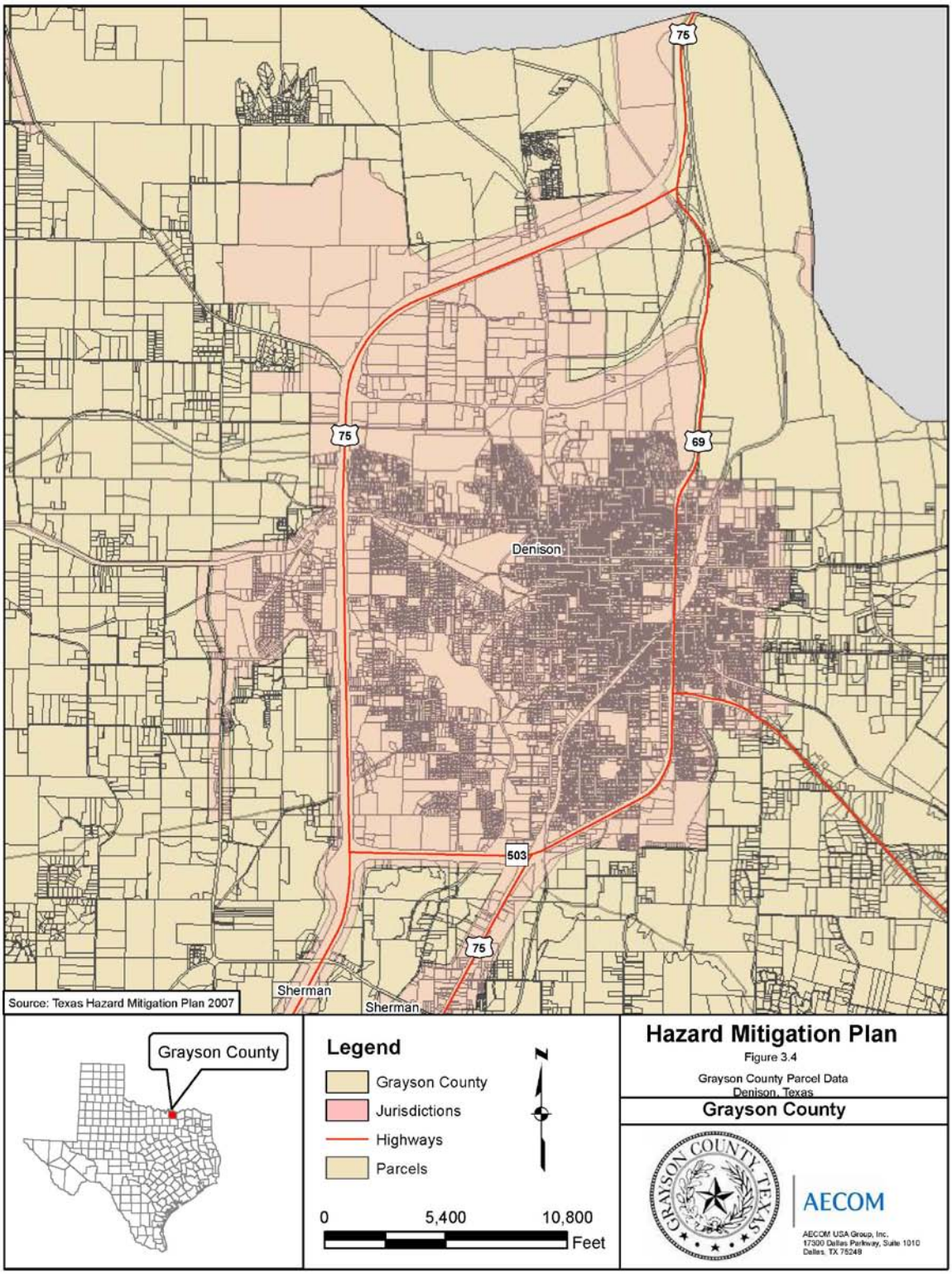
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


Collinsville
37
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
1,250
2,500
Feet
Hazard Mitigation Plan
Figure 3.3
Grayson County Parcel Data
City of Collinsville
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


75
75
69
Denison
503
75
Sherman
Sherman
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
5,400
10,800
Feet
Hazard Mitigation Plan
Figure 3.4
Grayson County Parcel Data
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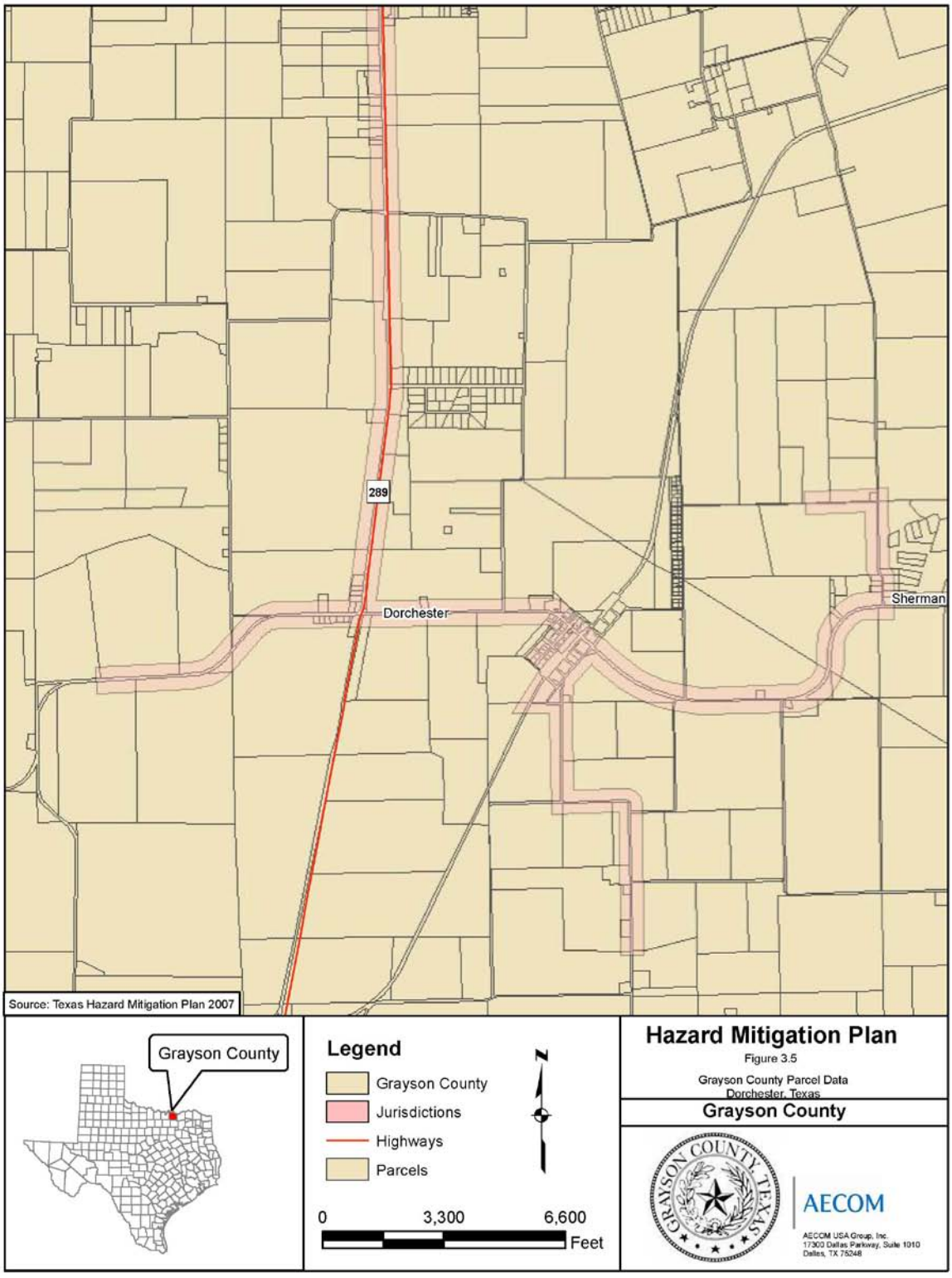
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


289
Dorchester
Sherman
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
3,300
6,600
Feet
Hazard Mitigation Plan
Figure 3.5
Grayson County Parcel Data
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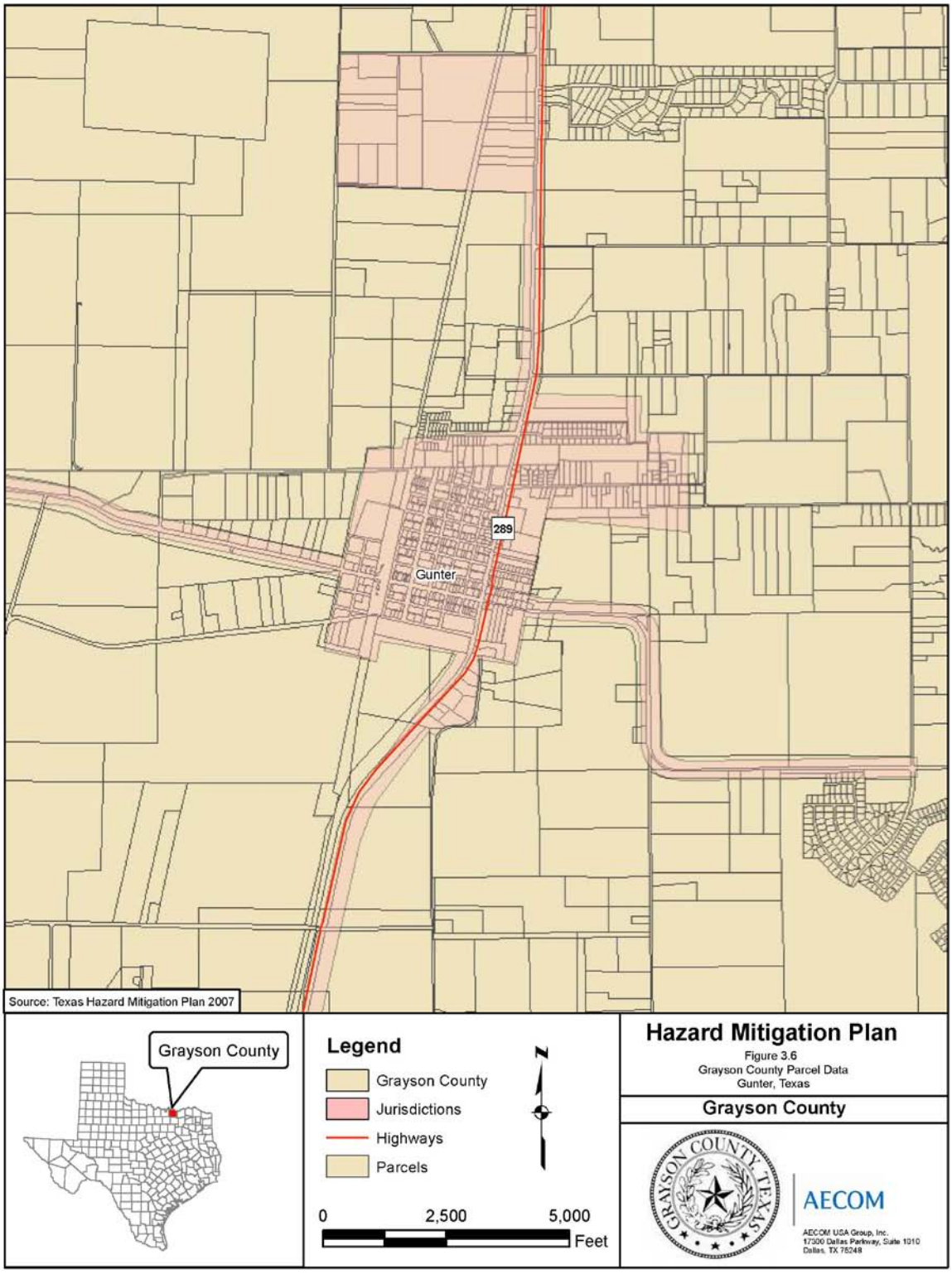
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


289
Gunter
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
2,500
5,000
Feet
Hazard Mitigation Plan
Figure 3.6
Grayson County Parcel Data
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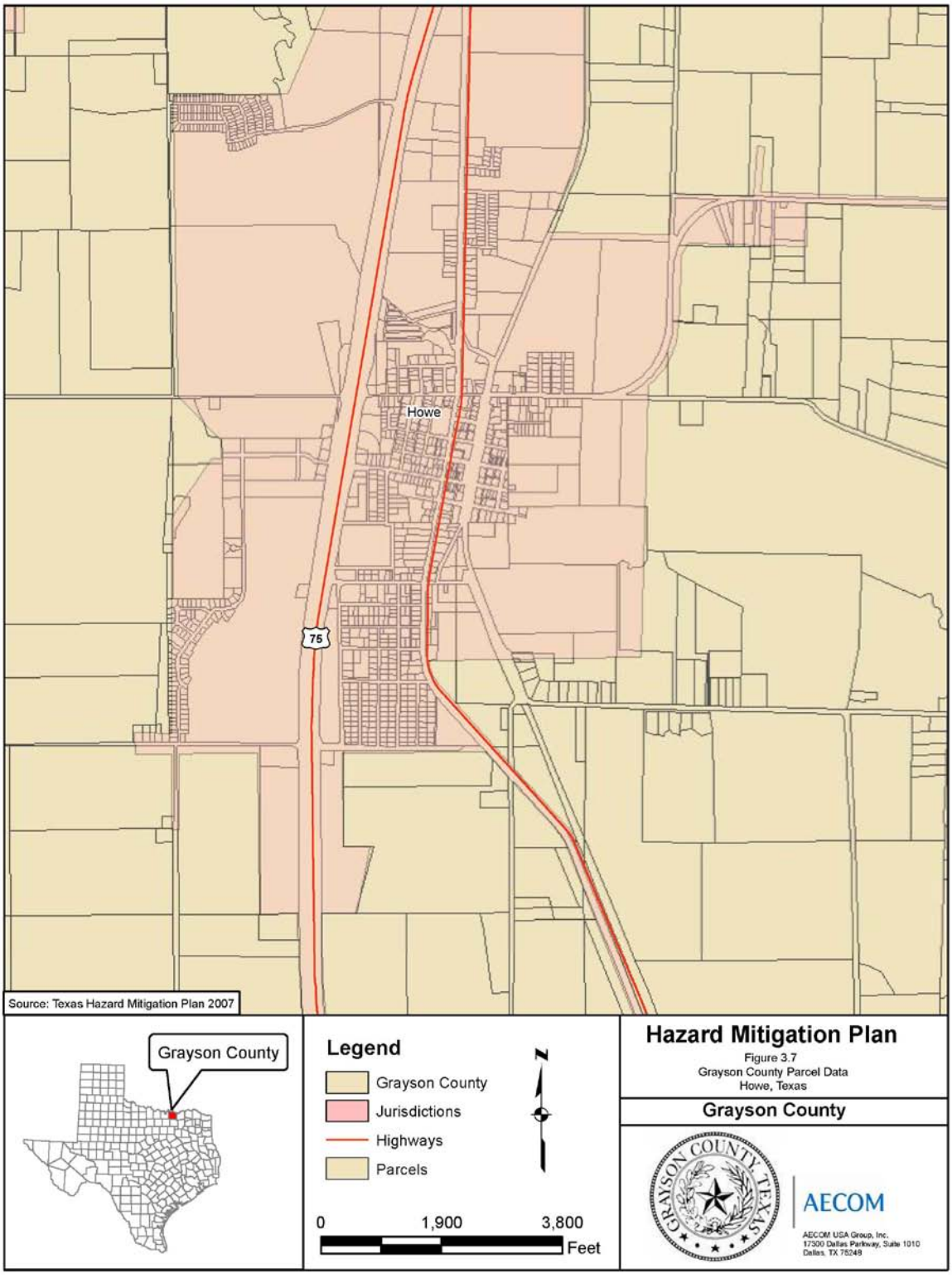
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


Howe
75
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
1,900
3,800
Feet
Hazard Mitigation Plan
Figure 3.7
Grayson County Parcel Data
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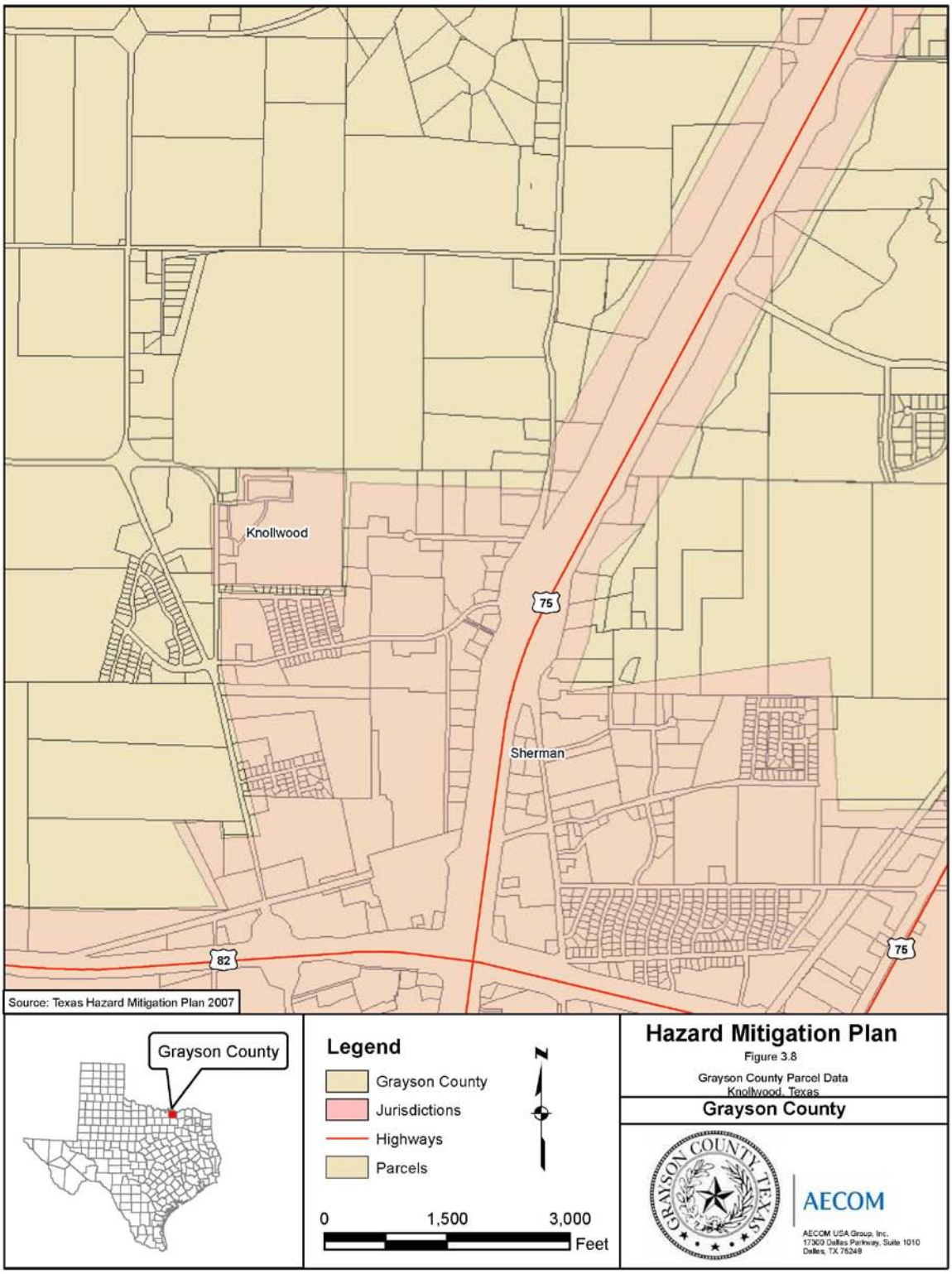
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


Knollwood
Sherman
75
82
75
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
1,500
3,000
Feet
Hazard Mitigation Plan
Figure 3.8
Grayson County Parcel Data
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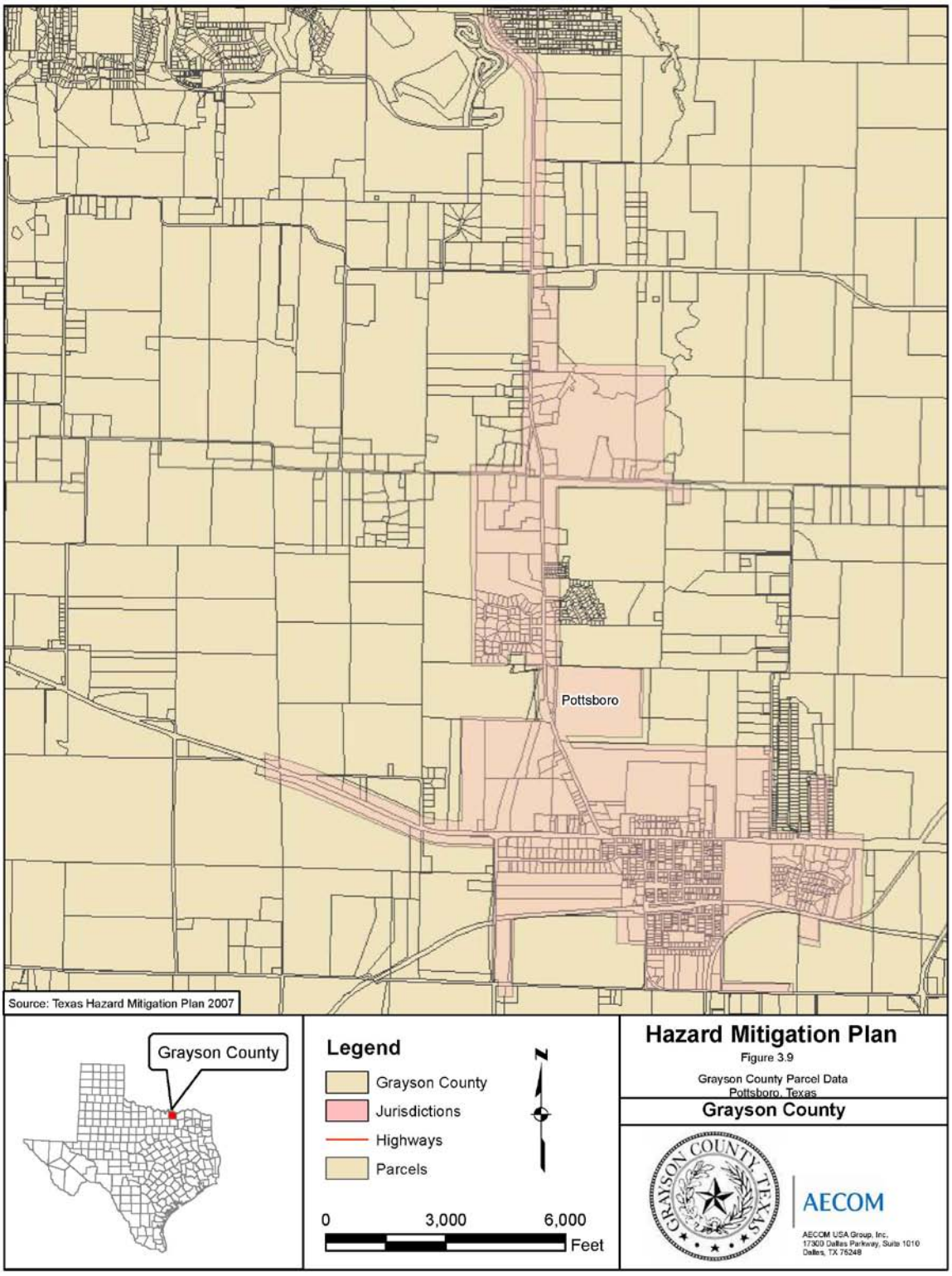
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17304 Dallas Parkway, Suite 1010
Dallas, TX 75248


Pottsboro
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
3,000
6,000
Feet
Hazard Mitigation Plan
Figure 3.9
Grayson County Parcel Data
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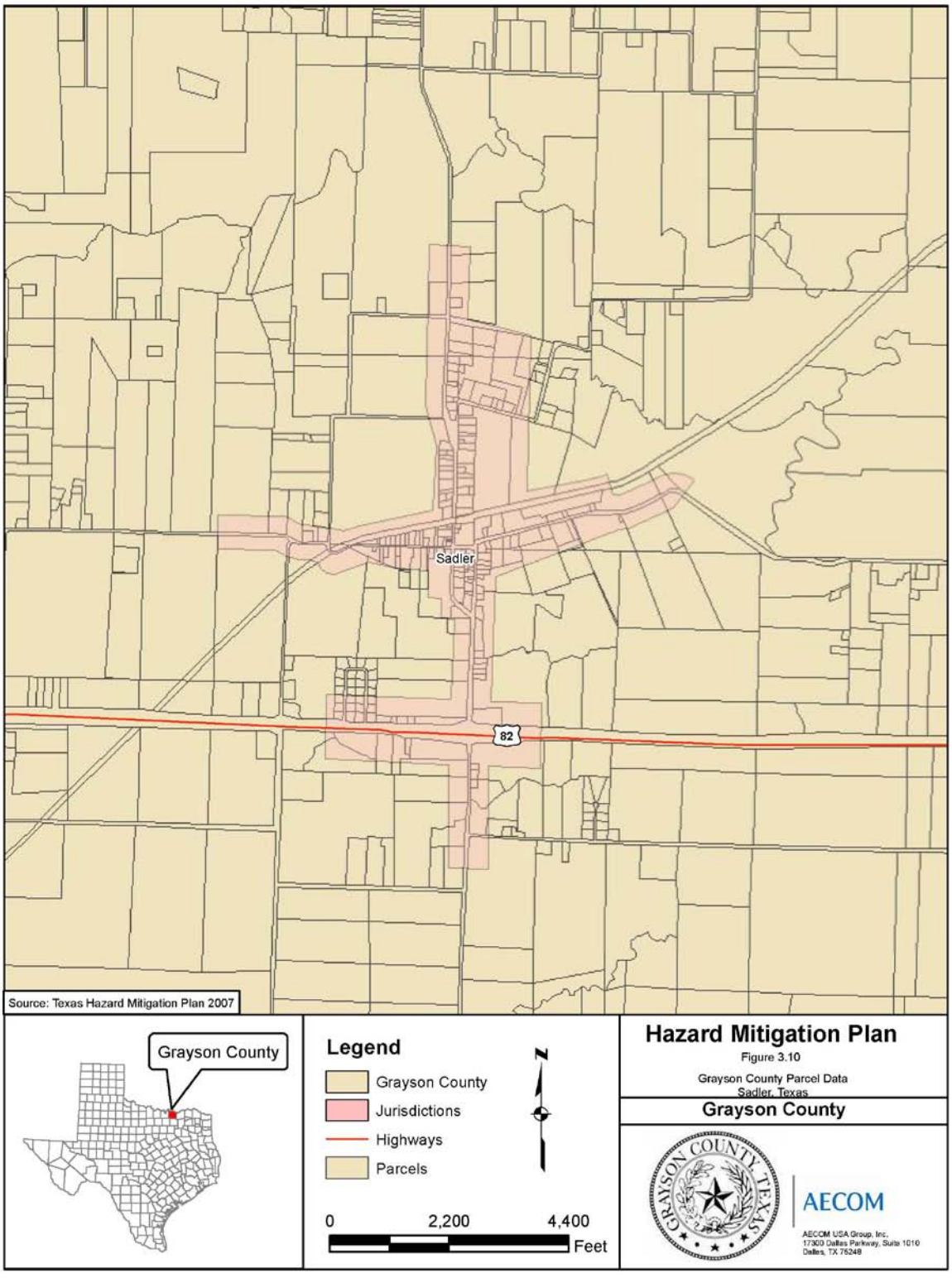
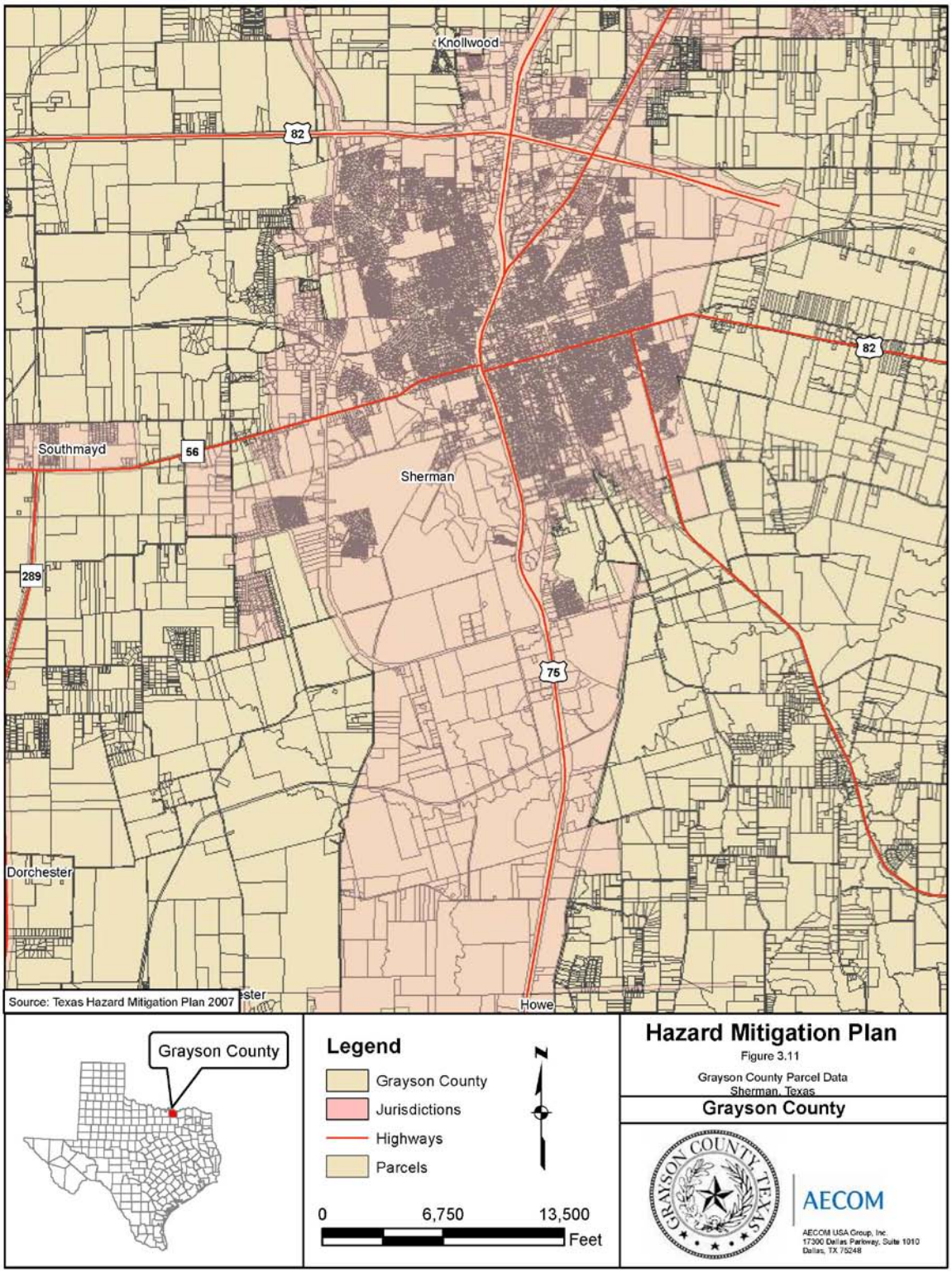
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


Sadler
82
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
2,200
4,400
Feet
Hazard Mitigation Plan
Figure 3.10
Grayson County Parcel Data
Sadler, Texas
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


Knollwood
82
82
Southmayd
56
Sherman
289
75
Dorchester
Howe
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
6,750
13,500
Feet
Hazard Mitigation Plan
Figure 3.11
Grayson County Parcel Data
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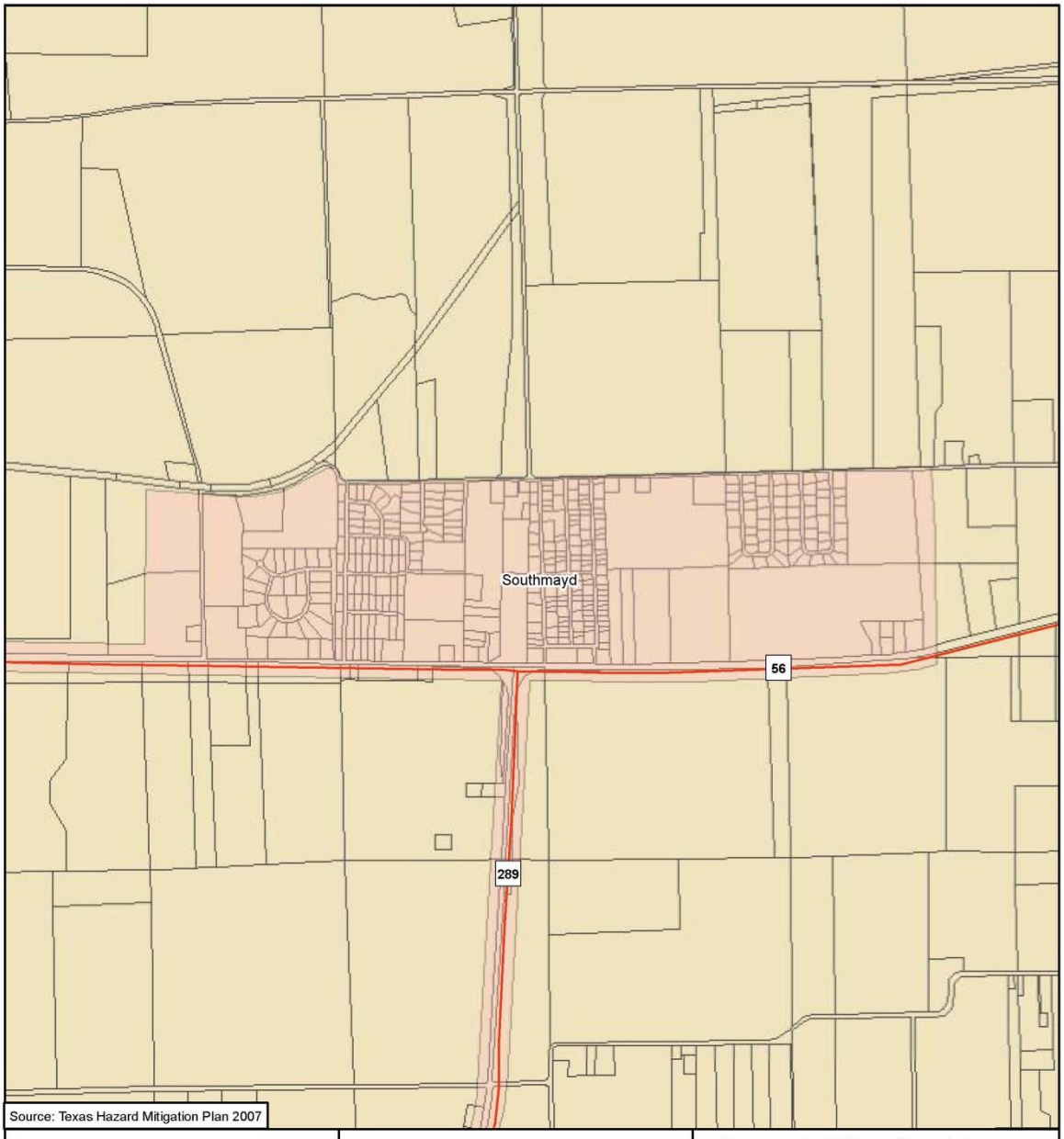
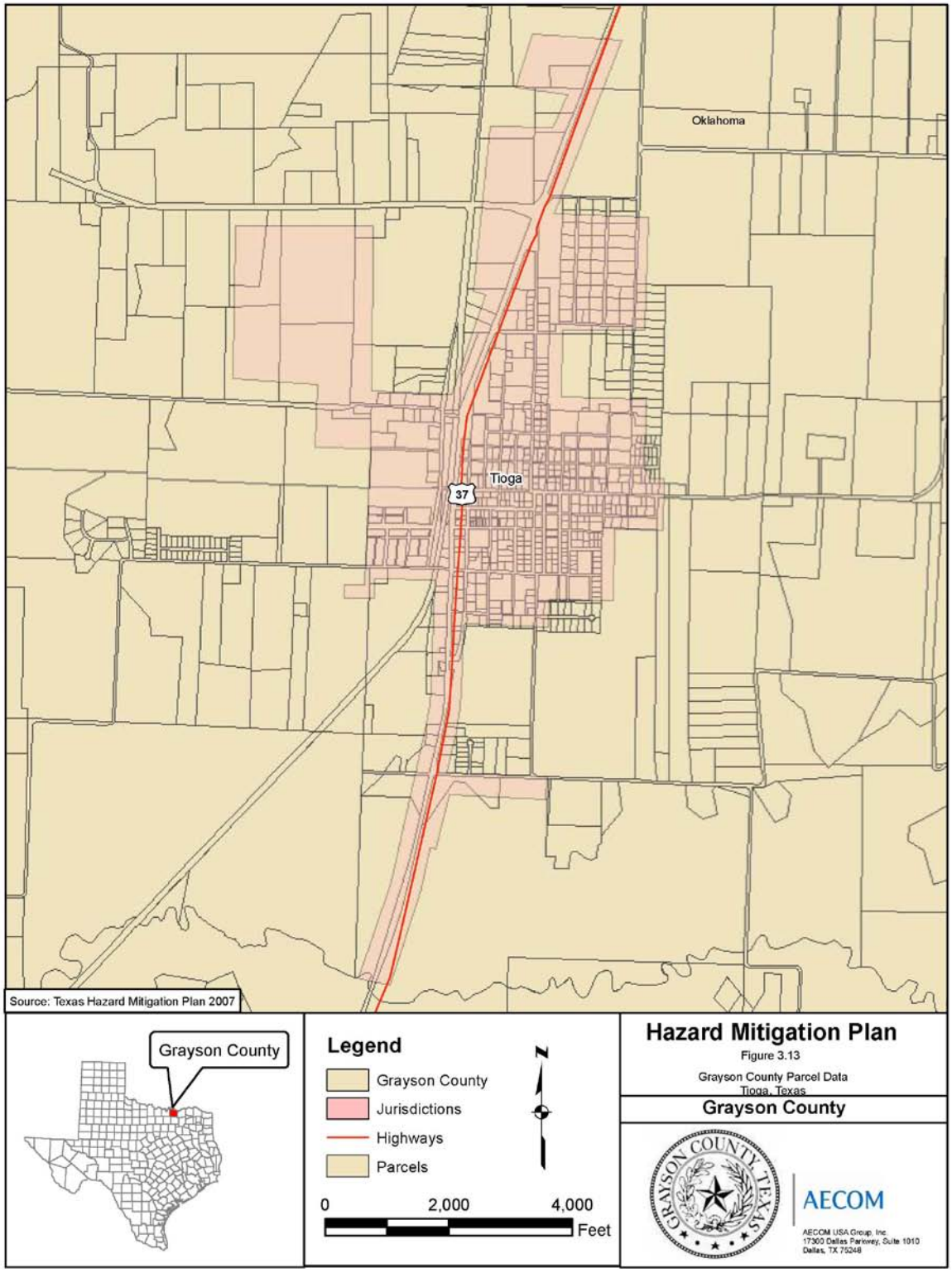
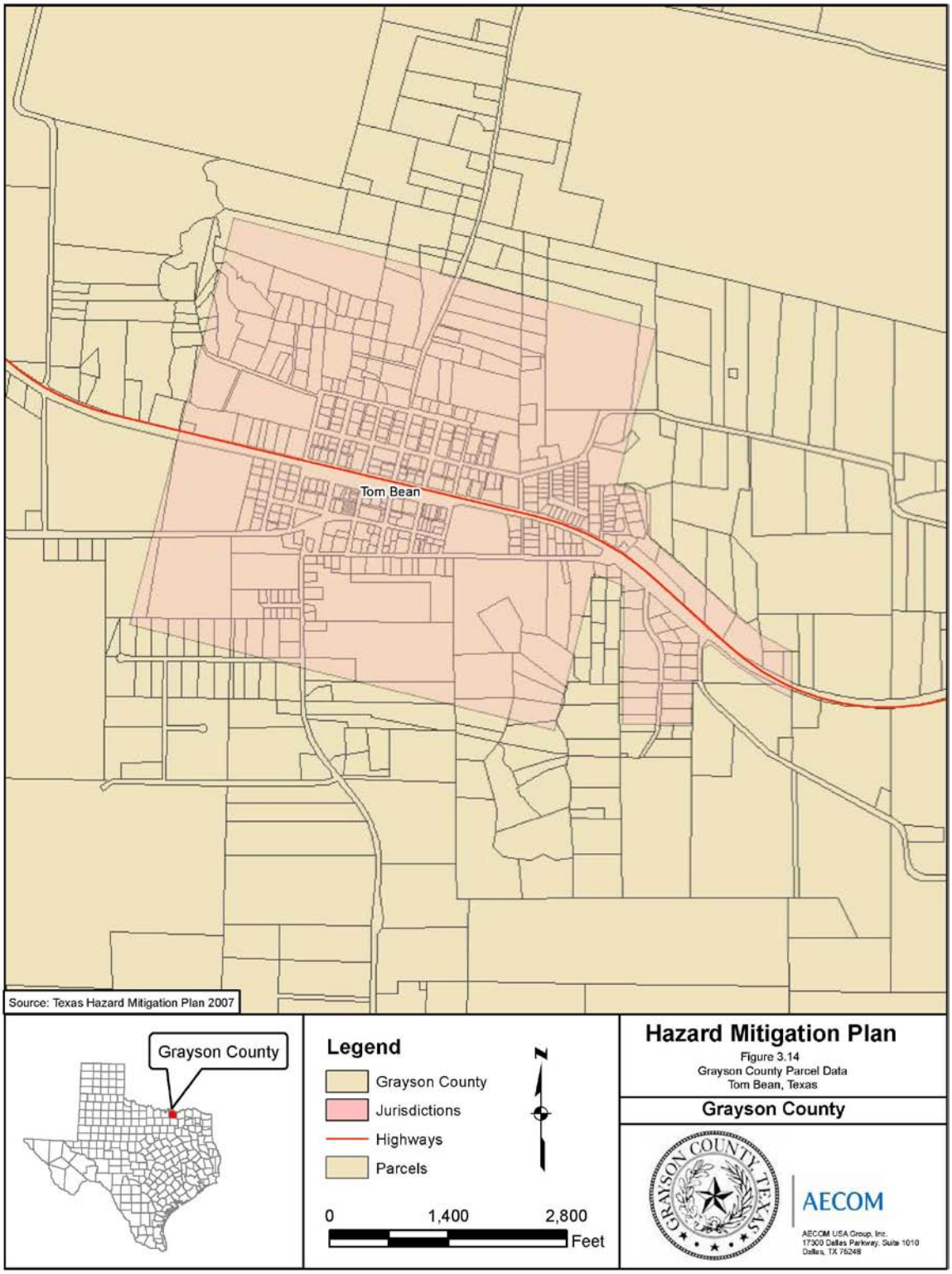
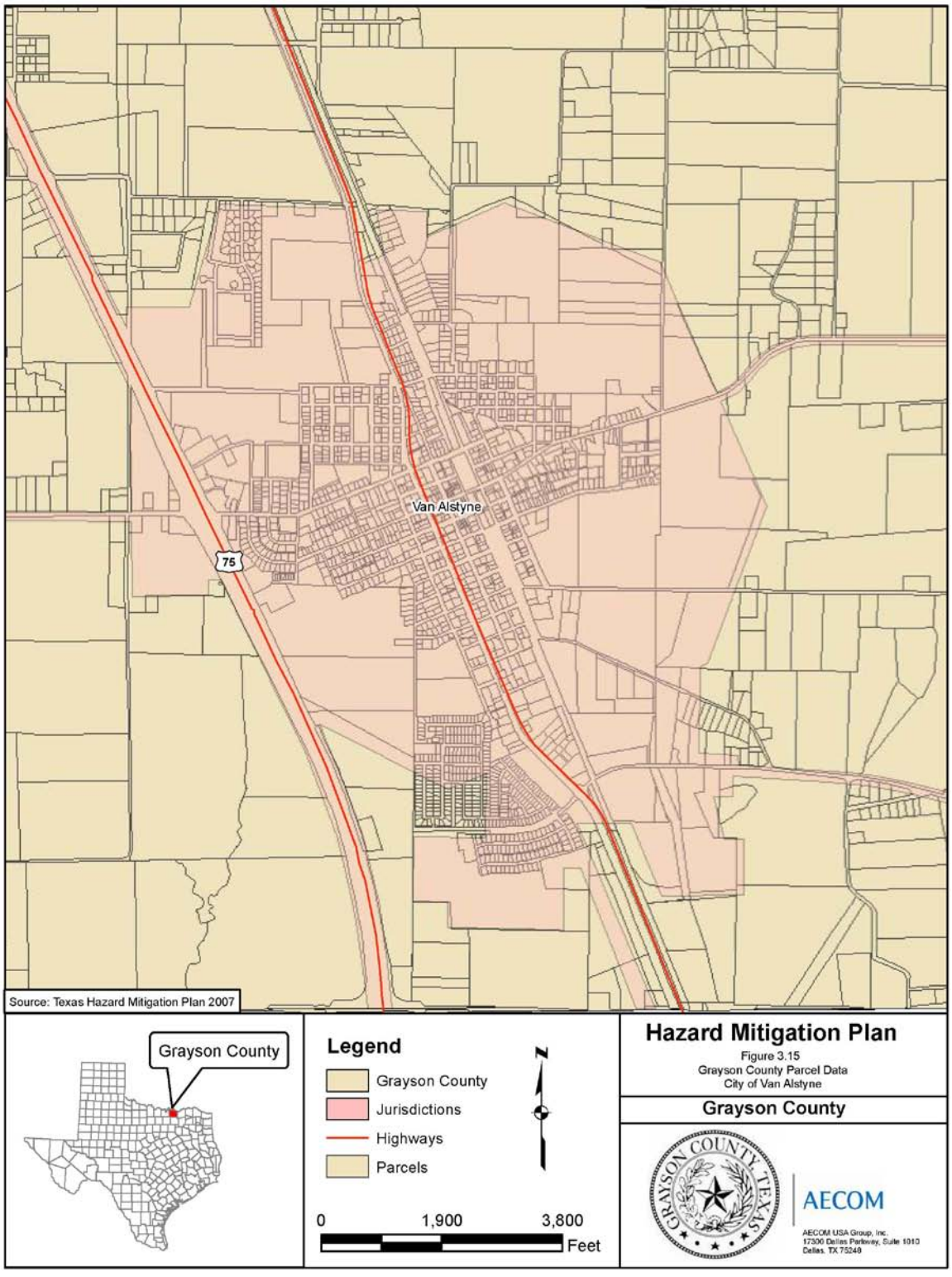
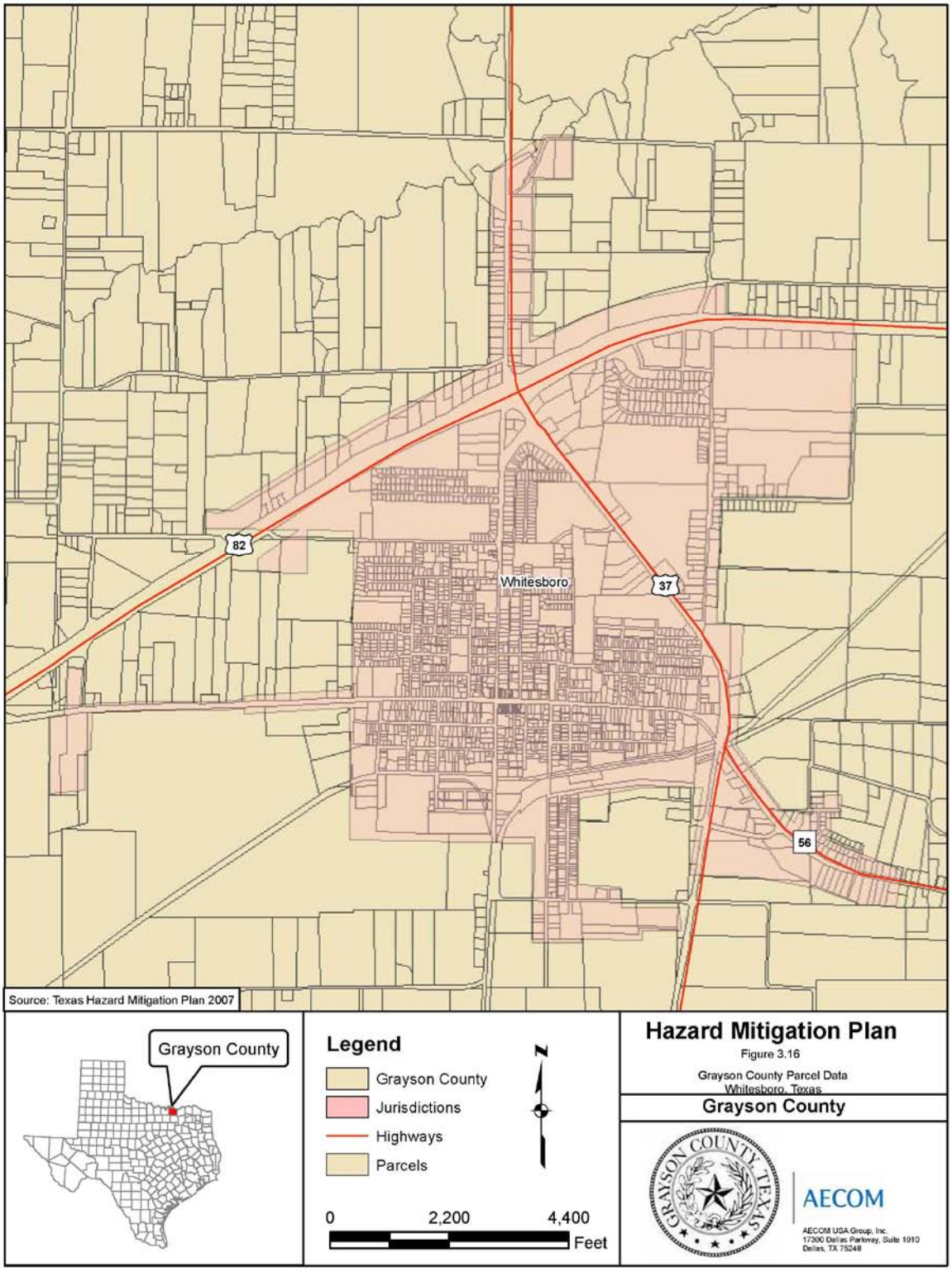
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

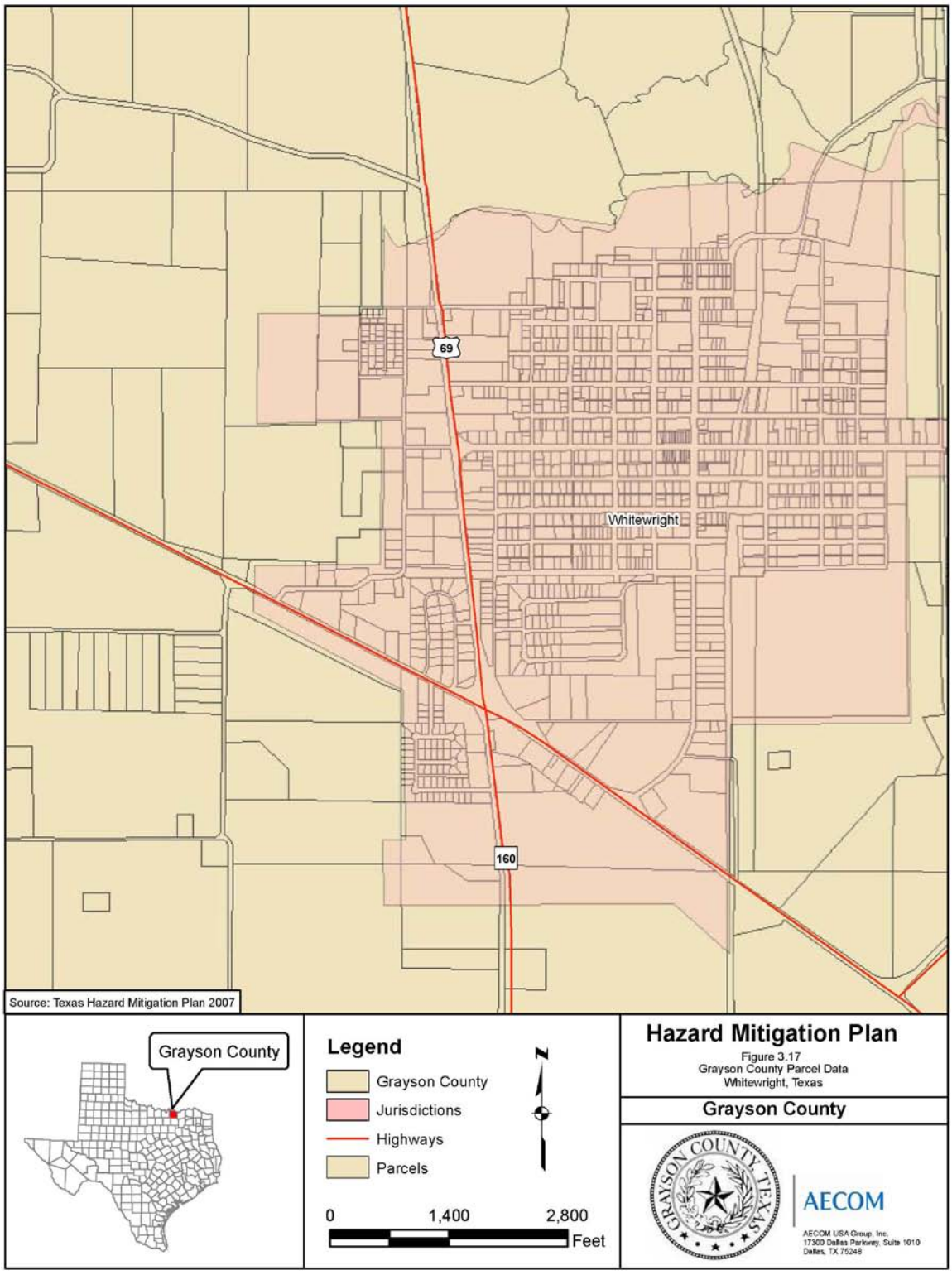

Southmayd
56
289
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
1,900
3,800
Feet
Hazard Mitigation Plan
Figure 3.12
Grayson County Parcel Data
Southmayd, Texas
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

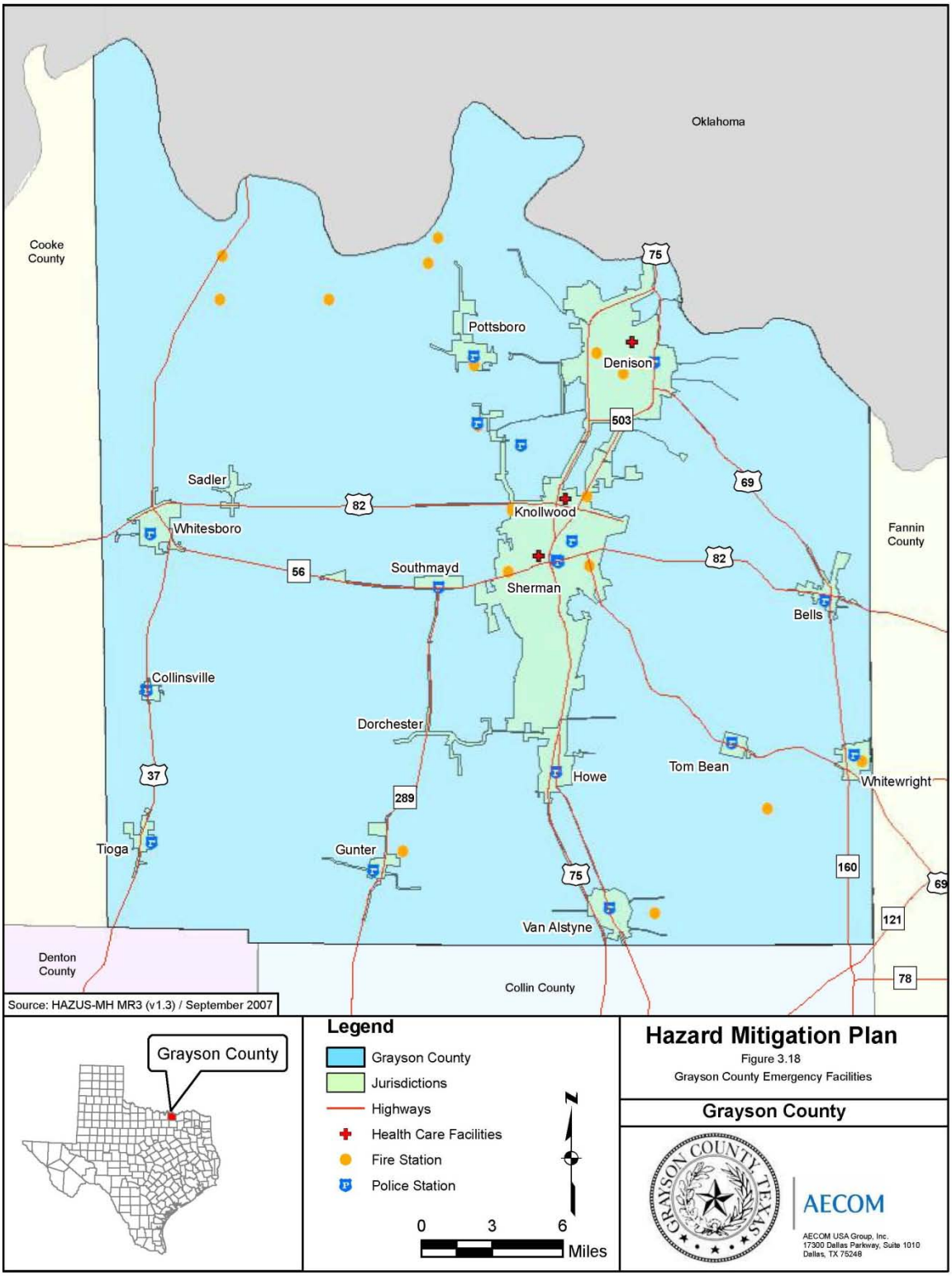

Oklahoma
Tioga
37
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
2,000
4,000
Feet
Hazard Mitigation Plan
Figure 3.13
Grayson County Parcel Data
Tioga, Texas
Grayson County
GRAYSON COUNTY TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

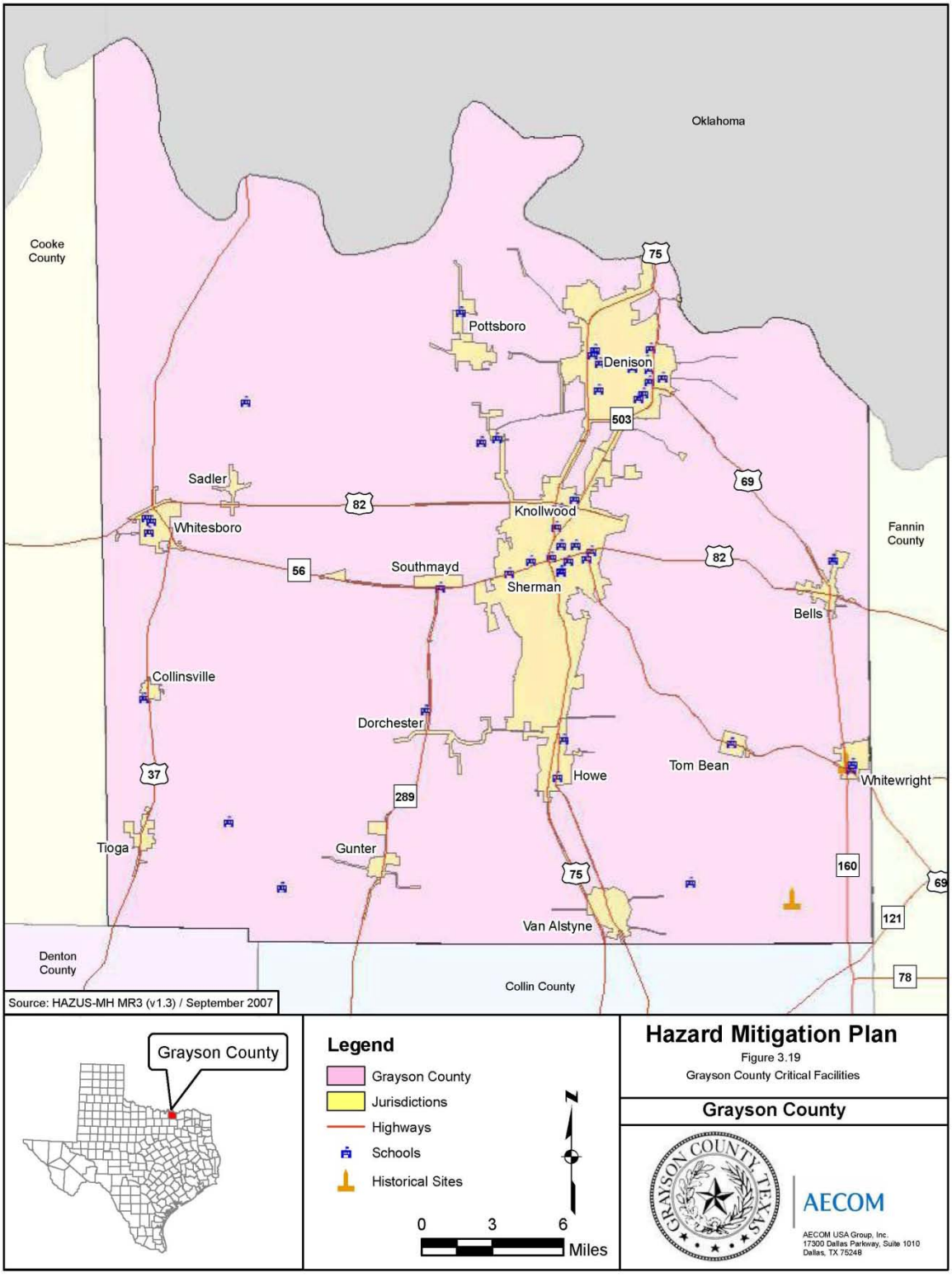

Tom Bean
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
1,400
2,800
Feet
Hazard Mitigation Plan
Figure 3.14
Grayson County Parcel Data
Tom Bean, Texas
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

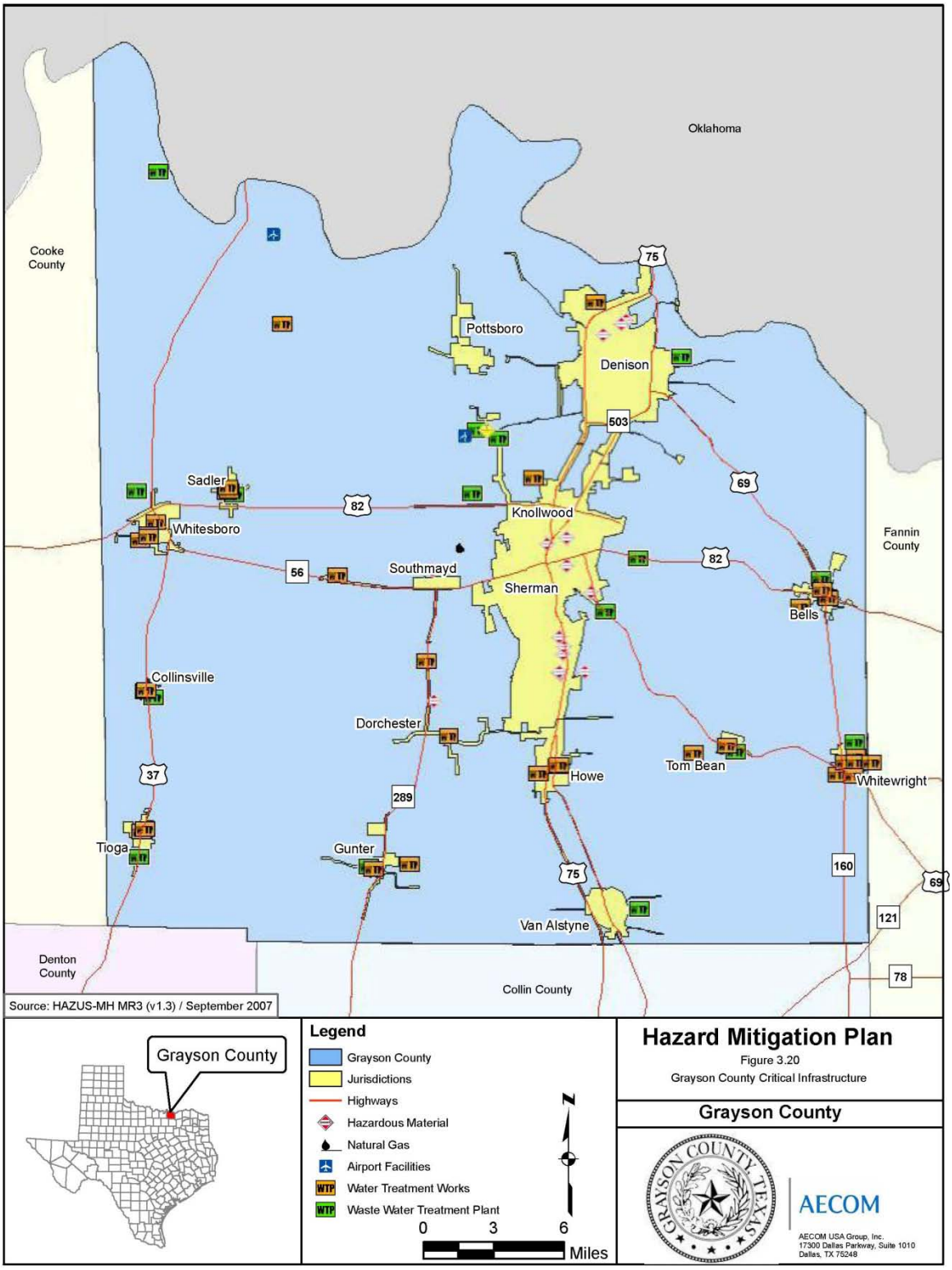

Van Alstyne
75
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
1,900
3,800
Feet
Hazard Mitigation Plan
Figure 3.15
Grayson County Parcel Data
City of Van Alstyne
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17304 Dallas Parkway, Suite 1010
Dallas, TX 75249

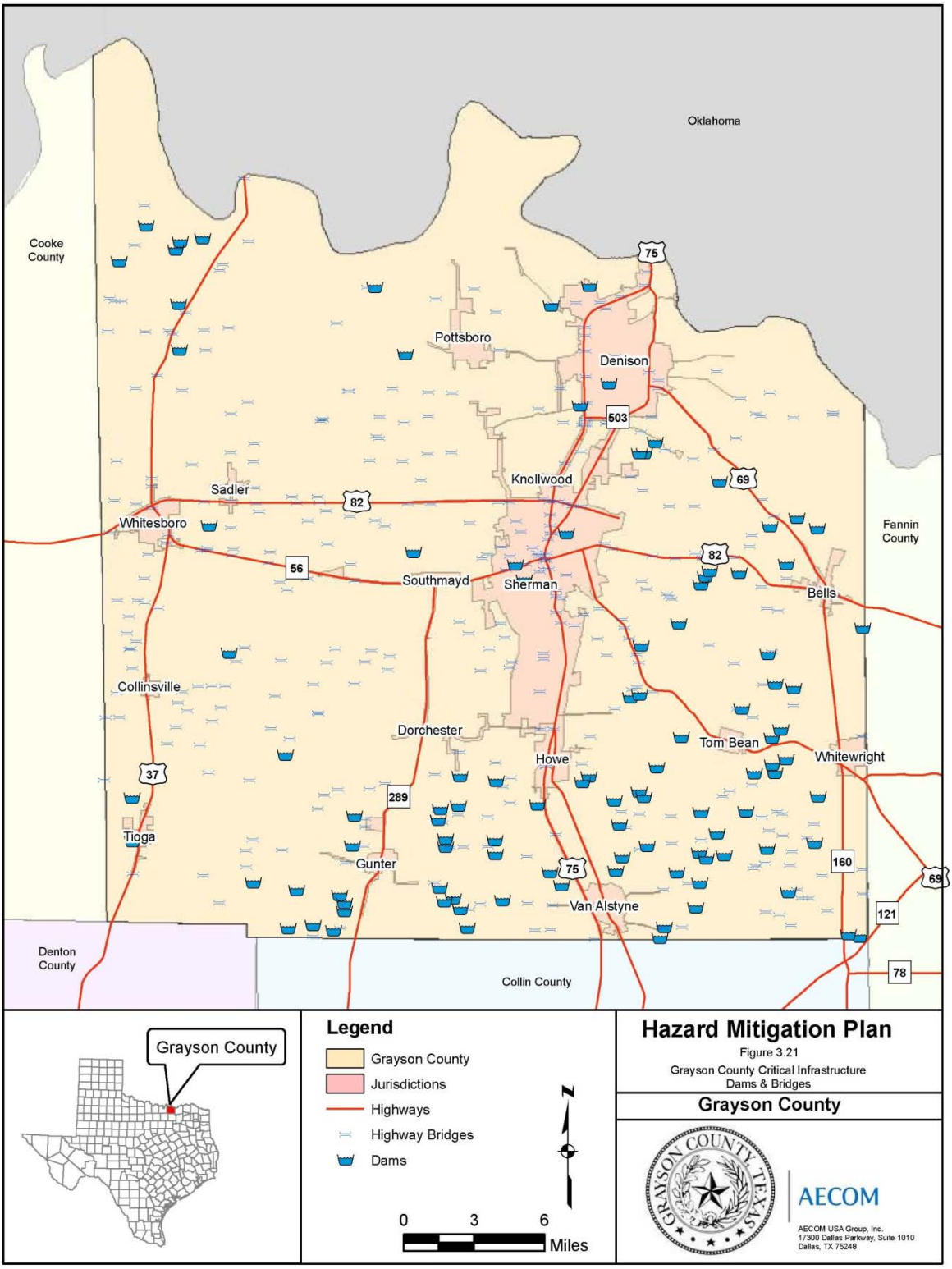

Whitesboro
82
37
56
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
2,200
4,400
Feet
Hazard Mitigation Plan
Figure 3.16
Grayson County Parcel Data
Whitesboro, Texas
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

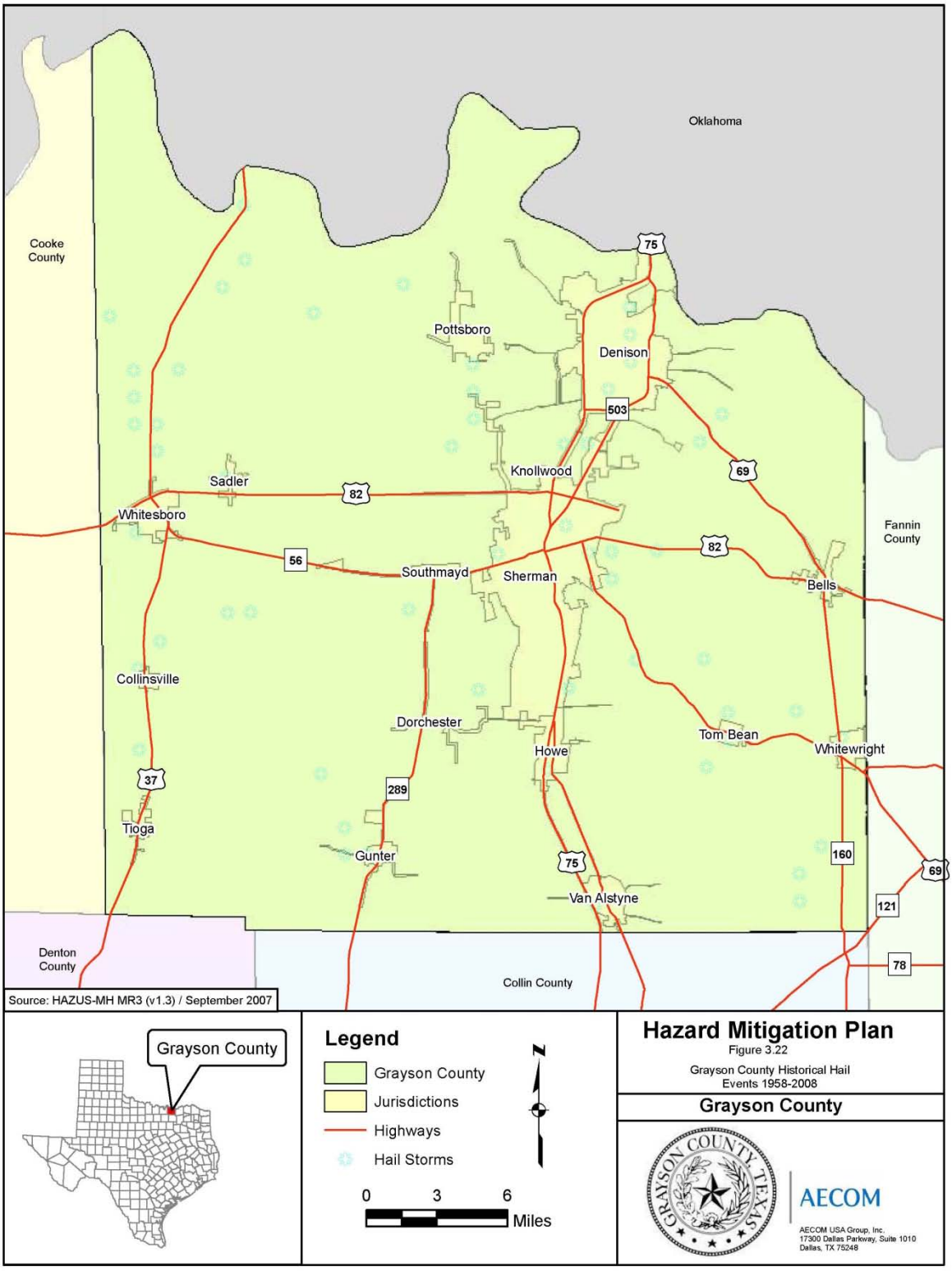

69
Whitewright
160
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Parcels
N
0
1,400
2,800
Feet
Hazard Mitigation Plan
Figure 3.17
Grayson County Parcel Data
Whitewright, Texas
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17303 Dallas Parkway, Suite 1010
Dallas, TX 75248

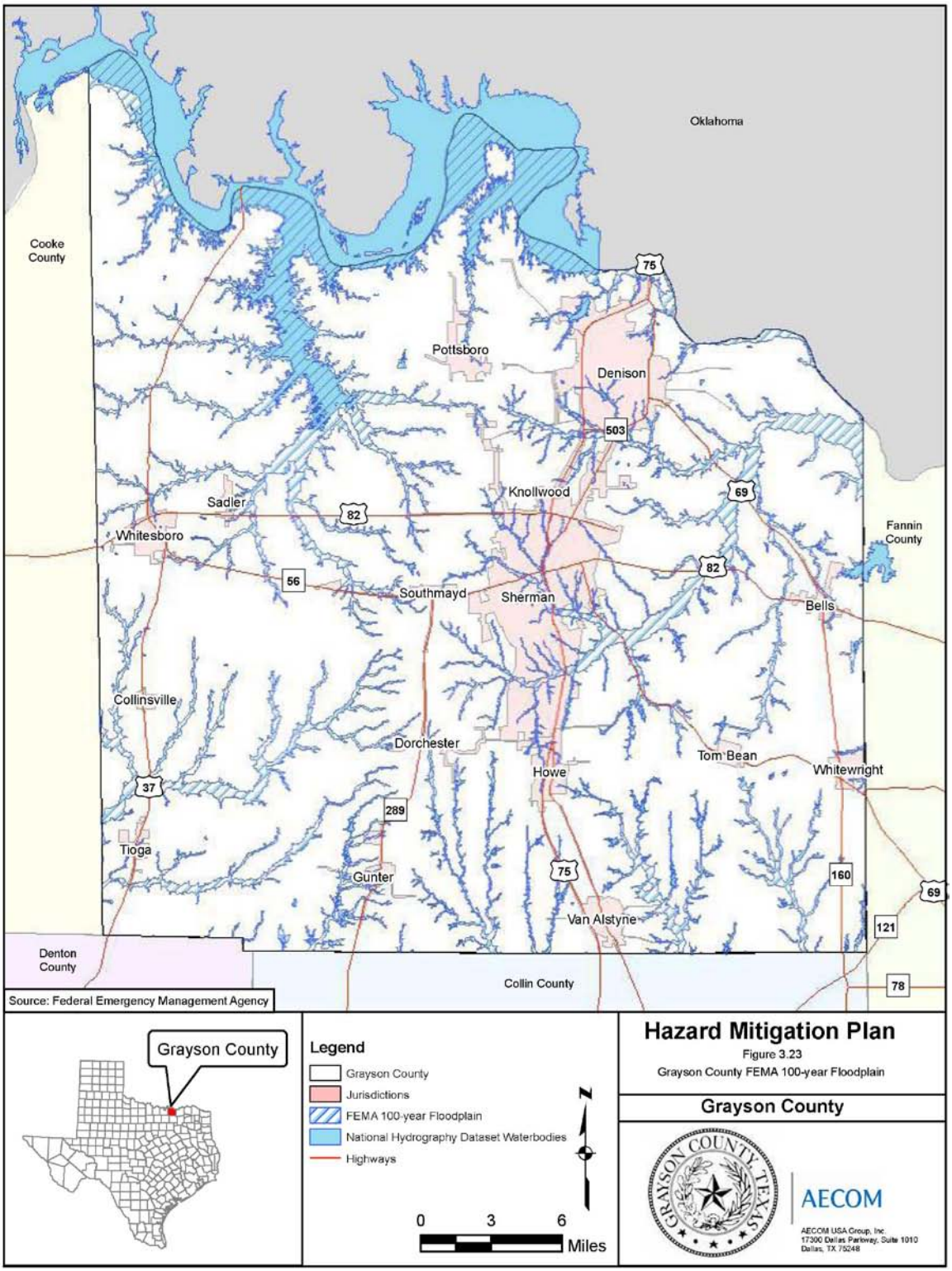

Oklahoma
Cooke County
Pottsboro
Denison
Sadler
Whitesboro
Knollwood
Southmayd
Sherman
Fannin County
Bells
Collinsville
Dorchester
Howe
Tom Bean
Whitewright
Tioga
Gunter
Van Alstyne
Denton County
Collin County
75
503
69
82
56
37
289
160
121
78
Source: HAZUS-MH MR3 (v1.3) / September 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Health Care Facilities
Fire Station
Police Station
N
0 3 6
Miles
Hazard Mitigation Plan
Figure 3.18
Grayson County Emergency Facilities
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

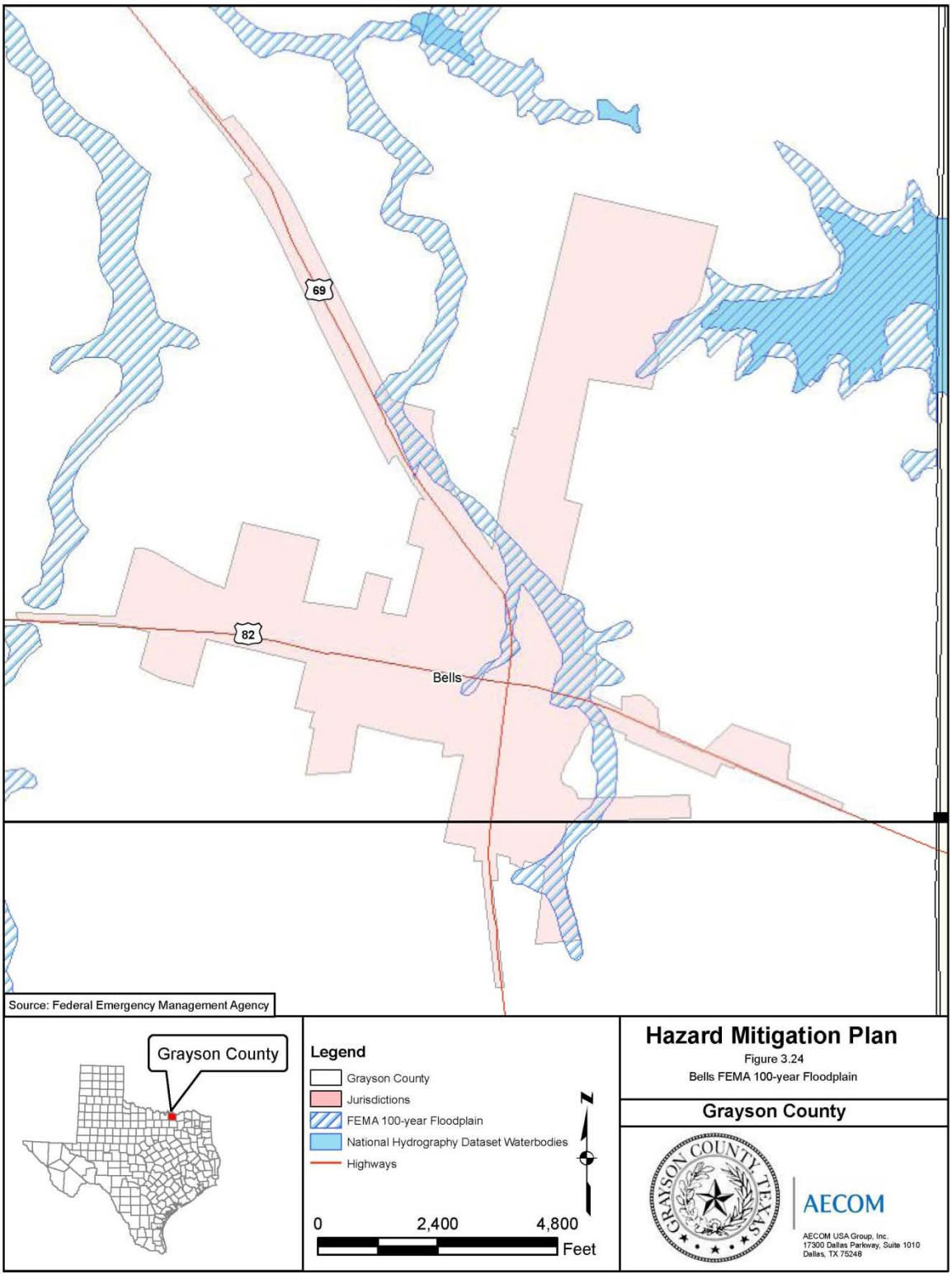

Oklahoma
Cooke County
Pottsboro
Denison
Sadler
Whitesboro
Knollwood
Fannin County
Southmayd
Sherman
Bells
Collinsville
Dorchester
Tom Bean
Howe
Whitewright
Tioga
Gunter
Van Alstyne
Denton County
Collin County
75
503
69
82
56
289
37
160
121
78
Source: HAZUS-MH MR3 (v1.3) / September 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Schools
Historical Sites
N
0 3 6
Miles
Hazard Mitigation Plan
Figure 3.19
Grayson County Critical Facilities
Grayson County
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

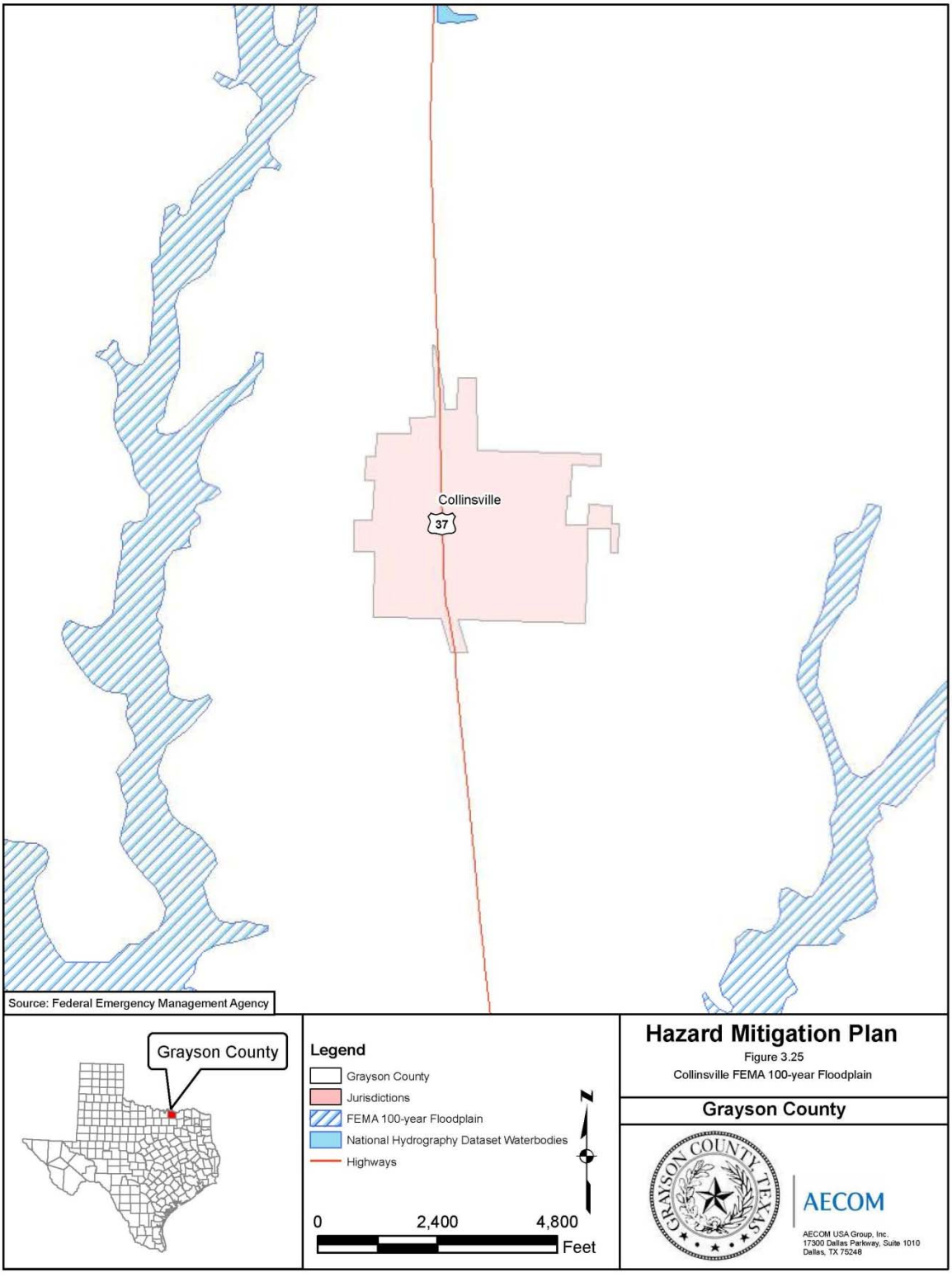

Oklahoma
Cooke County
Pottsboro
Denison
Sadler
Whitesboro
Knollwood
Southmayd
Sherman
Fannin County
Bells
Collinsville
Dorchester
Howe
Tom Bean
Whitewright
Tioga
Gunter
Van Alstyne
Denton County
Collin County
75
503
69
82
56
37
289
160
121
78
Source: HAZUS-MH MR3 (v1.3) / September 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Hazardous Material
Natural Gas
Airport Facilities
Water Treatment Works
Waste Water Treatment Plant
0 3 6
Miles
N
Hazard Mitigation Plan
Figure 3.20
Grayson County Critical Infrastructure
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

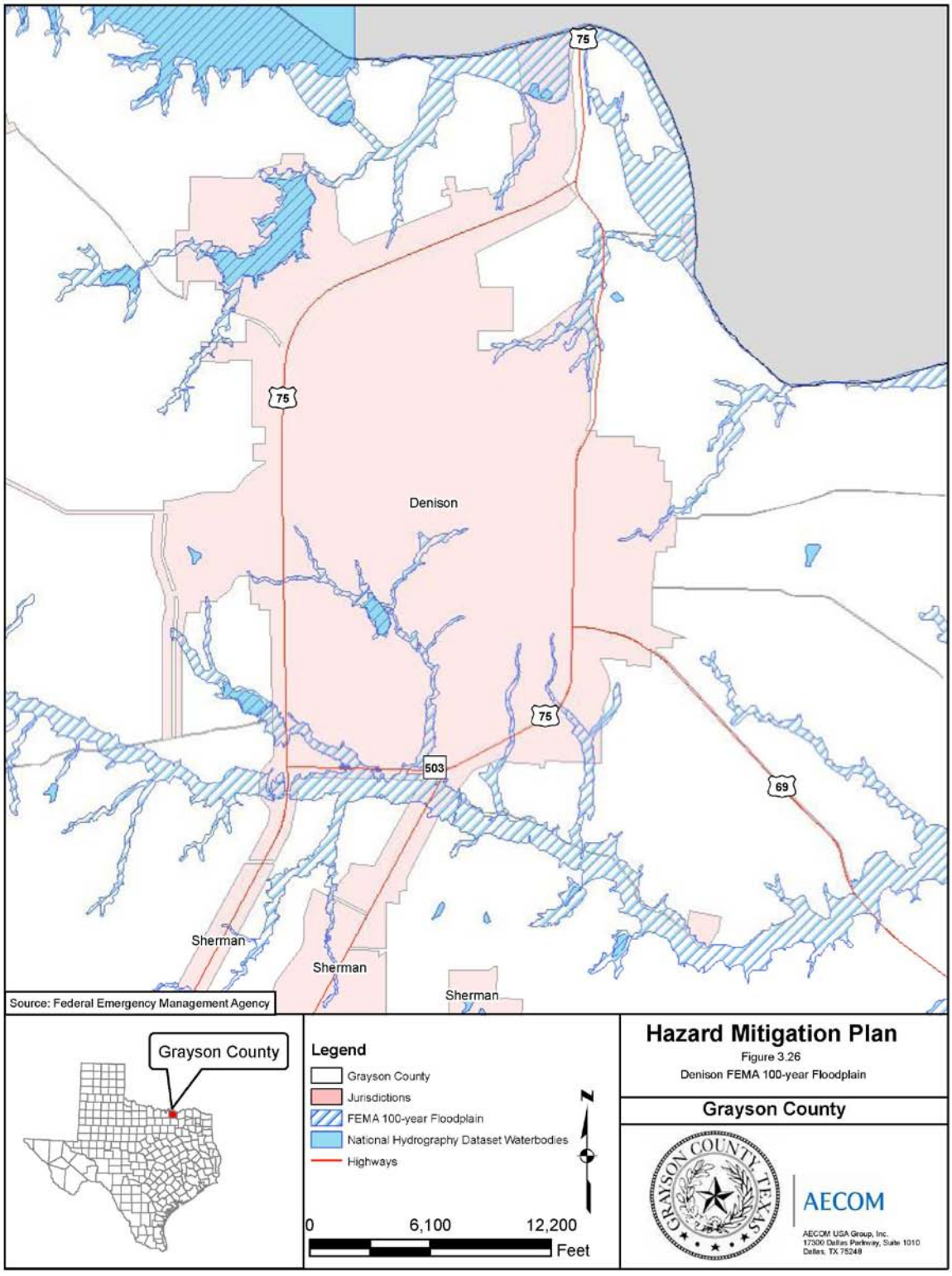

Oklahoma
Cooke County
Pottsboro
Denison
Knollwood
Sadler
Whitesboro
Fannin County
Southmayd
Sherman
Bells
Collinsville
Dorchester
Tom Bean
Howe
Whitewright
Tioga
Gunter
Van Alstyne
Denton County
Collin County
75
503
69
82
56
37
289
160
121
78
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Highway Bridges
Dams
0 3 6
Miles
Hazard Mitigation Plan
Figure 3.21
Grayson County Critical Infrastructure
Dams & Bridges
Grayson County
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

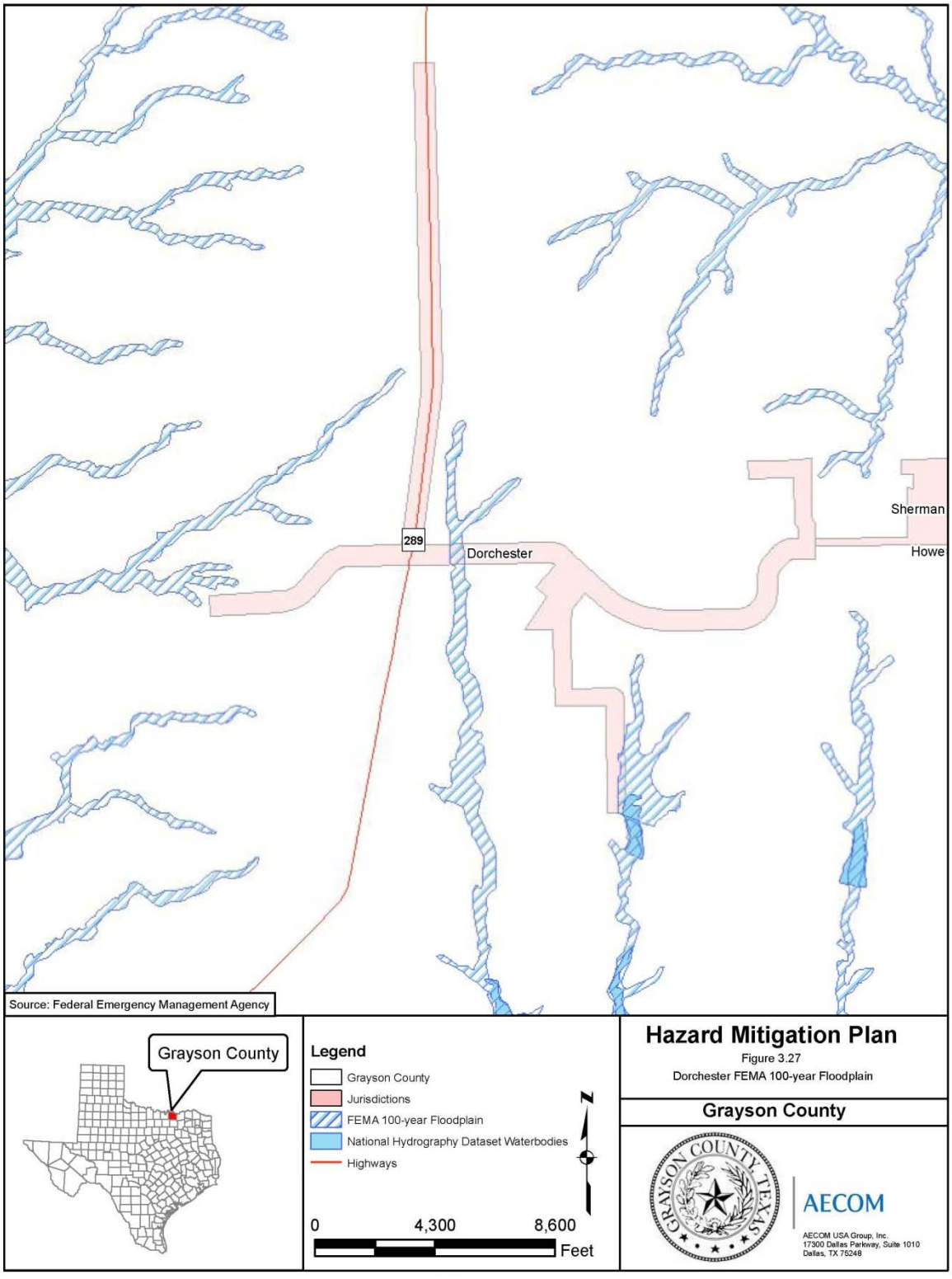

Oklahoma
Cooke County
Pottsboro
Denison
Knollwood
Sadler
Whitesboro
Fannin County
Southmayd
Sherman
Bells
Collinsville
Dorchester
Tom Bean
Howe
Whitewright
Tioga
Gunter
Van Alstyne
Denton County
Collin County
75
503
69
82
56
37
289
160
121
78
Source: HAZUS-MH MR3 (v1.3) / September 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
Hail Storms
N
0 3 6
Miles
Hazard Mitigation Plan
Figure 3.22
Grayson County Historical Hail Events 1958-2008
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

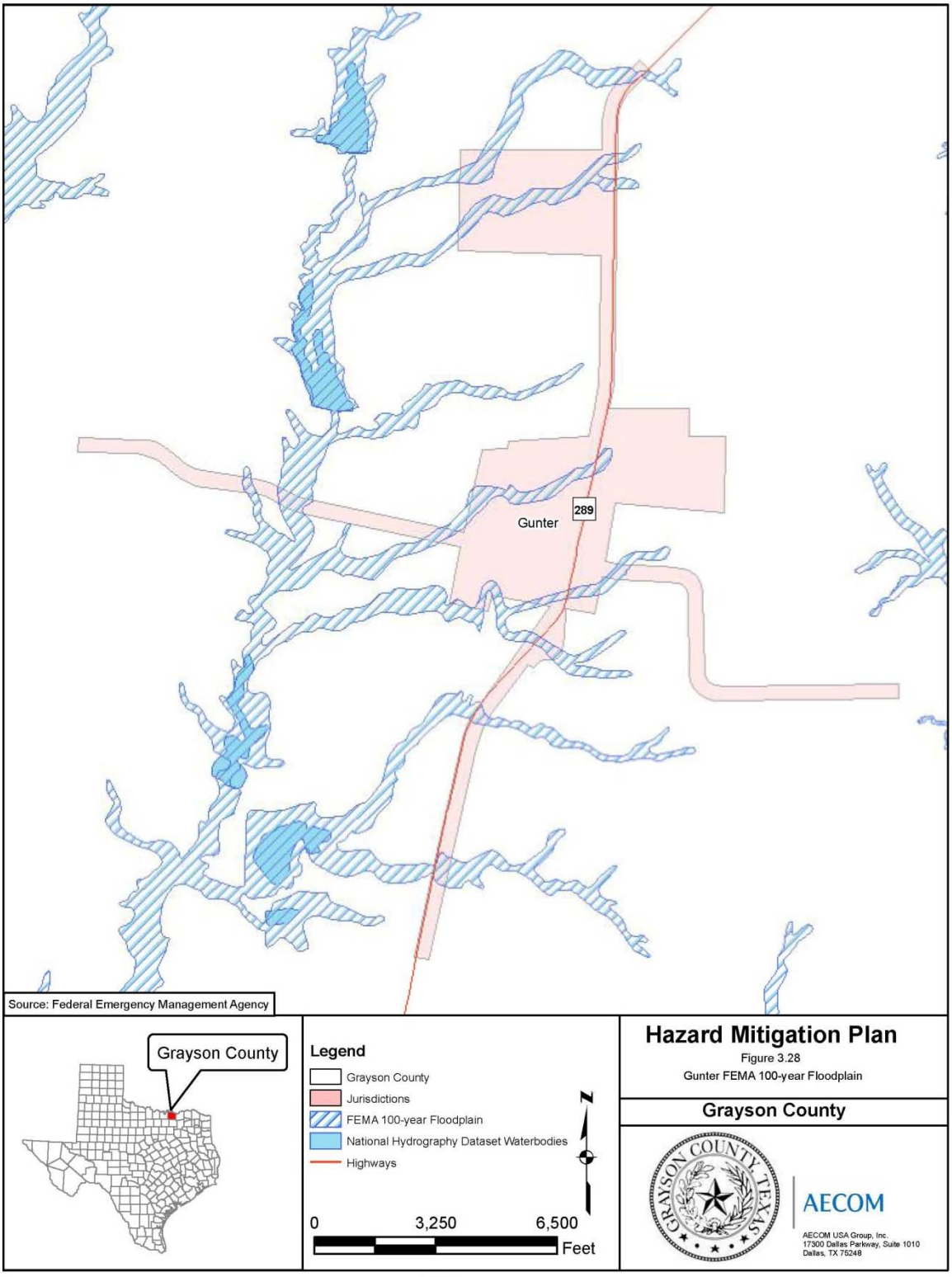

Oklahoma
Cooke County
Pottsboro
Denison
Knollwood
Sadler
Whitesboro
Fannin County
Southmayd
Sherman
Bells
Collinsville
Dorchester
Tom Bean
Howe
Whitewright
Tioga
Gunter
Van Alstyne
Denton County
Collin County
75
503
69
82
56
289
37
160
121
78
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0 3 6
Miles
Hazard Mitigation Plan
Figure 3.23
Grayson County FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

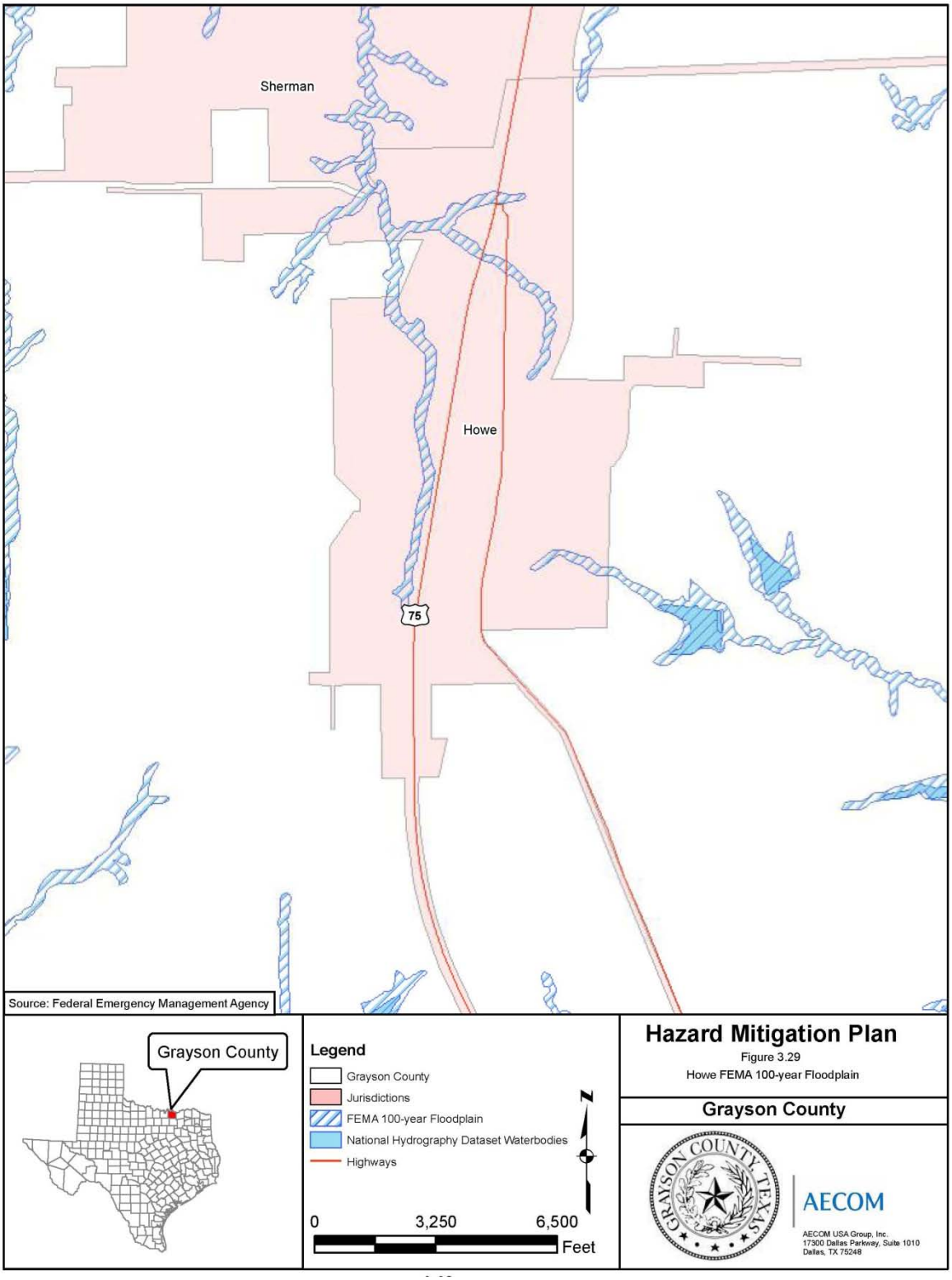

69
82
Bells
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
2,400
4,800
Feet
Hazard Mitigation Plan
Figure 3.24
Bells FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

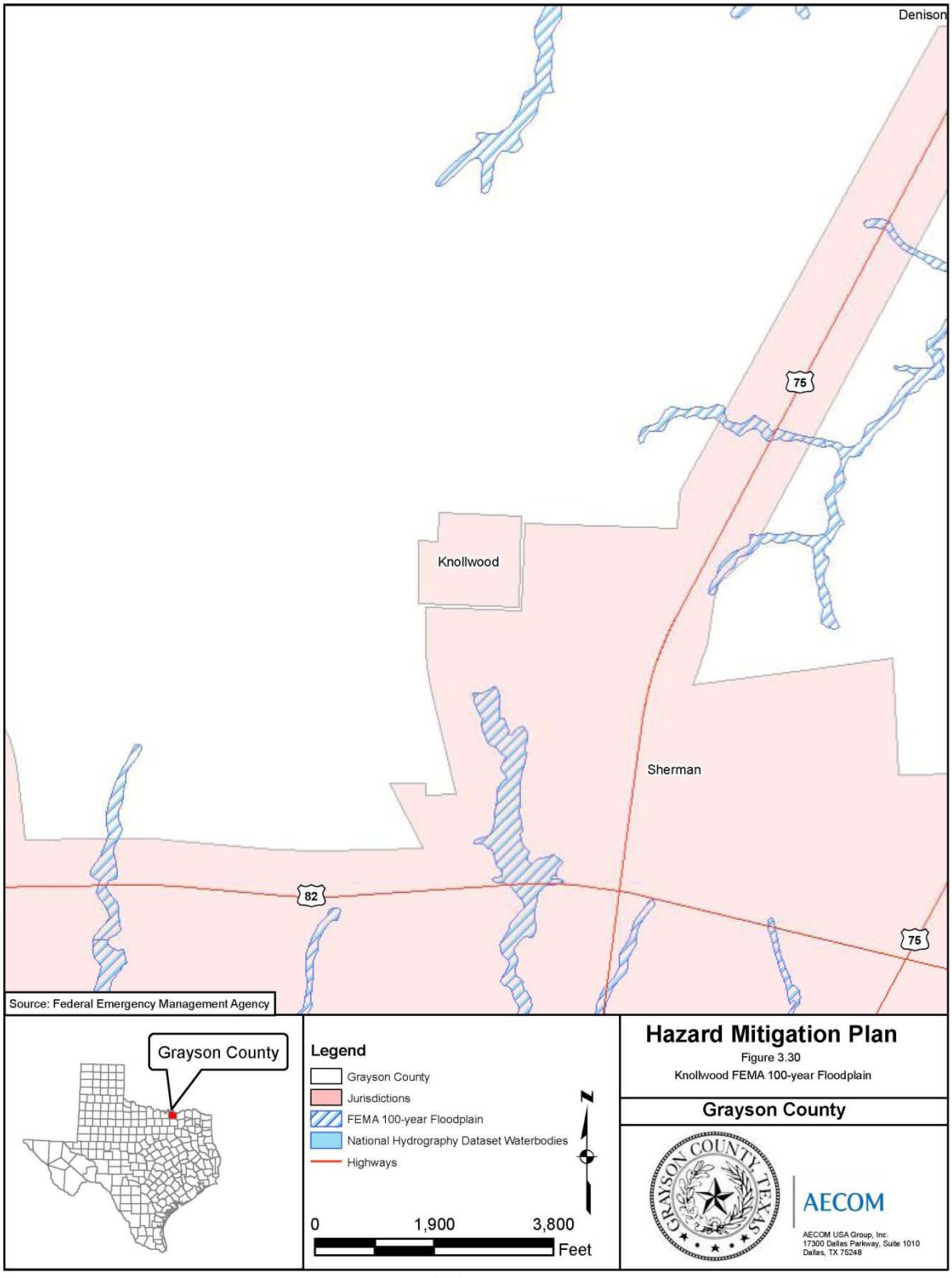

Collinsville
37
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
2,400
4,800
Feet
Hazard Mitigation Plan
Figure 3.25
Collinsville FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

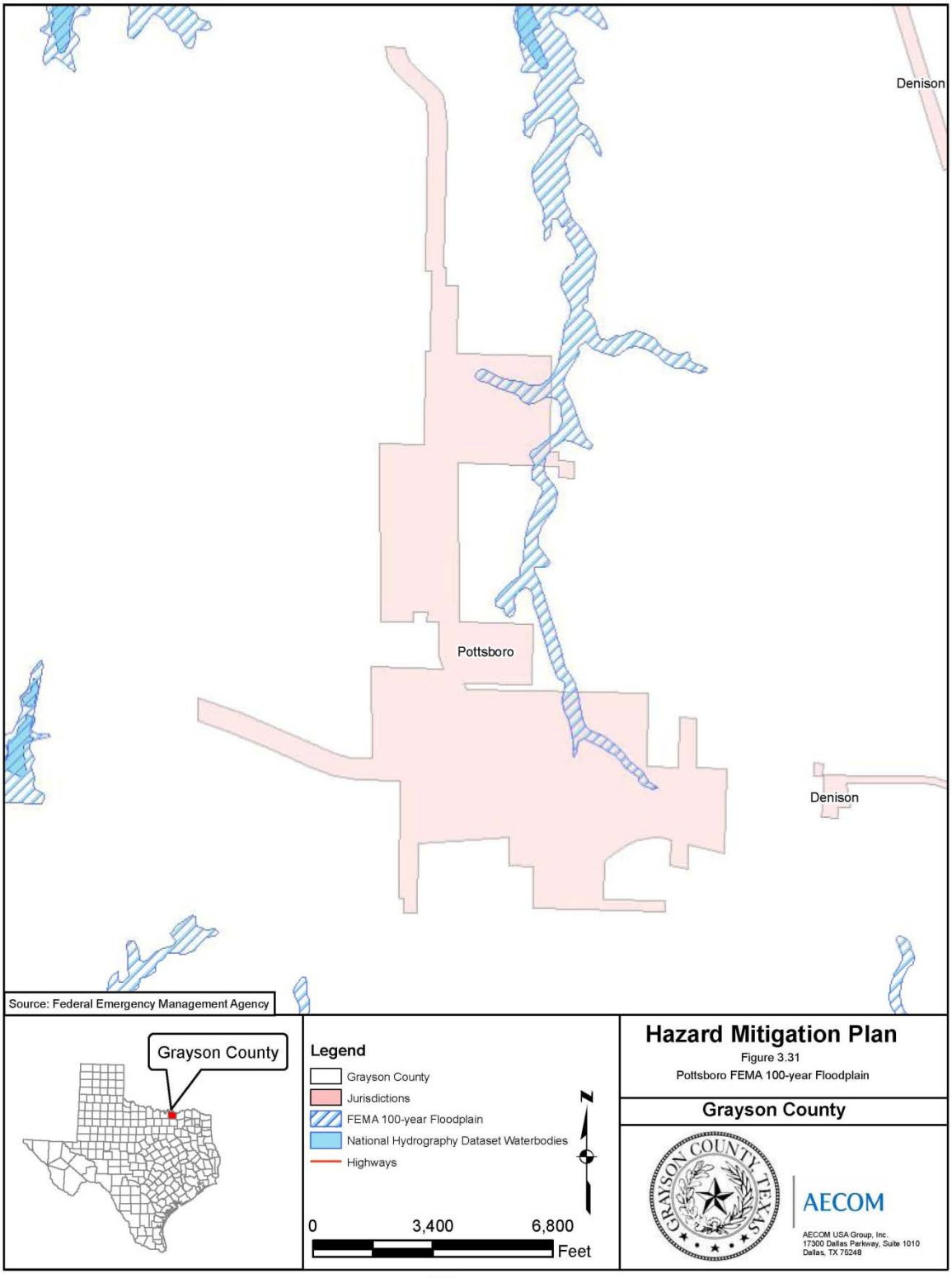

75
75
Denison
75
503
69
Sherman
Sherman
Sherman
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
6,100
12,200
Feet
Hazard Mitigation Plan
Figure 3.26
Denison FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

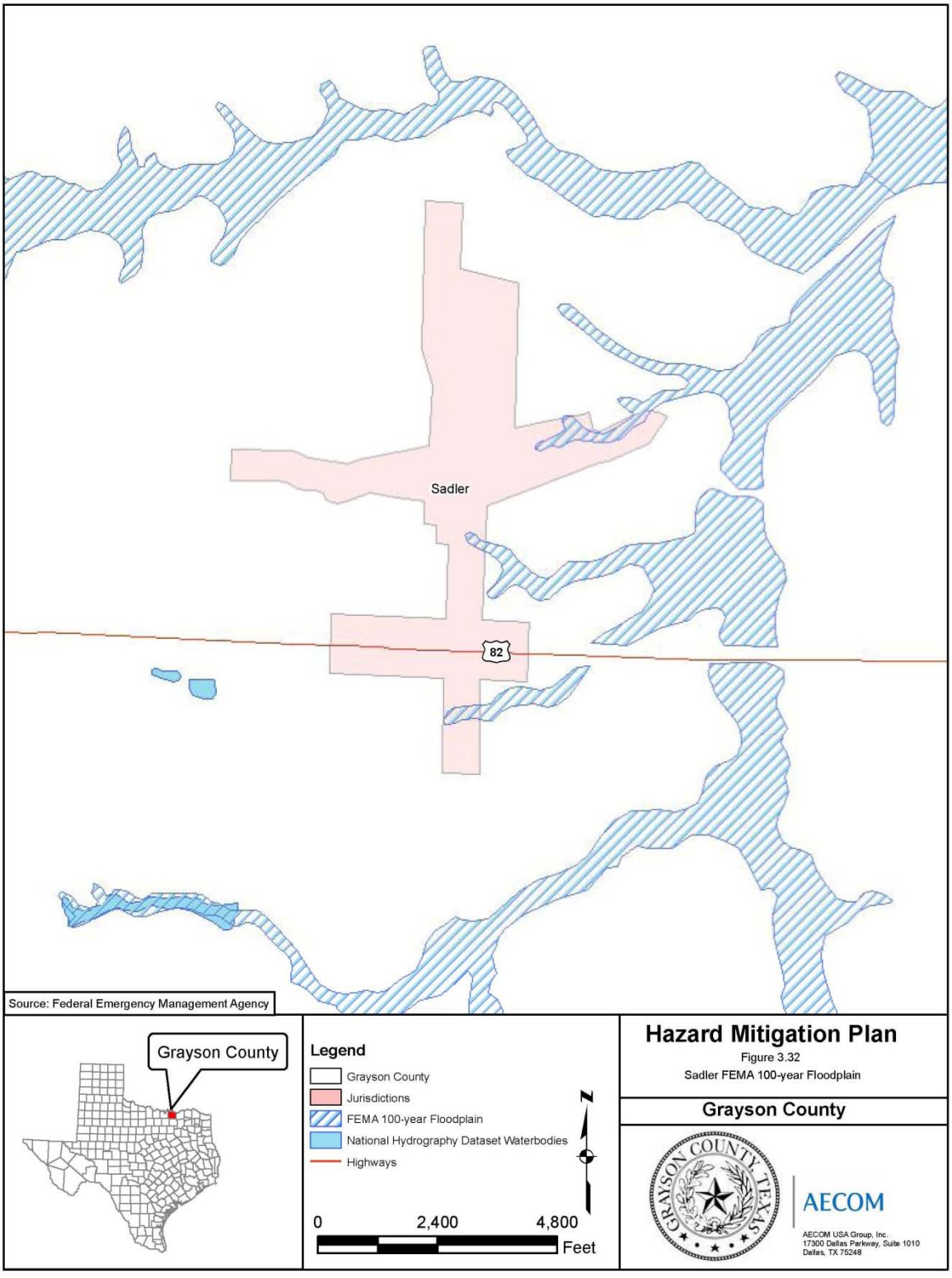

289
Dorchester
Sherman
Howe
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
4,300
8,600
Feet
Hazard Mitigation Plan
Figure 3.27
Dorchester FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

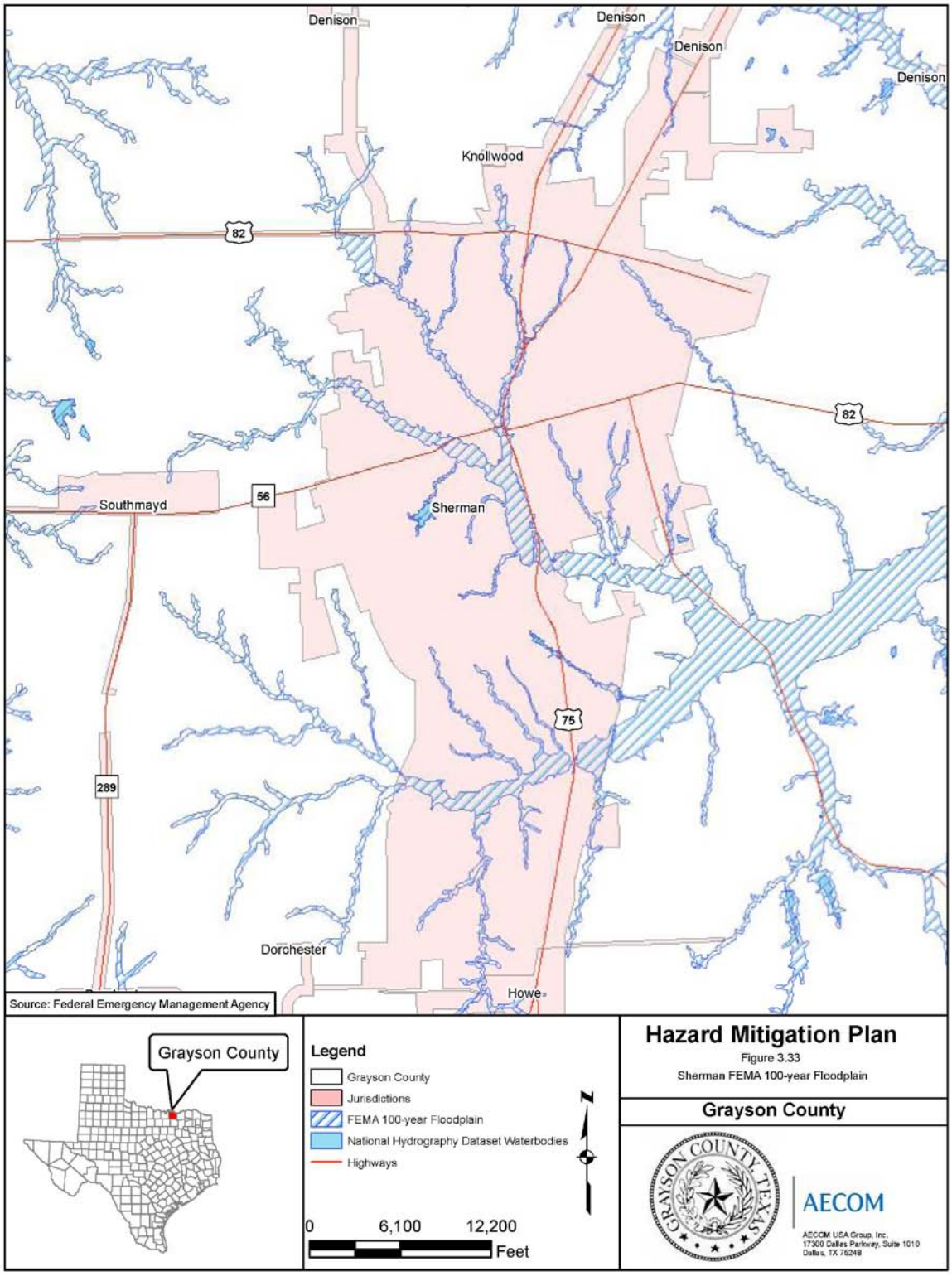

Gunter
289
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
3,250
6,500
Feet
Hazard Mitigation Plan
Figure 3.28
Gunter FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

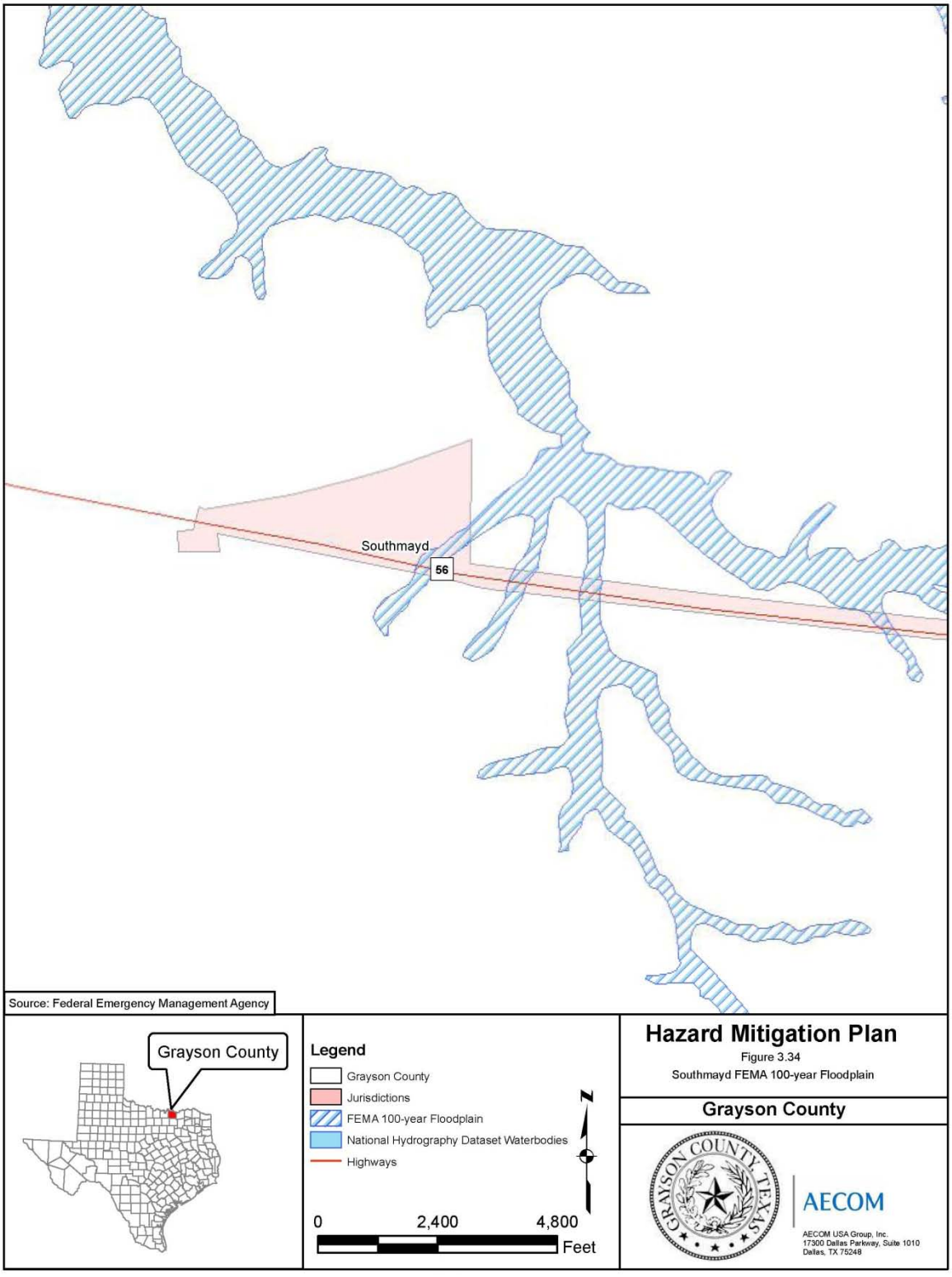

Sherman
Howe
75
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
3,250
6,500
Feet
Hazard Mitigation Plan
Figure 3.29
Howe FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

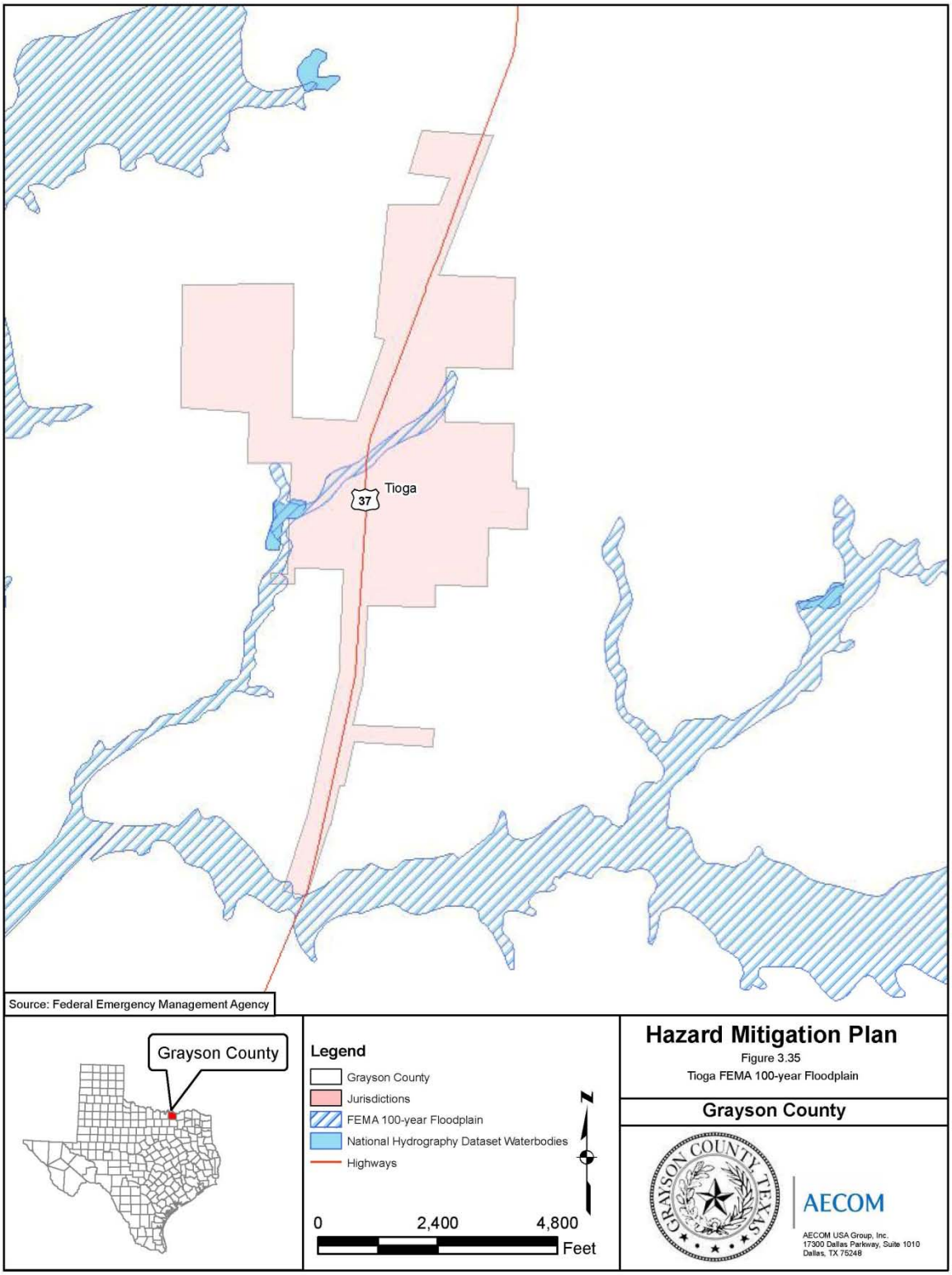

Denison
75
Knollwood
Sherman
82
75
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
1,900
3,800
Feet
Hazard Mitigation Plan
Figure 3.30
Knollwood FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

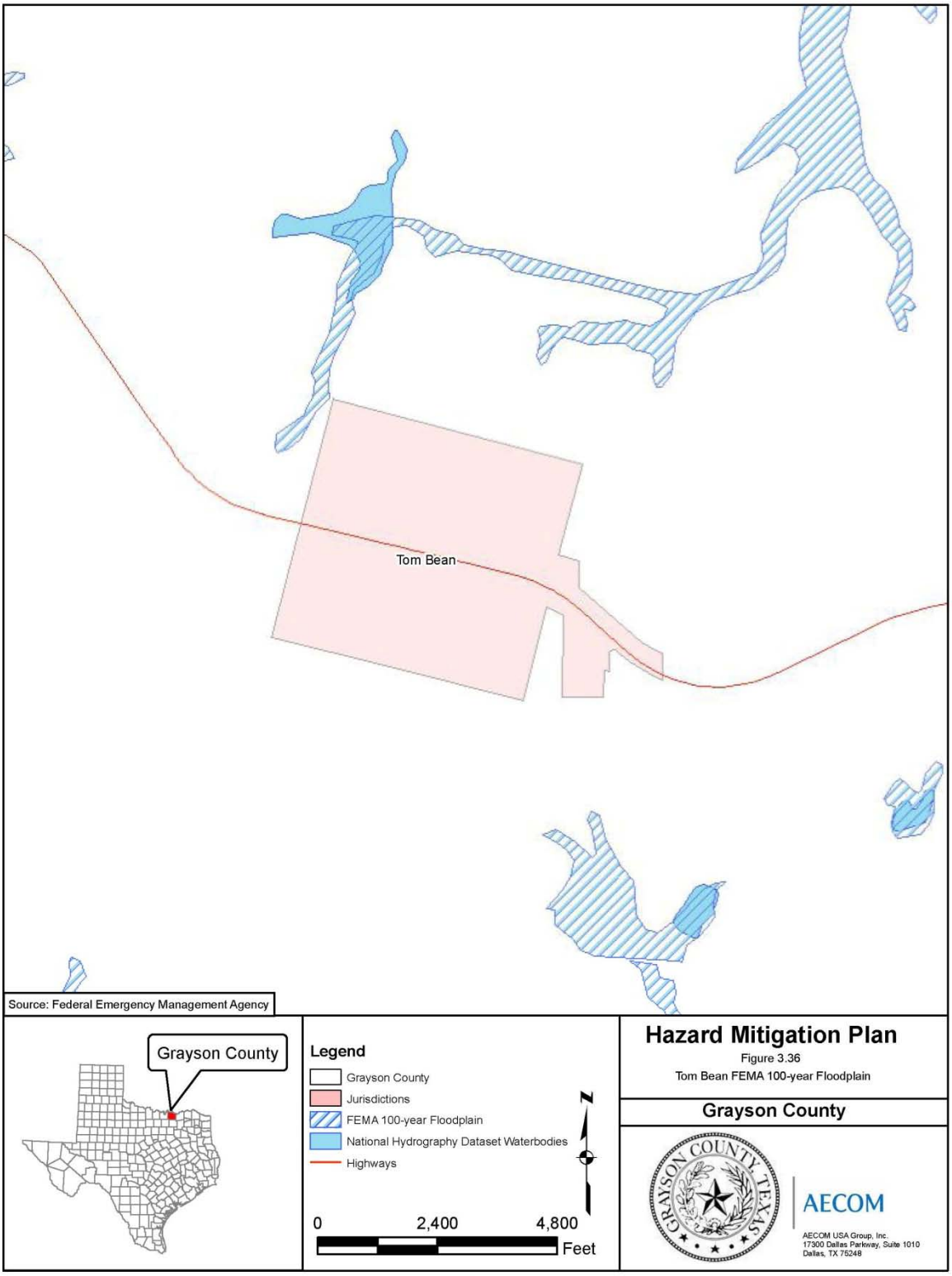

Denison
Pottsboro
Denison
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
3,400
6,800
Feet
Hazard Mitigation Plan
Figure 3.31
Pottsboro FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

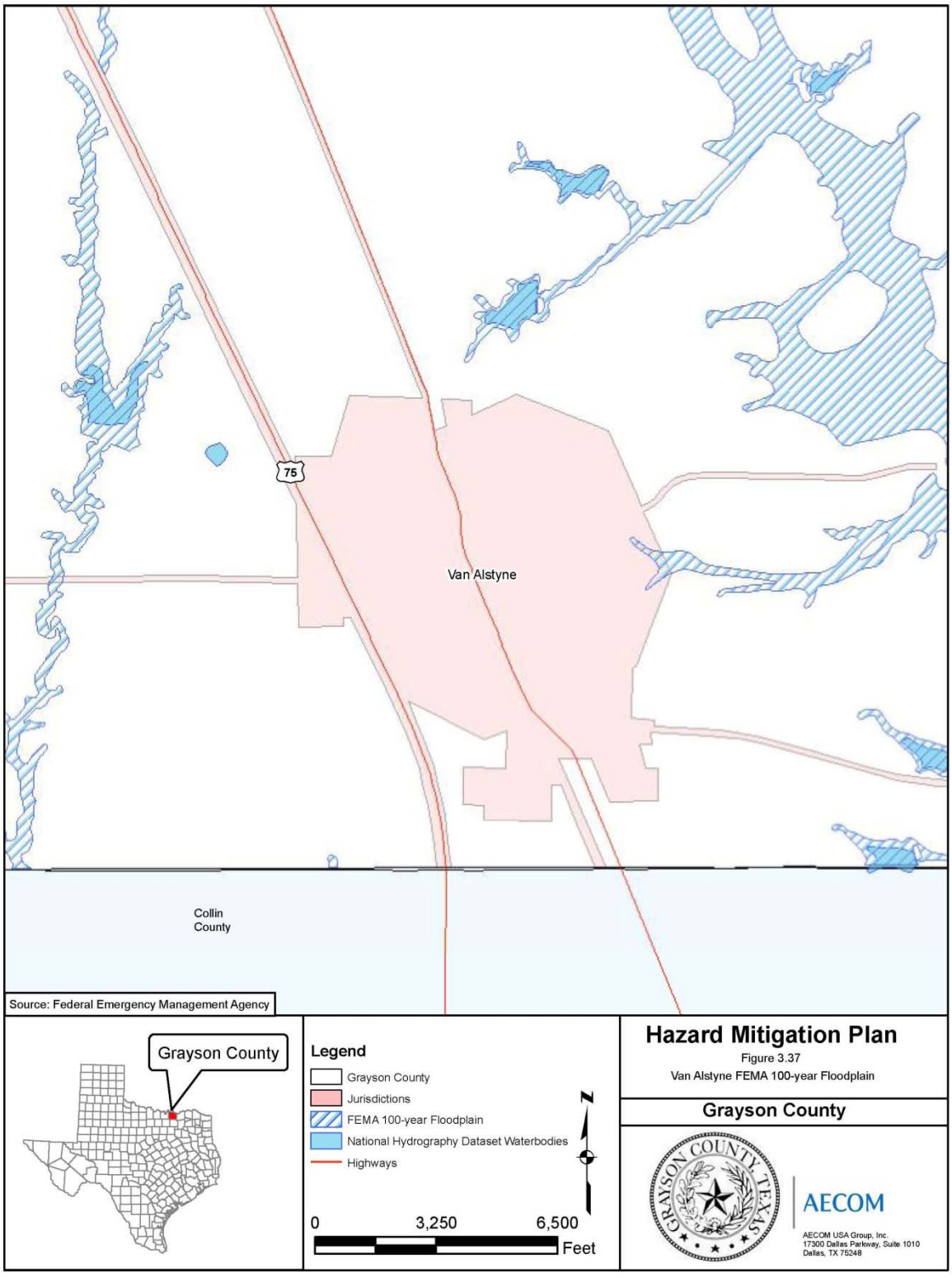

Sadler
82
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
2,400
4,800
Feet
Hazard Mitigation Plan
Figure 3.32
Sadler FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

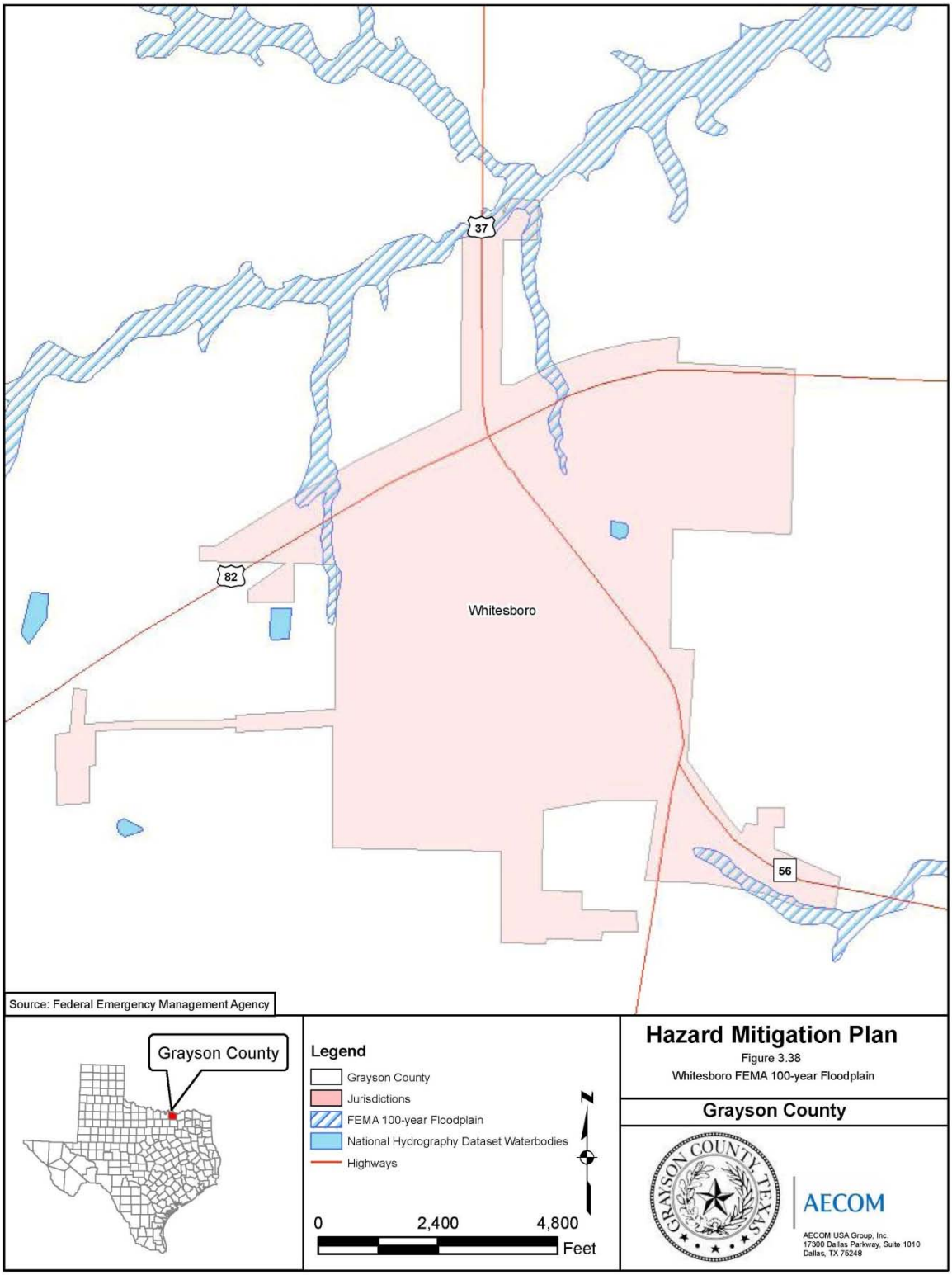

Denison
Denison
Denison
Denison
Knollwood
82
82
Southmayd
56
Sherman
75
289
Dorchester
Howe
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
6,100
12,200
Feet
Hazard Mitigation Plan
Figure 3.33
Sherman FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17304 Dallas Parkway, Suite 1010
Dallas, TX 75248

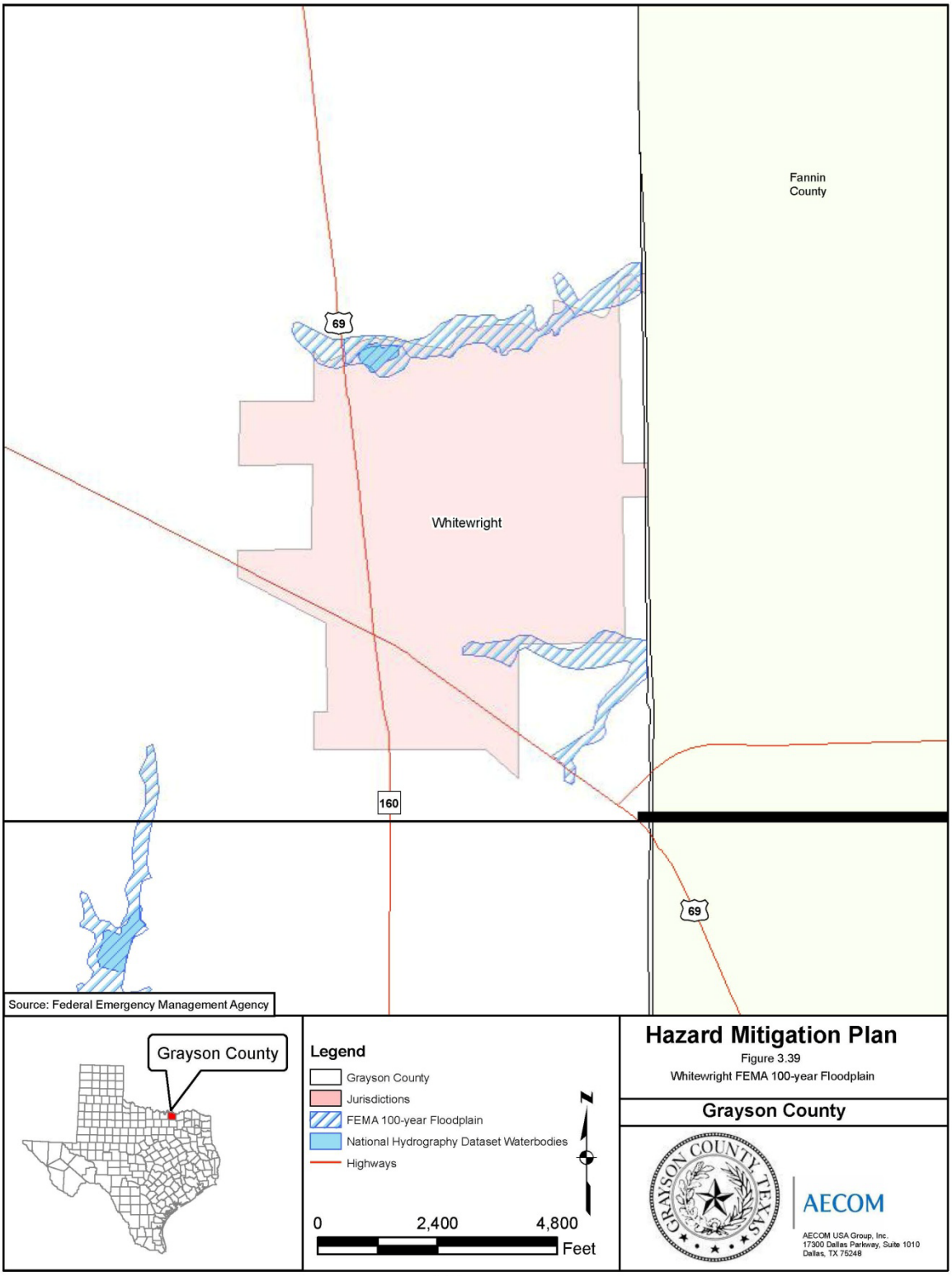

Southmayd
56
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
2,400
4,800
Feet
Hazard Mitigation Plan
Figure 3.34
Southmayd FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

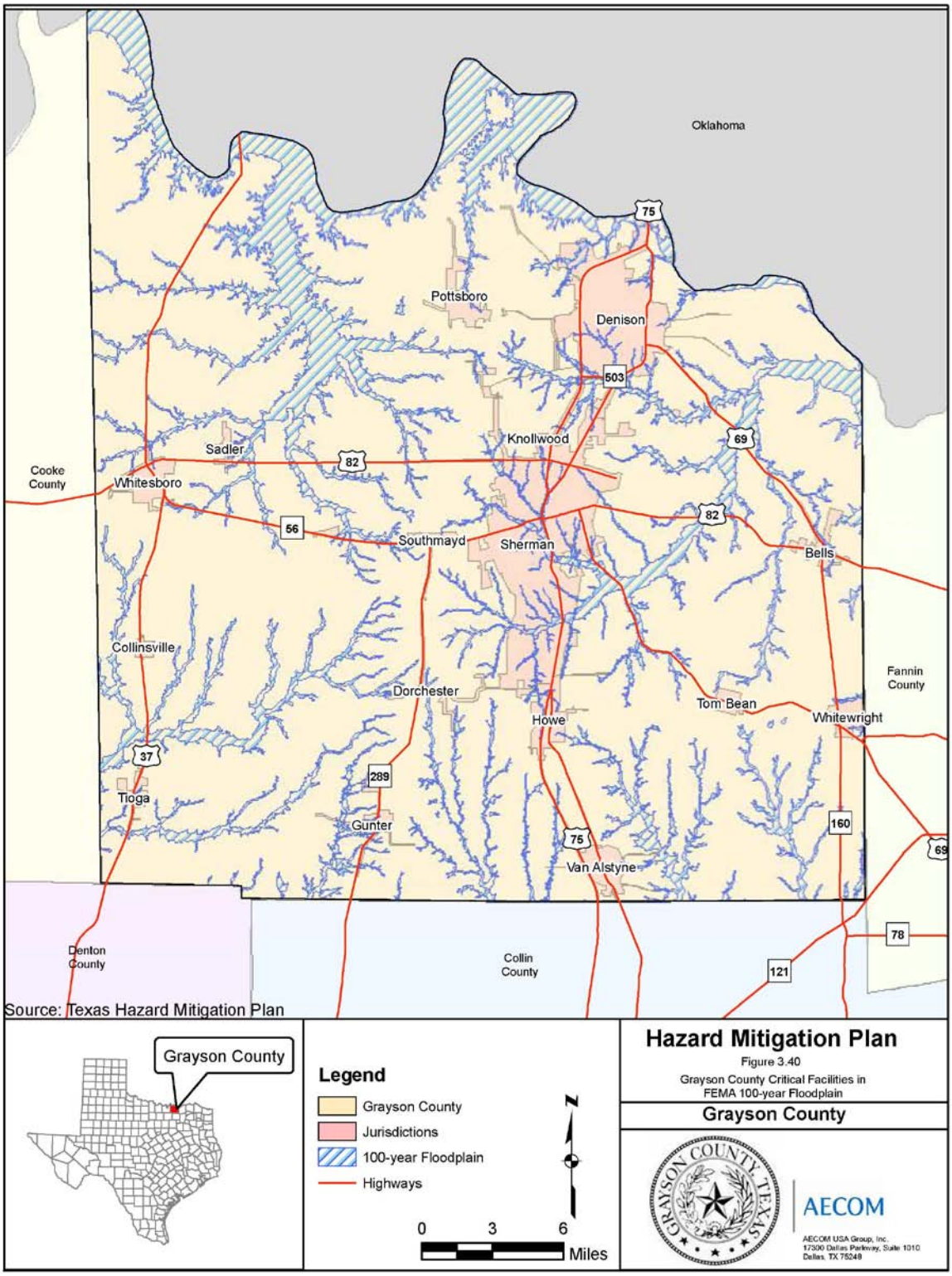

Tioga
37
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
2,400
4,800
Feet
Hazard Mitigation Plan
Figure 3.35
Tioga FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


Tom Bean
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
2,400
4,800
Feet
Hazard Mitigation Plan
Figure 3.36
Tom Bean FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

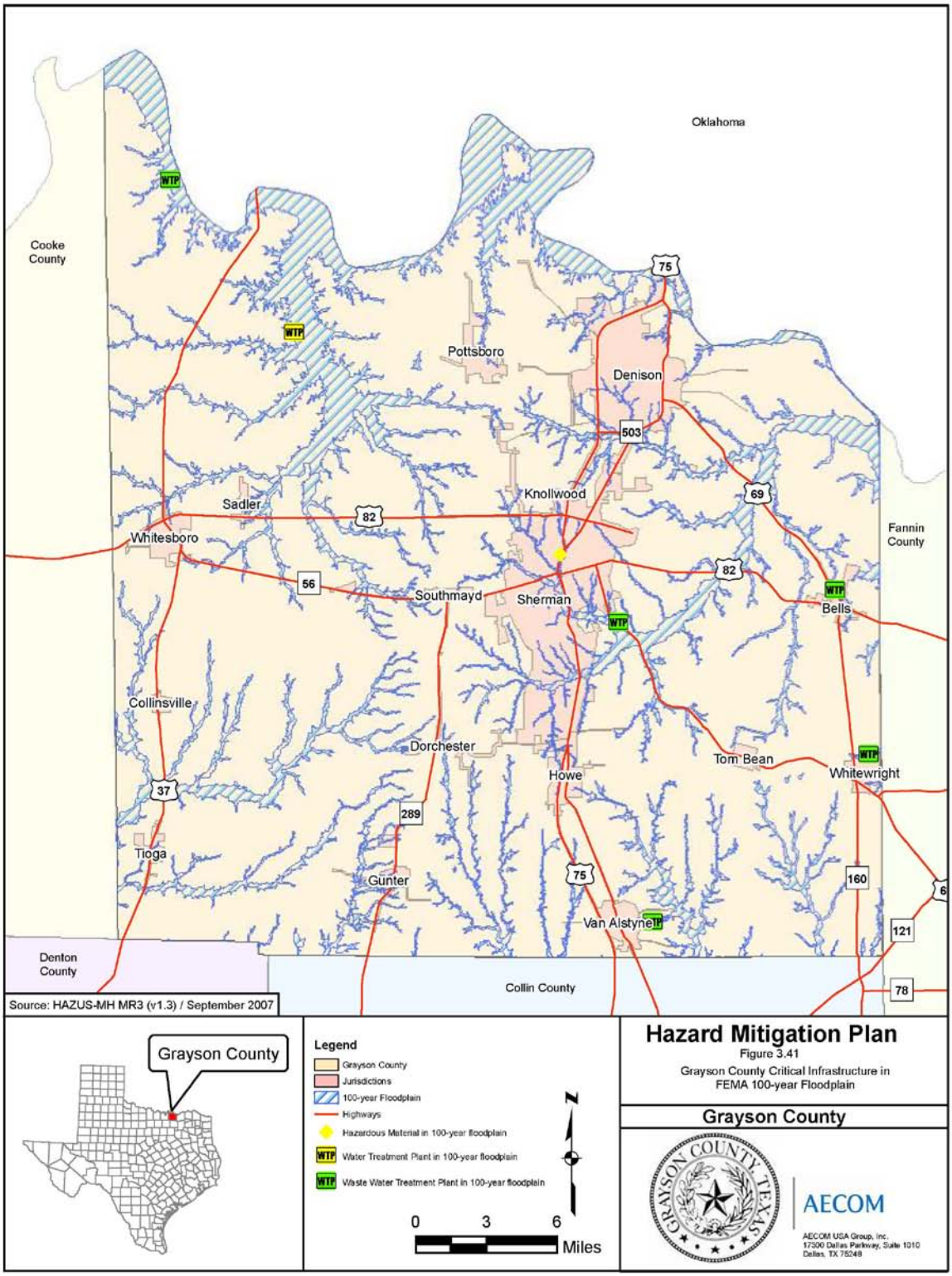

75
Van Alstyne
Collin
County
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
3,250
6,500
Feet
Hazard Mitigation Plan
Figure 3.37
Van Alstyne FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

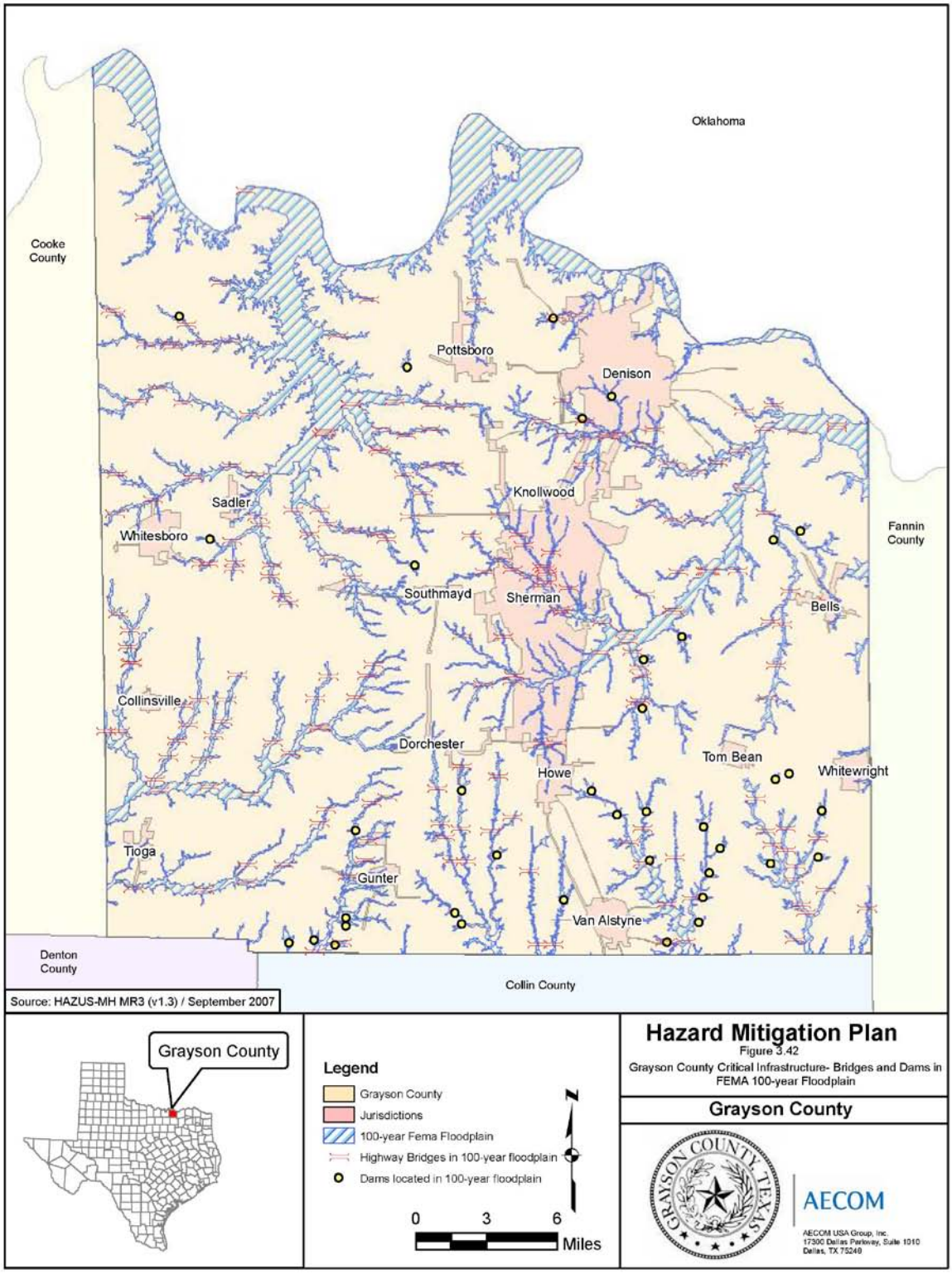

37
82
56
Whitesboro
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
2,400
4,800
Feet
Hazard Mitigation Plan
Figure 3.38
Whitesboro FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

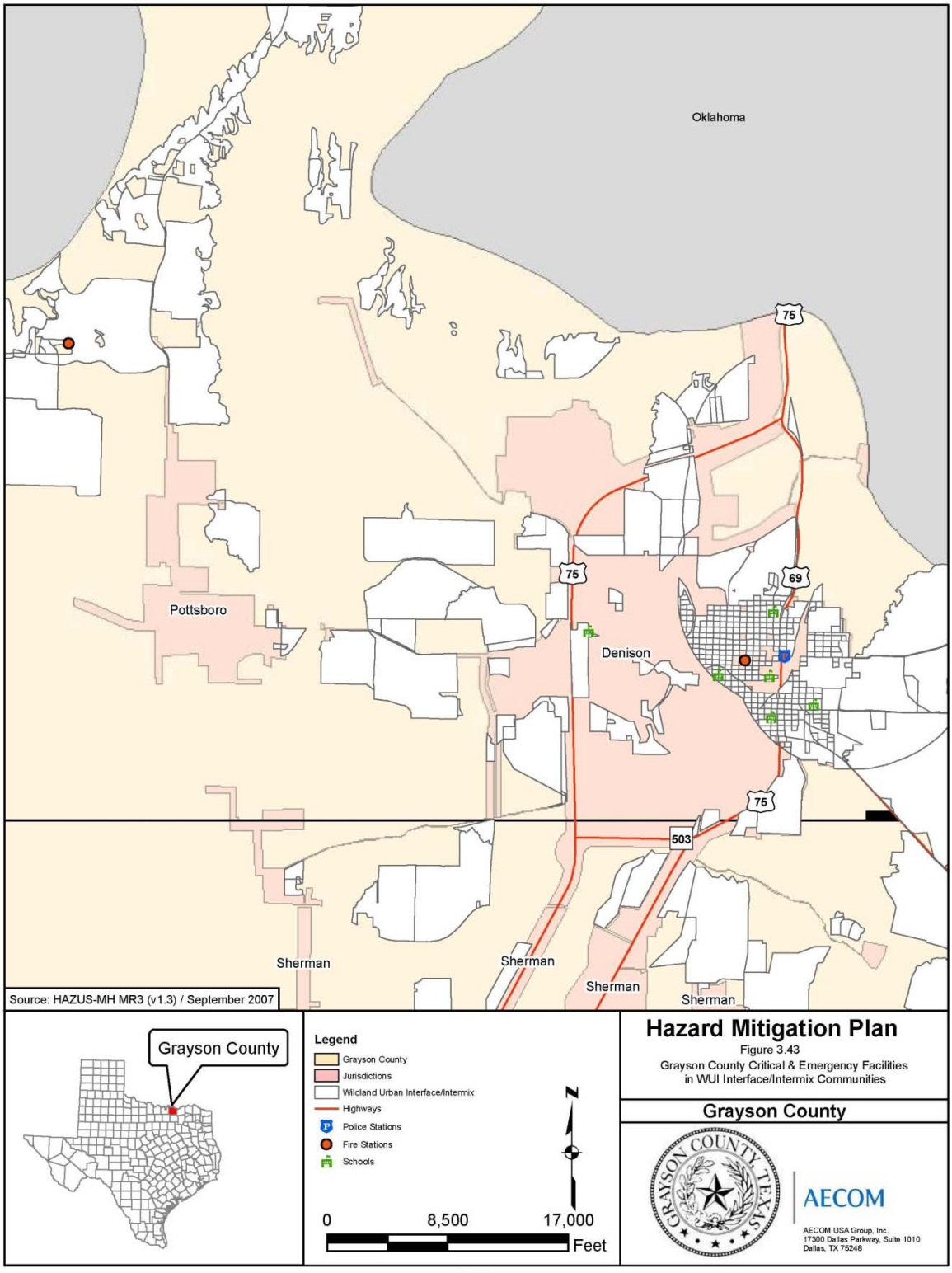

Fannin
County
69
Whitewright
160
69
Source: Federal Emergency Management Agency
Grayson County
Legend
Grayson County
Jurisdictions
FEMA 100-year Floodplain
National Hydrography Dataset Waterbodies
Highways
N
0
2,400
4,800
Feet
Hazard Mitigation Plan
Figure 3.39
Whitewright FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248

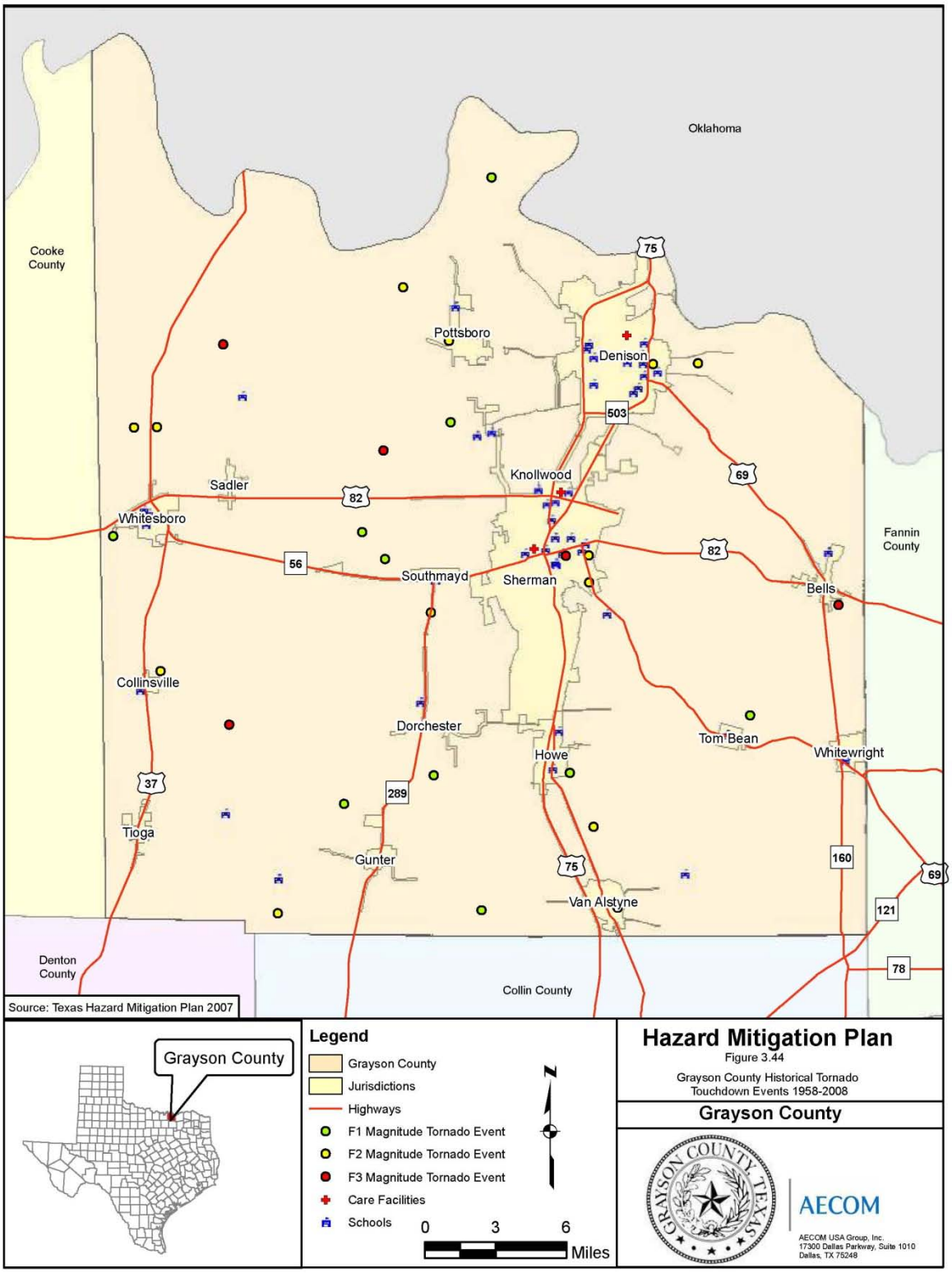

Oklahoma
Pottsboro
Denison
Knollwood
Sadler
Cooke County
Whitesboro
Southmayd
Sherman
Bells
Collinsville
Dorchester
Howe
Tom Bean
Whitewright
Fannin County
Tioga
Gunter
Van Alstyne
Denton County
Collin County
75
503
69
82
56
37
289
160
78
121
Source: Texas Hazard Mitigation Plan
Grayson County
Legend
Grayson County
Jurisdictions
100-year Floodplain
Highways
N
0
3
6
Miles
Hazard Mitigation Plan
Figure 3.40
Grayson County Critical Facilities in FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17304 Dallas Parkway, Suite 1010
Dallas, TX 75248

F


Oklahoma
Cooke County
Fannin County
Denton County
Collin County
Pottsboro
Denison
Knollwood
Sadler
Whitesboro
Southmayd
Sherman
Bells
Collinsville
Dorchester
Howe
Tom Bean
Whitewright
Tioga
Gunter
Van Alstyne
75
503
69
82
56
289
37
160
121
78
WTP
Source: HAZUS-MH MR3 (v1.3) / September 2007
Grayson County
Legend
Grayson County
Jurisdictions
100-year Floodplain
Highways
Hazardous Material in 100-year floodplain
Water Treatment Plant in 100-year floodplain
Waste Water Treatment Plant in 100-year floodplain
N
0 3 6
Miles
Hazard Mitigation Plan
Figure 3.41
Grayson County Critical Infrastructure in FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


Oklahoma
Cooke County
Pottsboro
Denison
Knollwood
Sadler
Whitesboro
Fannin County
Southmayd
Sherman
Bells
Collinsville
Dorchester
Tom Bean
Howe
Whitewright
Tioga
Gunter
Van Alstyne
Denton County
Collin County
Source: HAZUS-MH MR3 (v1.3) / September 2007
Grayson County
Legend
Grayson County
Jurisdictions
100-year Fema Floodplain
Highway Bridges in 100-year floodplain
Dams located in 100-year floodplain
N
0
3
6
Miles
Hazard Mitigation Plan
Figure 3.42
Grayson County Critical Infrastructure- Bridges and Dams in FEMA 100-year Floodplain
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


Oklahoma
75
69
503
Pottsboro
Denison
Sherman
Sherman
Sherman
Sherman
Source: HAZUS-MH MR3 (v1.3) / September 2007
Grayson County
Legend
Grayson County
Jurisdictions
Wildland Urban Interface/Intermix
Highways
Police Stations
Fire Stations
Schools
N
0
8,500
17,000
Feet
Hazard Mitigation Plan
Figure 3.43
Grayson County Critical & Emergency Facilities
in WUI Interface/Intermix Communities
Grayson County
GRAYSON COUNTY TEXAS
AECOM
AECOM USA Group, Inc.
17300 Dallas Parkway, Suite 1010
Dallas, TX 75248


Oklahoma
Cooke County
Pottsboro
Denison
Knollwood
Sadler
Whitesboro
Fannin County
Southmayd
Sherman
Bells
Collinsville
Dorchester
Tom Bean
Whitewright
Howe
Tioga
Gunter
Van Alstyne
Denton County
Collin County
75
503
69
82
56
37
289
160
121
78
Source: Texas Hazard Mitigation Plan 2007
Grayson County
Legend
Grayson County
Jurisdictions
Highways
F1 Magnitude Tornado Event
F2 Magnitude Tornado Event
F3 Magnitude Tornado Event
Care Facilities
Schools
0 3 6
Miles
N
Hazard Mitigation Plan
Figure 3.44
Grayson County Historical Tornado Touchdown Events 1958-2008
Grayson County
GRAYSON COUNTY, TEXAS
AECOM
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4 CAPABILITY ASSESSMENT

The capability assessment examines the ability of Grayson County and participating jurisdictions to implement and manage a comprehensive mitigation strategy. The strengths, weaknesses, and resources of these jurisdictions are identified in this assessment as a means to develop an effective Hazard Mitigation Plan. The capabilities identified in this assessment are evaluated collectively to develop recommendations that are considered feasible given existing local conditions, which support the implementation of effective mitigation actions throughout Grayson County.

AECOM distributed capability survey questionnaires to the Grayson County Office of Emergency Management and to the Planning Committee in order to initiate this assessment. These capability assessments were distributed to the participating jurisdictions to request information pertaining to existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation actions including legal and regulatory capability, administrative and technical capability, and fiscal capabilities. Completed questionnaires were received in June 2009 (*Appendix C*), including 16 jurisdictions, illustrating their capability to implement a mitigation strategy.

Grayson County's legal and regulatory capabilities are associated with the meaningful policies and projects designed to reduce the impacts of future hazard events. The administrative and technical capabilities are assessed by evaluating whether there are an adequate number of personnel to complete mitigation activities, and assessing the level of knowledge and technical expertise of local government employees. The fiscal capabilities are associated with the financial ability of a local government to implement mitigation activities.

Table 4.1, Table 4.2, and Table 4.3 provides a summary of the legal and regulatory capabilities, administrative and technical capabilities, and fiscal capabilities for Grayson County and participating jurisdictions. To assess the capabilities of each participating jurisdiction, the number of "yes" answers is added horizontally in each Table. Then, a percentage is obtained relative to the total number of "yes" answers possible. To assess the capabilities of Grayson County in each category, the number of "yes" answers is added vertically in each column. Then, a percentage is obtained relative to the number of jurisdictions (16).

Table 4.1 Legal and Regulatory Capability Summary

Legal and Regulatory Capabilities															
Jurisdiction	**Building Code**	**Zoning Ordinance**	**Subdivision Ordinance or regulation**	**Special purpose ordinances (floodplain management, stormwater management, hillside or steep slope ordinances wildfire ordinances, hazard setback requirements)**	**Growth management ordinances (also called "smart Growth" or anti-sprawl programs)**	**Site Plan review requirements**	**General or comprehensive plan**	**A capital improvements plan**	**An economic development plan**	**An emergency response plan**	**A post-disaster recovery plan**	**A post-disaster recovery ordinance**	**Real estate disclosure requirements**	**Other**	**% Yes per Jurisdiction**
Grayson County	N	N		Y	Y	N	Y	N	N	Y	Y	Y	N	N	**46**
Bells	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N	N		**54**
Collinsville	Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	N	N		**62**
Denison	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		**100**
Dorchester	Y	N	Y	N	N	Y	Y	N	N	Y	Y	N	N		**46**
Gunter	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N		**77**
Howe	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	?	**54**
Knollwood	Y	Y	N	N	N	Y	Y	N	?	Y	Y	N	N		**46**
Pottsboro	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N		**85**
Sadler	Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	N	N		**62**
Southmayd	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	N		**62**
Sherman	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N		**92**
Tioga	Y	Y	Y	Y	?	Y	Y	N	N	Y	Y	N	N		**62**
Tom Bean	N	Y	Y	Y	N	Y	Y				Y				**69**
Van Alstyne	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		**100**
Whitesboro	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N		**77**
Whitewright	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y		**85**
% Yes of Capabilities	**82**	**88**	**88**	**82**	**35**	**82**	**88**	**59**	**47**	**100**	**100**	**24**	**24**		
Total % Yes Capabilities – 69%															
Y- Yes N- No ?- Don't Know															

Table 4.2 Administrative and Technical Capability Summary

Administrative and Technical Capabilities											
Jurisdiction	**Planner(s) or engineer(s) with knowledge of land development and land management**	**Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure**	**Planners or engineer(s) with an understanding of natural and/or human caused hazards**	**Floodplain manager**	**Surveyors**	**Staff with education or expertise to assess the community's vulnerability to hazards**	**Personnel skilled in GIS and/or HAZUS**	**Scientists familiar with the hazards of the community**	**Emergency manager**	**Grant writers**	**% Yes per Jurisdiction**
Grayson County	Y	Y	Y	Y	Y	Y	Y		Y	Y	**90**
Bells	Y	Y	Y	N	N	N	N	N	Y	Y	**50**
Collinsville	Y	Y	Y	Y	Y	Y	N	N	Y	Y	**80**
Denison	Y	Y	?	Y	N	Y	N	N	Y	N	**50**
Dorchester	Y	Y	Y	N	N	Y	N	N	N	Y	**50**
Gunter	Y	Y	Y	Y	N	Y	N	N	Y	Y	**70**
Howe	Y	Y	Y	N	N	N	N	N	Y	Y	**50**
Knollwood	N	N	N	N	N	N	N	N	N	N	**0**
Pottsboro	Y	N	Y	Y	N	Y	N	?	Y	Y	**60**
Sadler	Y	Y	Y	Y	Y	Y	N	N	Y	Y	**80**
Southmayd	Y	Y	Y	Y	N	Y	N	N	Y	Y	**70**
Sherman	Y	Y	Y	Y	N	Y	Y	N	Y	Y	**80**
Tioga	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**100**
Tom Bean	N	N	N	N	Y	N	N	N	N	Y	**20**
Van Alstyne	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**100**
Whitesboro	Y	Y	Y	N	N	Y	N	N	Y	Y	**60**
Whitewright	Y	Y	Y	Y	Y	Y	Y	N	Y	N	**80**
% Yes of Capabilities	**88**	**82**	**82**	**65**	**41**	**76**	**29**	**12**	**82**	**82**	
Total % Yes Capabilities – 64%											
Y- Yes N- No ?- Don't Know											

Table 4.3 Fiscal Capability Summary

Fiscal Capabilities											
Jurisdiction	**Community Development Block Grants (CDBG)**	**Capital improvements project funding**	**Authority to levy taxes for specific purposes**	**Fees for water, sewer, gas, or electric service**	**Impact fees for homebuyers or developers for new developments/homes**	**Incur debt through general obligation bonds**	**Incur debt through special tax bonds**	**Incur debt through private activity bonds**	**withhold spending in hazard-prone areas**	**Other**	**% Yes per Jurisdiction**
Grayson County	Y	Y	Y	N	N	Y	Y	Y	Y		**78**
Bells	N	N	Y	Y	N	Y	N	N	N		**33**
Collinsville	?	Y	?	Y	Y	Y	N	N	?		**44**
Denison	Y	Y	Y	Y	Y	Y	?	?	Y		**78**
Dorchester	?	Y	?	Y	Y	Y	N	N	?		**44**
Gunter	Y	Y	Y	Y	N	Y	Y	Y	N		**78**
Howe	Y	Y	Y	Y	N	Y	Y	N	N		**67**
Knollwood	Y	Y	Y	Y	Y	?	?	?	?		**56**
Pottsboro	Y	Y	Y	Y	Y	Y	Y	Y	Y		**100**
Sadler	Y	Y	Y	Y	Y	Y	Y	Y	Y		**100**
Southmayd	Y	Y	Y	Y	Y	Y	Y	Y	?		**89**
Sherman	Y	?	Y	Y	N	Y	Y	Y	?		**67**
Tioga	N	N	Y	Y	Y	N	N	?	?		**33**
Tom Bean	Y	N	N	Y	N	Y	N	N	N		**33**
Van Alstyne	Y	Y	Y	Y	Y	Y	Y	Y	Y		**100**
Whitesboro	Y	Y	Y	Y	N	Y	Y	N	N		**67**
Whitewright	Y	Y	Y	Y	N	Y	N	N	N		**56**
% Yes of Capabilities	**76**	**76**	**82**	**94**	**53**	**88**	**53**	**41**	**29**		
Total % Yes Capabilities – 66%											
Y- Yes N- No ?- Don't Know											

To quantify Grayson County's legal and regulatory capabilities, administrative and technical, and fiscal capabilities, an overall rating system was administered for each category; limited (0 – 30%), moderate (31 – 70%), and strong (71 – 100%). Survey responses indicate that in average Grayson County and its jurisdictions have 69% of legal and regulatory capabilities, 64% of administrative and technical capabilities of, and 66% fiscal capabilities.

The risk assessment and capabilities assessment serves as the foundation for the development of a meaningful hazard mitigation strategy. During the process of identifying specific mitigation actions to pursue, Grayson County considered not only its level of hazard risk but also the existing capability to minimize or eliminate that risk.

5 MITIGATION STRATEGY

According to the Texas State Plan Mitigation Plan, hazard mitigation is defined as any action taken to eliminate or reduce the long-term risk to life and property from natural and human-caused hazards. This is a long-term, ongoing management process that consists of a variety of both pre-incident and post-incident actions.

Section 201.6(c)(3) of the mitigation planning regulation requires jurisdictions to develop a mitigation strategy. The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. In response to the findings in the vulnerability and risk assessment, Grayson County and its jurisdictions developed a mitigation strategy composed by the development of goals and prioritized mitigation actions to reduce the incidence of hazards in the communities.

5.1 MITIGATION GOALS

According to *Requirement 201.6(c)(3)(i)* the plan shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards. For the development of the mitigation goals, Grayson County took into consideration both state and jurisdictional needs. After considering these needs, the jurisdictions agreed on adopting the State's mitigation goals for their Multi-jurisdiction Hazard Mitigation Plan:

Reduce or eliminate hazardous conditions that cause loss of life.
Reduce or eliminate hazardous conditions that inflict injuries.
Reduce or eliminate hazardous conditions that cause property damage.
Reduce or eliminate hazardous conditions that degrade important natural resources.

Grayson County and participating jurisdictions concur with the reduction or elimination of hazards causing loss of life as the priority goal, followed by elimination/reduction of those hazards resulting in injuries, property damage, and those degrading the important natural resources. Therefore, Grayson County and jurisdiction agreed that adoption of the goals proposed in the State Plan would be in accordance to the goals of the community as a whole, anticipating that these goals can be achieved through implementation of the proposed Hazard Mitigation Plan.

5.2 MITIGATION ACTIONS

Once the mitigation goals were adopted, a workshop open to the public was held on August 13, 2009. The purpose of the workshop was to present the jurisdictions and public with the different groups for which mitigation actions can be developed including: prevention, property protection, public education and awareness, natural resource protection and structural projects, as cited in the mitigation planning guideline. In addition to the categories, the attendants were introduced to the STAPLEE method, the technique for identifying, evaluating, and prioritizing mitigation actions based on existing local conditions as presented in FEMA's *Developing the Mitigation Plan* (FEMA 386-3) highlights and summarized in Table 5.1 below.

Table 5.1 FEMA's STAPLEE Criteria

FEMA's STAPLEE Criteria	
S Social	The public must support the overall implementation strategy and specific mitigation actions.
T Technical	Is the proposed action technically feasible, help to reduce losses in the long term, and have minimal secondary impacts?
A Administrative	Determine if the Jurisdictions have the personnel and administrative capabilities necessary to implement the action or whether outside help will be needed.
P Political	Are the actions politically favored
L Legal	Are there perceived legal problems in implementing the actions?
E Economic	Does implementing the action make economic sense?
E Environmental	Do the actions have adverse environmental effects?

In compliance with *Requirement 201.6(c)(3)(ii),* the Planning Committee identified and analyzed for a comprehensive range of specific mitigation actions and projects considered to reduce the effect of each hazard, with particular emphasis on both existing and future buildings.

According to *Requirement 201.6(c)(3) (iii)* the action plans should describe how actions will be prioritized, implemented, and administered by the local jurisdictions. Prioritizing shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs. In compliance with that requirement, the Planning Committee and members from the public were provided with worksheets for the development of mitigation actions as provided in Appendix D. The mitigation actions worksheets requested information regarding the priority of the hazard, description of the

mitigation action, cost-effectiveness, potential funding source, responsible party, implementation schedule, and effects on new and existing buildings. Each jurisdiction worked separately on the development of mitigation action, prioritizing each of them based on the perception of its cost-effectiveness and using the STAPLEE methodology.

For details on the cost-effectiveness, potential funding source, implementation schedule, and effects on new and existing buildings, refer to the completed worksheets for each of the jurisdictions included in *Appendix D*. A summary of the mitigation actions developed by each jurisdiction are provided in the sub-sections to follow.

5.3 SUMMARY OF GRAYSON COUNTY MITIGATION ACTIONS

Grayson County (unincorporated area)			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
General	• Obtain projections for future growth trends and anticipated land uses within Grayson County for purposes of evaluating whether new or special building codes or land development regulations should be considered by the County or any of the other participating jurisdictions in order to reduce potential damages from the hazards evaluated in this plan.	High/ Medium	Emergency Management Coordinator (EMC)
Hailstorms	• Develop a community outreach program to promote severe weather awareness. Work with local media to publish and air public safety information prior to storm peak season on how to be prepared. • Work with local, crop, auto, business, & residential insurance agents to educate the community on the importance of hail coverage. The agents would also encourage policyholders to evaluate current policies to ensure proper. This could help prevent economic hardship resulting from a major weather event. • Educate local residents on the importance of NOAA weather radios in homes and offices and how to use them properly. Research into funding opportunities to provide NOAA weather radios free or at a reduced rate to vulnerable and limited income populations.	Medium/ Low	EMC County Extension Agent & Farm Service Agency
Drought	• Educate local producers of the availability of insurance for hay & pasture loss from the local Farm Service Agency. Encourage local producers to report yearly hay production in normal rainfall years to assist in a more accurate loss calculation in drought years. • Work with County Extension Agent and local nurseries on the education of the general public on using drought resistance vegetation in landscaping. • Work with Grayson County Groundwater Conservation Committee to develop stringent water usage policies.	Medium	EMC County Extension Agent & Farm Service Agency County Commissioners
Flooding	• Clear debris and improve flow of waters. • Adding culverts/horns.	High	EMC Floodplain

Grayson County (unincorporated area)			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Create low water crossing alerts, based on a gauge notification system. • Develop relief creeks. • Enforce strict floodplain regulations. • Increase public awareness and create public service announcements. • Address flooding issues for the following areas: • Tributary to Iron Creek by Denison Independent School District training office and bus barn. Major flooding issues during the flood event of 2007 (Precinct 2). • Erosion and channel natural re-routing issues observed at Choctaw Bottom Rd. (Precinct 2). • Frequent flooding issues (two to three times per year) of Choctaw Creek crossing with Davenport Rd. (Precinct 1). The flooding events block the only access for emergency vehicles and homeowners of eight or nine homes. • Work with local jurisdiction in the buyout of repetitive flood properties. This includes any structures found to be located in flood areas that are in incorporated and unincorporated areas. (NFIP) • Turn Around Don't Drown Campaign. This is a campaign that would be aired through the media to educate people on the dangers of driving through floodwaters. Obtain additional barricades with special signage linked to "Turn Around, Don't Drown" logo. • Better inform residents of mitigation activities that they can implement in their homes such as elevation of appliances above expected flood levels. The information would be provided by, publications, & booths at community events. (NFIP) • Education of the public on the importance of Flood Insurance. Most homeowners are unaware that their homeowner policy does not provide coverage for this event. Work with local insurance agents to notify homeowners. (NFIP)		Manager County Commissioners
Wildfires	• Burn bans. • Fuel reduction projects.	High/ Medium	EMC Fire

Grayson County (unincorporated area)			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Increase public awareness and create public service announcements. • Work with fire departments to ensure countywide NIMS compliance. • Develop a method using the media and the internet to notify county residents of the burn ban status and the enforcement of the ban when in place. • Apply for federal and state grants to enhance the fire fighting capability of the local volunteer fire departments. This would include equipment, water supply, and dry hydrants. • Educate community on the Fire Wise Program & how to protect your home by establishing a defensible space and fuel reduction management.		Departments Commissioners Court
Extreme Temperature	• Assist the regional 211 to distribute fans to those who are in need of relief from the Texas heat. • Notify current residents of utility assistance programs at TCOG. • Work with local Churches and public building officials to set up a cooling center for in extreme heat events • Set and action plan to keep roads open during extreme temperature events. • Keep roads free of vegetation to prevent it from blocking roads during extreme temperature events.	High/ Medium	EMC
Windstorm	• Work with local jurisdictions to apply for a Multi-Jurisdictional FEMA Safe Room Rebate program. • Develop a community outreach program to promote severe weather awareness. Work with local media to publish and air public safety information prior to storm peak season on how to be prepared. • Set and action plan to keep vegetation under control to prevent it from road blockage during windstorm events. • Keep roads free of vegetation to prevent it from blocking roads during windstorm events.	High/ Medium	EMC Fire Departments
Lightning	• Yearly updating of building codes and continual education of the public, realtors, and home inspectors on the dangers associated with substandard construction. • Develop a community outreach program to	High/ Medium	EMC Fire Departments

Grayson County (unincorporated area)			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	promote severe weather awareness. Work with local media to publish and air public safety information prior to storm peak season on how to be prepared.		
Severe Winter Storm	• Continuation of the Grayson County CERT program. Work with local businesses to encourage employee participation. Explore possible donation sources for CERT supplies. • Educate local residents on the importance of NOAA weather radios in homes and offices and how to use them properly. Research into funding opportunities to provide NOAA weather radios free or at a reduced rate to vulnerable and limited income populations. • Develop a plan for emergency shelters setup in the event of a winter storm. This plan would include the search for funds to provide an adequate back up power supply for the shelter. • Set and action plan to keep roads open during severe winter storms. • Keep roads free of vegetation to prevent it from blocking roads during severe winter storms.	High/ Medium	EMC Fire Departments
Tornado	• Develop a community outreach program with a focus on Web 2.0 products and public presentations to promote severe weather awareness. Work with local media to publish and air public safety information prior to storm peak season on how to be prepared. • Continuation of the Grayson County CERT program. Work with local businesses to encourage employee participation to strengthen private sector preparedness. • Work with local jurisdictions to apply for a Multi-Jurisdictional FEMA Safe Room Rebate program. • Educate local residents on the importance of NOAA weather radios in homes and offices and how to use them properly. Research into funding opportunities to provide NOAA weather radios free or at a reduced rate to vulnerable and limited income populations. • Work with high risk communities to apply for a Community Safe Room Project	High/ Medium/ Low	EMC Fire Departments

Grayson County (unincorporated area)			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Set and action plan to keep roads open after tornado events. • Have an active plan for removal of debris and vegetation to prevent them from blocking the roads after a tornado event.		
Dam & Levee Failure	• Develop printed materials, utilize existing materials, conduct workshops, and encourage residents to have family disaster plans that include emergency evacuation procedures & shelter-in-place emergency guidelines. • Educate property owners near high hazard dams of the potential of a dam failure. Inform them of signs to watch for that might signal a weakening of the dam and who to contact if suspicious activity is spotted. • Work with local resident and County Commissioners to ensure that if roadways are lost due to a dam failure that properties owners are not isolated. • Spillway for Dam located upstream Dessert Lake Rd. at the southeast limit of the County (Precinct 2) appears inadequate, increasing the risk of flooding of Desert Lake Rd. and downstream property. • Loy Lake Dam is owned by Grayson County and is classified as a small, significant hazard structure due to the size of the dam and downstream hazard. Grayson County will prepare an Emergency Action Plan pursuant to guidelines established through the TCEQ Dam Safety Program and submit it to the TCEQ Dam Safety Section. Grayson County will then review the Emergency Action Plan annually and update it as necessary. Grayson County will perform a tabletop exercise of the emergency action plan at least every five years. • Determine owners of all high and significant hazard dams in Grayson County and obtain copies of all EAPs submitted to TCEQ for these dames. Review inundation mapping and disseminate copies to appropriate jurisdictions for incorporation into the Hazard Mitigation Plan. • Obtain available dam failure impact data necessary	Medium/ High	EMC

Grayson County (unincorporated area)			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	for determining the most appropriate mitigation approach that would achieve compliance with the State's TCEQ regulations for all high and significant hazard dams which are lacking necessary data.		
Earthquake	• Continuation of the Grayson County CERT program. Work with local businesses to encourage employee participation and encourage private sector coordination. • Develop printed materials, utilize existing materials, conduct workshops, and encourage residents to have family disaster plans that include emergency evacuation procedures & shelter-in-place emergency guidelines. • Work with local resident and County Commissioners to ensure that if roadways are loss due to a dam failure that properties owners are not isolated. • Obtain available earthquake impact data necessary for determining the most appropriate mitigation approach.	High/ Medium	EMC
Expansive Soils	• Meet with local insurance agents and foundation contractors to determine the historical level of claims and the extent of problems occurring in Grayson County. Determine whether additional action items are possible to reduce further these damage levels. • Review city street standards and ensure that methods to reduce soil expansion are used in areas with extremely expansive soils. These methods such as kneading the soil, extreme compacting, and treating of soils with non-swell additives will extend the life of the roadways. • Obtain available expansive soil impact data necessary for determining the most appropriate mitigation approach.	High/ Medium	EMC
Landslide	*Based on the topography, expected landslides are minimal and, if anything, are limited to those created by erosion issues, which will be addressed as part of the flooding issues; however, mitigation action items are included to further study this issue within the next round of planning and to further evaluate this hazard.*	Low	EMC

Grayson County (unincorporated area)			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Obtain additional historical loss, previous occurrence, location, extent, and impact data that becomes available to evaluate further the historical hazards associated with landslides during the next planning cycle. • Determine probability of future events, their location, extent and impact and establish appropriate mitigation actions based on findings in the next planning cycle, should necessary information become available.		
Land Subsidence	*Based on the geological formations underlying Grayson County, land subsidence is not considered a potential hazard; however, mitigation action items are included to further study this issue within the next round of planning and to evaluate further this hazard.* • Obtain available, additional historical loss, previous occurrence, location, extent, and impact data to evaluate further the historical hazards associated with landslides during the next planning cycle. • Determine probability of future events, their location, extent and impact and establish appropriate mitigation actions based on findings in the next planning cycle, should necessary information become available.	Low	EMC
Terrorism	• Continuation of previously started CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to form teams. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Local PSA‘s about what to have in Emergency Supply Kit Public. • Apply for funding and maintain a public health preparedness program with Grayson County Health Department which to include work to mitigate the impact of pandemic and bioterrorism	High/ Medium	EMC

Grayson County (unincorporated area)			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	public health events. • Apply for assistance in establishing a Full-time County Floodplain and Dam Safety Program Manager Position.		
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.	High/ Medium	EMC Commissioners

5.4 SUMMARY OF BELLS MITIGATION ACTIONS

Bells			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Continue to recruit, educate, and train volunteer fire department members to serve as storm spotters. • Yearly updating of building codes and continual education of the public, realtors, and home inspectors on the dangers associated with substandard construction. • Bells has no outdoor warning siren. Grant funding would be needed to fund this project due to the cost of approximately $30K.	High/ Medium	FVD City Clerk & Elected Officials
Drought	• Develop a plan to reduce water consumption and implement a water conservation awareness program. Develop a method to detect and stop unauthorized water use by other entities. • Annual update of Drought Contingency Plan. • Maintain and implement the adopted "Fire Plan" for the local school district. This includes installing a well, fire line, & a 500 gpm pump.	High/ Medium	City Clerk & Elected Officials
Flooding	• Pursue adoption of required ordinances and approval to participate in NFIP. (NFIP) • Work with engineers to develop a storm drainage system and seek funding for help with cost of installation. • Educate local residents on the participation of the city in the NFIP program and the importance of purchasing flood insurance. (NFIP)	High	City Clerk & Elected Officials
Wildfires	• Follow plan to ensure that new staff members meet NIMS compliance as soon as possible. • Develop and maintain mutual aid agreements with neighboring jurisdictions. • Develop an enhanced Fire Plan for the local school district including equipping the District with any additional items necessary to implement the Plan. • Educate the community on the evacuation routes from and through the City of Bells and	High/ Medium	Fire Department School Admin Elected Officials

Bells			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	the school campuses.		
Extreme Temperature	• Establish and educate residents on "Cooling Shelter" locations. • Annual update of Drought Contingency Plan. • Develop a plan to reduce water consumption and implement a water conservation awareness program. Develop a method to detect and stop unauthorized water use by other entities.	High/ Medium	City Clerk & Elected Officials
Windstorm	• Yearly updating of building codes and continual education of the public, realtors, and home inspectors on the dangers associated with substandard construction. • Continue to recruit, educate, and train volunteer fire department members to serve as storm spotters. • Bells has no outdoor warning siren. Grant funding would be needed to fund this project due to the cost of approximately $30K per siren.	High/ Medium	Fire Department City Clerk & Elected Officials
Lightning	• Yearly updating of building codes and continual education of the public, realtors, and home inspectors on the dangers associated with substandard construction. • Bells has no outdoor warning siren. Grant funding would be needed to fund this project due to the cost of approximately $30K per siren.	Medium	City Clerk & Elected Officials
Severe Winter Storm	• Educate residents on shelter-in-place planning and increase awareness that no public shelter is established in the City of Bells. Explore possibility of establishing public shelter. • Seek funding sources for the purchasing of a mobile generator for utility service or other critical infrastructure.	High /Low	City Clerk & Elected Officials
Tornado	• Continue to recruit, educate, and train volunteer fire department members to serve as storm spotters. • Insure that all critical instruments at City Hall have generator backup. • Yearly updating of building codes and	High/ Medium /Low	City Clerk & Elected Officials Fire Department

Bells			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	continual education of the public, realtors, and home inspectors on the dangers associated with substandard construction. • Maintain cell phone signal booster antenna at City Hall to provide for redundant communications. • Work with Grayson County and other local jurisdictions to apply for a countywide Safe Room Rebate Program.		
Earthquake	• Yearly updating of building codes and continual education of the public, realtors, and home inspectors on the dangers associated with substandard construction. • Educate the community on the evacuation routes from and through the City of Bells and the school campuses.	High/ Medium	To be provided
Expansive Soils	• Provide soil stabilization methods prior to construction or reconstruction of City roadways. • Control the design and construction of the foundation and foundation spaces for all buildings.	Medium	Mayor
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council
Hazardous	• Apply for assistance to install auxiliary air,	High/	EMC

Bells			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Materials	water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.	Medium	Fire and Police Chief City Council and City Manager

5.5 SUMMARY OF COLLINSVILLE MITIGATION ACTIONS

Collinsville			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Protect City owned vehicles and other equipment in the event of a hailstorm (action has been completed). • Encourage citizens to inspect tree limbs on their property and report potential problems to power company.	Low	Public Works Director
Flooding	• Improve drainage in southeast section of city by cleaning ditches and installing larger culverts. • Educate and encourage residents to refrain from raking leaves into ditches • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)	Medium Low	Mayor and Public Works Director Public Works Director
Extreme Temperature	• Maintain a routine vehicle and equipment maintenance schedule. • Encourage the elderly and those with medical problems to remain indoors during extreme hot or cold temperatures. Will also make a community building available if necessary.	Medium	Public Works Director City Mayor and Police Chief
Windstorm	• Inspect overhanging tree limbs on aerial power line routes to eliminate loss of power due to broken limbs. Report any potential problem areas to power company. • Encourage citizens to inspect tree limbs on their property and report potential problems to power company.	Medium	Public Works Director
Lightning	• Retrofit water facilities with alternative power source in the event of power loss or equipment damage associated with severe lightning. • Installed generator at wastewater plant. Provide a portable generator capable of operating a lift station.	Medium Low	Mayor and Public Works Director Public Works Director

Collinsville			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Severe Winter Storm	• Retrofit water facilities with alternative power sources in the event of power loss. • Installed generator at wastewater plant. • Provide a portable generator capable of operating a lift station	Medium Low	Mayor and Public Works Director Public Works Director
Tornado	• Provide storm spotters in several locations enabling the warning sirens to be activated giving ample time to seek shelter. • Open community building for an emergency shelter. • Educate residents on actions to take when sirens are activated	Medium	Fire and Police Department Chief
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous	High/ Medium	EMC Fire Chief Police Chief City Manager

Collinsville			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.		City Council

5.6 SUMMARY OF DENISON MITIGATION ACTIONS

Denison			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Enhance and add local outdoor warning sirens to ensure adequate coverage in all areas of the community and educate residents on the importance of NOAA weather radios in homes and businesses. Promote enrollment of all residents in existing telephone emergency notification system. Promote enrollment of deaf residents in DeafLINK and in available texting notices from existing emergency notification system. Encourage use of Web 2.0 social media information systems for special populations. • Distribute emergency preparedness information related to weather hazards. • Update communications and storm tracking capabilities of the Mobile Command Center. • Work towards the implementation and maintenance of a Citizens Fire Academy for community education. Explore possible donation sources for supplies.	High/ Medium	EMC Local Staff
Drought	• Regularly update and maintain drought contingency plan. • Work with Grayson County in the formation of a groundwater conservation education program.	High/ Medium	EMC Local Staff
Flooding	• Cleaning and removing debris from Iron Ore Creek for better drainage and less debris floating on to roads. • Maintain, evaluate, and monitor city codes, to assure there are no repetitive losses on existing structures and new structures, due to flooding. (NFIP) • Increased Public Awareness prior to occurrences and during flooding. • Work with local jurisdictions to increase Wi-Fi and cellular signal ranges for Public Safety personnel. • Update communications and storm tracking capabilities of the Mobile Command Center.	High	Public Works Denison Emergency Management EMC Local Staff Public works Floodplain Manager & Building

Denison			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Turn Around Don't Drown Campaign. This is a campaign that would be aired through the media to educate people on the dangers of driving through floodwaters. Obtain additional barricades, including automatic, permanently fixed barricade systems tied to flood level monitoring systems and continuing the Turn Around Don't Drown logo. • Bi-annual storm drainage cleaning program to be implemented to keep debris from hampering drainage. • Better inform residents of mitigation activities that they can implement in their homes such as elevation of appliances above expected flood levels. The information would be provided by publications, & booths at community events.(NFIP) • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)		Inspector
Wildfires	• Increase public awareness of burn ban status and areas that are permanently prohibited from burns. • Educate & empower residents about the importance of having an Emergency Preparedness Kit. Education will inform the public on what is needed in the kit and on how to shelter in place. • Update communications and storm tracking capabilities of the Mobile Communications Center. • Work towards the implementation and maintenance of a Citizens Fire Academy for community education. Explore possible donation sources for supplies. • Establish a Critical Facility Contingency Plan and apply for funding to purchase auxiliary power sources for critical facilities. This would include the purchase of mobile generators to be where needed though out the city.	High/ Medium/ Low	EMC Local Staff

Denison			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Ensure all dead-end segments of roads in high fire hazard areas have a turn-around sufficient for fire equipment. • Apply for federal and state grants to enhance the capability of the local fire department. • Develop a coordinated approach between the Fire Department and the Public Services Department to identify needed improvements to the water distribution system.		
Extreme Temperature	• Work with neighboring communities to facilitate mutual agreements between jurisdictions for emergency backup water sources. • Assist the regional 211 to distribute fans to those who are in need of relief from the extreme heat. • Work with neighboring communities to facilitate mutual agreements between jurisdictions for emergency backup water sources. • Assist the regional 211 to distribute fans to those who are in need of relief from the Texas heat. • Work towards the implementation and maintenance of a Citizens Fire Academy for community education. Explore possible donation sources for supplies. • Work with local service organizations to host a local fan drive as their community service project. These fans would be kept on the local level for quicker distribution. • Work towards the implementation and maintenance of a Citizens Fire Academy for community education. Explore possible donation sources for supplies. • Work with local service organizations to host a local fan drive as their community service project. These fans would be kept on the local level for quicker distribution. • Work with local non-profits, faith based organizations and schools to set up cooling	High/ Medium	EMC Local Staff

Denison			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	centers for extreme heat events..		
Windstorm	• Educate residents on the importance of NOAA weather radios in school, homes and businesses and how to operate them properly. • Update communications and storm tracking capabilities of the Mobile Communications Center. • Enhance and increase number of local outdoor warning sirens to ensure adequate coverage is all areas of the community. • Pursue designation as a NWS Storm READY community.	High/ Medium	EMC Local Staff IT
Lightning	• Install lightning grade surge protection devices for city computer systems. • Citywide brush & debris disposal to encourage proper trimming and disposal of vegetation.	Medium	Public Works & Sanitation Code Enforcement IT
Severe Winter Storm	• Update communications and storm tracking capabilities of the Mobile Communications Center. • Notify residents of utility assistance programs at TCOG. • Work towards the implementation and maintenance of a Citizens Fire Academy for community education. Explore possible donation sources for supplies. • Apply for funding to purchase auxiliary power sources for critical facilities. This would include the purchase of mobile generators for use as needed throughout the city.	High/ Medium	EMC Local Staff
Tornado	• Evaluate and refurbish public warning siren system from six units to 10 to give 100% coverage within the city limits. • Modify city ordinances that enforce tornado-warning sirens within new developments. • Public Awareness. • Mark public shelters for general public awareness.	High/ Medium/ Low	Denison Emergency Management Planning department

Denison			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Upgrade the current 911 system to include a reverse 911 system. • Work with local media to publish and air public safety information prior to storm peak season on how to be prepared. • Update communications and storm tracking capabilities of the Mobile Communications Trailer. • Work with local jurisdictions to increase Wi-Fi and cellular signal ranges for Public Safety personnel. This would include updating, adding, and replacing radios. • Work towards modernizing our government access channel to include real-time alerts and the ability to post information remotely from the Emergency Operations Center during an event. • Develop a program to provide NOAA weather radios to limited-income residents that live in high-risk areas such a mobile home parks. • Explore the benefits of being certified as a NWS StormREADY Community. • Work with Grayson County to apply for a Multi-Jurisdictional FEMA Safe Room Rebate program. • Work towards the implementation and maintenance of a Citizens Fire Academy for community education. Explore possible donation sources for supplies.		
Dam & Levee Failure	• Educate property owners near high hazard dams of the potential of a dam failure. Inform them of signs to watch for that might signal a weakening of the dam and who to contact if suspicious activity is spotted. • Determine ownership of the one high hazard dam and one significant hazard dam located within or near the city. Evaluate the owner's dam safety program, emergency action plan, and compliance with state dam safety regulations. • If needed, apply for assistance in funding local dam evaluations and improvements.	High/ Medium/ Low	EMC Local Staff

Denison			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Work with residents in fire district areas of responsibility and County Commissioners to ensure that if roadways are loss due to a dam failure that properties owners are not isolated.		
Earthquake	• Educate & empower residents about the importance of having an Emergency Preparedness Kit • Work towards the implementation and maintenance of a Citizens Fire Academy for community education. Explore possible donation sources for supplies. • Implement citywide street vegetation management. Educate the public on ability to reduce the loss of property and facilitate emergency response by trimming trees near streets and power lines.	High/ Medium	EMC Local Staff
Expansive Soils	• Review city street standards and ensure that methods to reduce soil expansion are used in areas with extremely expansive soils. These methods such as kneading the soil, extreme compacting, and treating of soils with non-swell additives will extend the life of the roadways. • Train and educate contractors of the potential for expansive soils.	Medium	EMC Local Staff
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Denison			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.		
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

5.7 SUMMARY OF DORCHESTER MITIGATION ACTIONS

Dorchester			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Keep operational the emergency protection for water systems that helps the City provide with emergency supply until repairs are conducted. • Increase citizen advanced warning/notification capabilities.	Medium	City Mayor Water Department Director
Drought	• Keep Multi – Phase Drought Contingency plan for water system operational. • Increase public awareness of drought contingency plan.	High	Water Department Director
Flooding	• Pursue adoption of required ordinances and approval to participate in NFIP. (NFIP) • • Enforce application of flooding regulation for new construction by conducting regular inspections to new development in the City • As development and construction continue, keep waterways clean and clear of obstruction for proper flow. Continued upkeep for erosion control and water flow. • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)	High	Mayor and City Attorney City Mayor
Wildfires	• Provide community wide education programs to help reduce the risk of wildfire. • Scout for overgrowth of brush or a large number of acres not being cultivated that would allow a wildfire to get out of control.	Medium	City Mayor and City employees
Extreme Temperature	• Fit necessary water system plumbing with insulation • Educate Public on dangers of dehydration in high temperatures.	Medium	Water Department Manager
Windstorm	• Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during windstorms. Report any identified potential problem areas to local power company for mitigation. • Educate the public to inspect overhanging	Medium	Public Works Director City Mayor and City

Dorchester			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during windstorms. Report any identified potential problem areas to local power company for mitigation.		employees
Lightning	• Keep operational the lighting protection for water systems that helps the City provide with emergency supply until repairs are conducted. • Lightning protection on electronic equipment. Computers are backed up on a regular interval.	High	Water Department City Mayor and City employees
Severe Winter Storm	• Keep operational the emergency protection for water systems that helps the City provide with emergency supply until repairs are conducted. • Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during windstorms. Report any identified potential problem areas to local power company for mitigation.	High	Mayor, Water Department Manager Mayor and all City employees
Tornado	• Keep operational the emergency protection for water systems that helps the City provide with emergency supply until repairs are conducted. • Increase citizen advanced warning/notification capabilities.	High	Mayor, Water Department Director Mayor
Expansive Soils	• Provide soil stabilization methods prior to construction or reconstruction of city roadways. • Provide soil stabilization methods prior to construction of residences and/or commercial facilities.	Medium	Mayor Building Inspector
Landslide	• Based on topography of the City of Dorchester, landslides are not considered a potential hazard.		
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities.	High/ Medium	EMC Fire Chief

Dorchester			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.		Police Chief City Manager City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Dorchester			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	hazardous materials transportation routes around areas of greatest population density in County.		

5.8 SUMMARY OF GUNTER MITIGATION ACTIONS

Gunter			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Protect city-owned vehicles and other assets in the event of a hailstorm by locating them in covered parking areas. • Retrofit water and wastewater facilities with alternative power sources in the event of power loss during a hailstorm. Includes generators and hard wiring of equipment to prepare for power outage.	Medium	City Supervisor
Flooding	• Clearing and re-channelization of two (2) feeder creeks that flow from East to West through town to feeder creek by 2nd street. Areas impacted include College Street, Cedar Street, and Seventh Street and privately owned properties along a general line from the top of College Street down by cedar and 7th through town to FM 121 South West of Gunter. • Improve drainage for storm water run-off along State Highway 289 where it is curb and gutter form North to South through Gunter. • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)	High	City Supervisor
Wildfires	• Provide community wide education programs to help reduce the risk of wildfires. • Educate the community on the importance of the quick use of the 911 system to get sufficient help as soon as possible to keep the wildfire from spreading to a minimum. • Develop printed educational materials to help reduce risk of wildfires. • Promote an active mowing program to keep the vegetation heights to a minimum.	Medium	Fire Chief
Extreme Temperature	• Initiate a routine vehicle and equipment maintenance schedule to insure city-owned property is capable of withstanding extreme temperature changes. • Provide public information materials to citizens including helpful safety tips, public assistance availability from governmental	Medium	City Supervisor

Gunter			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	agencies and other services that may be available to handle extreme temperature situations.		
Windstorm	• Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during windstorms. Report any identified potential problem areas to local power company for mitigation. • Sponsor a citizen education program to inform public of the benefits of inspecting their property for overhanging tress limbs on aerial power lines and reporting potential problems to power company to avoid loss of power due to broken limbs pulling down power lines during windstorms.	Medium	City Supervisor
Lightning	• Retrofit wastewater facilities including plant and lift stations with alternative power source in the event of lightning strikes. Includes generators and hard wiring of equipment to prepare for power outage. • Retrofit water facilities including well sites, pump stations, SCADA system and storage facilities with alternative power source in the event of lightning strikes. Includes generators and hard wiring of equipment to prepare for power outage.	Medium	City Supervisor
Severe Winter Storm	• Retrofit water and wastewater facilities with alternative power sources in the event of a severe winter storm including power loss. Includes generators and hard wiring of equipment to prepare for power outage. • Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during severe winter storms. Report any identified potential problem areas to local power company for mitigation.	Medium	City Supervisor
Tornado	• Retrofit water and wastewater facilities with alternative power sources in the event of a tornado. Includes generators and hard wiring of equipment to prepare for power outage. • Increase citizen advanced	High	City Supervisor City

Gunter			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	warning/notification capabilities.		Supervisor, Fire Chief, Police Chief
Expansive Soils	• Provide soil stabilization methods prior to construction or reconstruction of city roadways within the southwestern areas of the city based on the existence of Crockett-Urban soil type, which has low strength and high shrink-swell ratings. • Provide soil stabilization methods prior to construction of residences and/or commercial facilities within the southwestern areas of the city based on the existence of Crockett-Urban soil type, which has low strength and high shrink-swell ratings.	Medium	City Supervisor
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related	High/ Medium	EMC Fire Chief Police Chief

Gunter			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.		City Manager City Council

5.9 SUMMARY OF HOWE MITIGATION ACTIONS

Howe			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Implement ordinances prohibiting price gouging during emergency situations • Notify emergency management agencies of disaster	High	Mayor
Drought	• Incorporate drought tolerant or xeriscape practices into landscape ordinances to reduce dependence on irrigation • Enforce mandatory water usage restrictions • Educate Public in water conservation	Medium	Mayor
Flooding	• Incorporate the procedures for tracking high water marks following a flood into emergency response plans • Retain thick vegetative cover on public lands flanking river • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)	High	Mayor
Wildfires	• Routinely inspect the functioning of fire hydrants • Require and maintain safe access for fire apparatus to wildland/urban interface neighborhoods/properties • Develop a Vegetation Management Plan	Medium	Mayor Fire Department
Extreme Temperature	• Notify Emergency Service Agencies of needs of elderly needs • Notify public of pending danger	High	Mayor
Windstorm	• Set up safe facility for public access/shelter from pending danger • Notify public to seek shelter of pending threat	Medium	Mayor
Lightning	• Set up safe facility for public access/shelter from pending danger • Notify public to seek shelter of pending threat	Medium	Mayor
Severe Winter Storm	• Set up safe facility for public access/shelter from pending danger • Notify public to seek shelter of pending threat	High	Mayor
Tornado	• Establish Early Warning System for Public Notification • Set up Inter-Local support agreements with neighboring communities	High	Mayor

Howe			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Earthquake	• Use flexible piping when extending water, sewer, or natural gas service • Require bracing of generators, elevators and other vital equipment in hospitals • Conduct seismic retrofitting for critical public facilities most at risk to earthquakes • Install shutoff valves and emergency connector hoses where water mains cross fault lines	Low	Mayor
Expansive Soils	• Provide soil stabilization methods prior to construction or reconstruction of City roadways. • Control the design and construction of the foundation and foundation spaces for all buildings.	Medium	Mayor
Landslide	• Conduct a detailed slope analysis of the jurisdiction to identify most suitable land uses / development patterns • Prohibit/restrict grading and hillside development in identified landslide hazard areas • Require specific land treatments to reduce landslide hazards (e.g. slope stabilization, landscape design, etc.) • Plant soil-stabilizing vegetation on steep publicly owned slopes	Low	Mayor
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Howe			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	mitigate the impact of pandemic and bioterrorism public health events.		
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

5.10 SUMMARY OF KNOLLWOOD MITIGATION ACTIONS

Knollwood			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Build shelter. • Retrofit community center. • Build out safe room. • Inspect and manage large trees and landscape concerns. • Acquire required infrastructure and equipment (communication devices, heavy equipment to clear up debris, siren warning system, search and rescue equipment, barricades) to prevent/respond to emergency • Provide training for city officials • Distribute information via website and newsletters..	High	Mayor Director of Emergency Management
Drought	• Build shelter. • Retrofit community center. • Provide a rainwater catchment system • Acquire required infrastructure and equipment (communication devices, heavy equipment to clear up debris, siren warning system, search and rescue equipment, barricades) to prevent/respond to emergency	Low	Mayor Director of Emergency Management
Flooding	• Build shelter. • Retrofit community center. • Build out safe room. • Install generator(s) for electrical back up. • Install solar panels (backup for fuel burning generator). • Acquire required infrastructure and equipment (communication devices, heavy equipment to clear up debris, siren warning system, search and rescue equipment, barricades) to prevent/respond to emergency	Low	Mayor Director of Emergency Management
Wildfires	• Build shelter. • Retrofit community center. • Build out safe room. • Install generator(s) for electrical back up. • Install warning sirens. • Pass a no burn ordinance. • Conduct annual fire drill. • Inspect, replace smoke alarms.	Medium	Mayor Director of Emergency Management

Knollwood			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Hire expert to assess wildfire prevention techniques (wind break-berms, walls, landscaping, etc). • Sponsor a community fair to promote wildfire safety. • Improve signage, addressing and other route finding conditions to improve access to emergency vehicles		
Extreme Temperature	• Initiate a routine vehicle and equipment maintenance schedule to insure city-owned property is capable of withstanding extreme temperature changes. • Provide public information materials to citizens including helpful safety tips, public assistance availability from governmental agencies and other services that may be available to handle extreme temperature situations.	High	Mayor Director of Emergency Management
Windstorm	• Inspect and manage large trees and landscape concerns. • Require all mobile homes to be anchored and properly tied down and inspect when located within the city. • Sponsor a community fair to promote safety. Distribute information via website and newsletters. • Acquire required infrastructure and equipment (communication devices, heavy equipment to clear up debris, siren warning system, search and rescue equipment, barricades) to prevent/respond to emergency	High	Mayor Director of Emergency Management
Lightning	• Install generator(s) for electrical back up. • Install solar panels for back up.. • Inspect and manage large trees and landscape concerns. • Replace existing telephone poles with safer models. • Sponsor a community fair to promote lightning safety. Distribute information via website and newsletters. • Provide training for city officials. • Sponsor a community fair to promote	Medium	Mayor Director of Emergency Management

Knollwood			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	lightning safety.		
Severe Winter Storm	• Build shelter. • Retrofit community center. • Build out safe room. • Install generator(s) for electrical back-up • Install solar panels (backup for fuel burning generator). • Inspect and manage large trees and landscape concerns. • Acquire required infrastructure and equipment (communication devices, heavy equipment to clear up debris, siren warning system, search and rescue equipment, barricades) to prevent/respond to emergency	High	Mayor Director of Emergency Management
Tornado	• Build shelter. • Retrofit community center. • Build out safe room. • Inspect and manage large trees and landscape concerns. • Sponsor a community fair to promote TORNADO safety. • Distribute information via website and newsletters. • Acquire required infrastructure and equipment (communication devices, heavy equipment to clear up debris, siren warning system, search and rescue equipment, barricades) to prevent/respond to emergency	High	Mayor Director of Emergency Management
Earthquake	• Build shelter. • Retrofit community center. • Build out safe room. • Install generator(s) for electrical back-up • Install solar panels (backup for fuel burning generator). • Acquire required infrastructure and equipment (communication devices, heavy equipment to clear up debris, siren warning system, search and rescue equipment, barricades) to prevent/respond to emergency.	Medium	Mayor Roelke, Director of Emergency Management
Expansive Soils	• Meet with local insurance agents and foundation contractors to determine the historical level of claims and the extent of	High/ Medium	EMC

Knollwood			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	problems occurring in Grayson County. Determine whether additional action items are possible to reduce further these damage levels. • Review city street standards and ensure that methods to reduce soil expansion are used in areas with extremely expansive soils. These methods such as kneading the soil, extreme compacting, and treating of soils with non-swell additives will extend the life of the roadways.		
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Knollwood			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.		

5.11 SUMMARY OF POTTSBORO MITIGATION ACTIONS

Pottsboro			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Protect city-owned vehicles and other assets in the event of a hailstorm by relocating vehicles to roofed areas and constructing additional parking areas for police cruisers. • Retrofit water and wastewater facilities with alternative power sources in the event of power loss during a hailstorm (includes generators and hard wiring of equipment to prepare for power outage).	Medium	City Manager Public Works Director
Flooding	• Clearing and re-channelization of two (2) existing feeder creeks that flow from South to North through town to Little Mineral Creek. Areas impacted include Elm Creek subdivision and privately owned properties along a general line from Front Street along Thompson/Houston Streets to FM Highway 120. • Improve drainage for storm water run-off along Pearce Drive, Preston Drive and in Texoma Ranch Estate subdivision. • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)	High	City Manager Public Works Director
Wildfires	• Provide community-wide education programs to help reduce the risk of wildfires. • Develop printed educational materials to help reduce risk of wildfires.	Medium	Fire Chief
Extreme Temperature	• Initiate a routine vehicle and equipment maintenance schedule to insure city-owned property is capable of withstanding extreme temperature changes. • Provide public information materials to citizens including helpful safety tips, public assistance availability from governmental agencies and other services that may be available to handle extreme temperature situations.	Medium	Public Works Director
Windstorm	• Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power	Medium	Public Works Director

Pottsboro			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	lines during windstorms. Report any identified potential problem areas to local power company for mitigation. • Sponsor a citizen education program to inform public of the benefits of inspecting their property for overhanging tress limbs on aerial power lines and reporting potential problems to power company to avoid loss of power due to broken limbs pulling down power lines during windstorms.		
Lightning	• Retrofit wastewater facilities including plant and lift stations with alternative power source in the event of lightning strikes. (Includes generators and hard wiring of equipment to prepare for power outage.) • Retrofit water facilities including well sites, pump stations, SCADA system, and storage facilities with alternative power source in the event of lightning strikes (includes generators and hard wiring of equipment to prepare for power outage).	Medium	City Manager Public Works Director
Severe Winter Storm	• Retrofit water and wastewater facilities with alternative power sources in the event of a severe winter storm including power loss (includes generators and hard wiring of equipment to prepare for power outage). • Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during severe winter storms. Report any identified potential problem areas to local power company for mitigation.	Medium	Public Works Director
Tornado	• Increase citizen advanced warning/notification capabilities. • Retrofit water and wastewater facilities with alternative power sources in the event of a tornado (includes generators and hard wiring of equipment to prepare for power outage).	High	City Manager Public Works Director

Pottsboro			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Expansive Soils	• Provide soil stabilization methods prior to construction or reconstruction of City roadways within the southwestern areas of the City based on the existence of Crockett-Urban soil type, which has low strength and high shrink-swell ratings. • Control the design and construction of the foundation and foundation spaces for all buildings. In lieu of a complete geotechnical evaluation, the use of presumptive load bearing values of foundation materials would be used to determine if soil should be removed and replaced to a depth and width sufficient to assure stable foundations	Medium	City Manager Public Works Director
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry	High/ Medium	EMC Fire Chief Police Chief City

Pottsboro			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.		Manager City Council

5.12 SUMMARY OF SADLER MITIGATION ACTIONS

Sadler			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Educate citizens to prepare an emergency kit for weather changes. • Replacing roofs on city buildings with metal roofing materials.	High Medium	City Council and City Mayor
Drought	• Initiate water supply rationing and storage procedures. • Drill new water well for second water source.	High	City Mayor and Water/Wastewater Operator City Mayor and City Council
Flooding	• Raise electrical panels and connections on lift stations above expected flood levels in flood prone areas. • In flood prone areas, encourage homeowners to install backflow valves to prevent reversal flow conditions within the city sewerage system. Provide valving component.	Medium	Water/Wastewater Operator City Mayor and City Council
Wildfires	• Encourage residents to remove limbs and high grass (by mowing) to reduce fore hazards by providing the community educational program to help reduce the risk of wildfires. • Initiate and maintain a contract for fire response within the city limits and provide water for fighting said fires.	High	Fire Department Fire Department and City Council
Extreme Temperature	• Provide public information materials with safety tips and government agencies that may be available. • Check city infrastructures to maintain uninterrupted service.	Low	City Mayor and City Secretary Water/Wastewater Operator
Windstorm	• Require all mobile homes to be anchored and properly tied down and inspect when located within the city. • Trim trees from infrastructures of lift stations and wells. Require utility providers and right of ways to inspect for same within the city.	High	Building Inspector City Council and Water/Wastewater Operator
Lightning	• Adopt NEC to enforce bonding grounds	Low	Building

Sadler			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	on electrical system with utility provider. • Install lighting arrestors on all panels at lift stations, wells, and WWTP. • Wire all infrastructures to accept connection of a locally owned generator. Purchase city generator.		Inspector Building Inspector and City Council
Severe Winter Storm	• Maintain and make available a listing of emergency and local hotels for travelers, elderly, etc. • Install connections for power generators and obtain generator for all main infrastructures.	Medium Low	City Council and City Secretary City Council and City Mayor
Tornado	• Repair emergency warning siren and test operation. Contact community about county code red program. • Review current alert and warning procedures and update/modify. Inform citizens. • Coordinate response with area schools and first response in simulated event.	High	Fire Department
Expansive Soils	• Using codes for construction of structures. Ensure that new structures being built are limited in risk due to expansion on clay soil base in the City of Sadler. • Encourage soil stabilization methods during inspections of new or existing structures. Soil in this area has low strength levels.	High	Building Inspector City Inspector
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Sadler			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.		
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Sadler			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	around areas of greatest population density in County.		

5.13 SUMMARY OF SHERMAN MITIGATION ACTIONS

Sherman			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Maintain and Operate Early Alert System- an outdoor warning system composed of nine sirens throughout the City. • Severe winter weather warnings and advisories. • Sponsor annual SKY Warn training program for citizens. • Amateur Radio Operators.	High	Police Department Emergency Management
Drought	• Study the need of water restriction plans and ordinances. • Strict compliance with the State of Texas Regional Water Conservation Plan and the development of dual water supply capability; that which being Wells Field and Lake Texoma.	High	Police Department Emergency Management
Flooding	• Land use planning and strict enforcement of ordinances and building codes on new development sites. • Removal of debris from creeks and streams. • Participation in NFIP. • Maintain and Operate Early Alert System- an outdoor warning system composed of nine sirens throughout the City. • Flood control siren. • Public announcements through reverse telephonic system as well through broadcasting local cable channels. • Public awareness through community outreach/education programs. (NFIP) • Flood control lakes. • Amateur radio operators. • Sponsor Sky Warn Training program by the National Weather Service. • Update and maintain accurate flood maps. • Update maps to address the three floodwater retention sites to the west and to the north of Sherman. • Re-assess the Choctaw Creek Watershed Plan to evaluate new land management and structural measures necessary to address	High	Public Works Public Information Officer Police Department Emergency Management

Sherman			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	flooding issues in Sherman. A re-assessment is recommended to determine the extent of the flooding issues in the watershed under existing and future development conditions. • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.		
Wildfires	• Grayson County mutual aid agreement with Fire Department. • Burn Ban implementation and efforts to ensure public awareness of these periods and the activities are prohibited.	High	Fire Department Emergency Management
Extreme Temperature	• Issue heat advisory. • Evaluate existing shelters and implement any necessary improvements • Public service announcements and media advisories. • Action plans to train volunteer citizens to look after vulnerable populations such as the elderly	High	Police Department Emergency Management
Windstorm	• Amateur radio operators. • Sponsor Sky Warn Training program by the National Weather Service. • Outdoor warning system.	High	Police Department Emergency Management
Lightning	• Amateur radio operators. • Sponsor SKY Warn training program by the National Weather Service. • Maintain and Operate Early Alert System- an outdoor warning system composed of nine sirens throughout the City.	High	Police Department Emergency Management
Severe Winter Storm	• Tree pruning around power lines to prevent power outages. • Severe winter weather warnings and advisories. • Evaluate and implement necessary improvements to designated shelters for public use.	Low	Utilities
Tornado and Hurricane	• Evaluate existing shelters and implement any necessary improvements.	High	Police Department

Sherman			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Maintain and operate Early Alert System- and outdoor warning systems composed of nine sirens throughout the City • Continue public awareness through media partnerships (Radio, Television) • Sponsor Sky Warn Training program by the National Weather Service. • Work with Grayson County to apply for a multijurisdictional FEMA Safe Room Rebate program for residents. • The City of Sherman has developed several mitigation programs. • Primarily, the City of Sherman has constructed three flood retention lakes in and around Sherman to reduce the impact of severe rainfall events. • The city has also adopted building codes that provide for safer structures. Those ordinances were developed to restrict development in the floodways and floodplains in Sherman. • The city will also work with the Red Cross and other organizations in order to provide hurricane evacuees with safety and shelter in Sherman.		Emergency Management
Dam & Levee Failure	• Continue to implement adopted program of scheduled inspections and maintenance of city owned facilities in coordination with the Natural Resources Conservation Service. • Continue the operation, monitoring, and maintenance of the three flood retention lakes and other dams throughout the City.	High	Police Department Emergency Management
Earthquake	• The City of Sherman is located in a stable geologic area of the United States with a low potential for earthquakes. • The City adheres to requirements of the International Building Codes for all Structures.	Low	Public Works
Expansive Soils	• Review city street standards and ensure that methods to reduce soil expansion are used in areas with extremely expansive soils. These methods such as kneading the soil, extreme compacting, and treating of soils with non-	Medium	Public Works Director and Engineering

Sherman			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	swell additives will extend the life of the roadways. • Train and educate contractors of the potential for expansive soils.		
Terrorism	• Define safe hazardous materials traffic routes • Adopt and enforce local codes that define the proper disposal of hazardous materials • Develop community programs that provide education on the safe use and disposal of hazardous materials. • The City of Sherman Police Department has implemented a well-trained and well-equipped Intelligence office, which works closely with the North Central Texas Fusion Center. • The police department has also undertaken major improvements in their technological capabilities. • The police department has also established mutual aid agreements with all of the law enforcement agencies in Grayson County to help with response to a significant law enforcement event. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit. • Coordinate with and support public health preparedness program of Grayson County.	High	Police Department Emergency Management Public Works Utilities
Hazardous materials events	• Define safe hazardous materials routes, • Adopt and enforce local codes that define the proper disposal of hazardous materials. • Develop community programs that provide education on safe use and disposal of hazardous materials. • Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification	High	Fire Department Police Department Emergency Management Public Works

Sherman			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazmat transportation routes around areas of greatest population density in County.		
Major Urban Fires	• Adopt and enforce local fire codes that include fire detection and suppression equipment. • Conduct fire safety inspections that identify potential fire risk and hazards. • Establish automatic and mutual aid agreements that provide for additional resources in the event of a major urban fire.	Medium	Fire Department Emergency Management Public Works
Catastrophic collisions	• The City of Sherman Police Department has formed a Traffic Safety Unit. • The unit dramatically increases traffic law enforcement efforts and is able to use traffic accident data to focus on areas with high accident rates. One major concern was the number of “Cross-over” accidents on US Hwy 75. Our fatal accident rate has been effectively eliminated with the placement of concrete barriers in the median of US Hwy 75 through the city.	Medium	Police Department Emergency Management Public Works

5.14 SUMMARY OF SOUTHMAYD MITIGATION ACTIONS

Southmayd			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Add on Garage/Carport for Police and Fire Dept. to protect city vehicles. • Develop a debris removal plan that includes the purchase of debris removal equipment such as wood chippers.	Medium High	Water Dept Maintenance / City Council
Drought	• Develop and maintain a firebreaks and debris removal program, especially around acreage. May need to purchase or rent equipment to get breaks established and maintained. Also, keep debris removed so that there is less fuel for the fire • Develop/Purchase additional water wells as additional firefighting supply for fire pumps. This may be wells that do not have to have drinkable water, but can be used for the purpose of fire protection only. • Install an elevated storage for water tank for filling firefighting equipment in an efficient way. Currently we have flush valves. The firefighters have to fill up the water tanks to take to the fires right now.	Medium	Fire and Water Dept. City Mayor
Flooding	• Increase the storm water detention capacity with the construction of structures such as Retention Pond / Damn/Flood Control Lakes. Possible Sites: • South side of Hwy 56, West of Baze residence • Southmayd Road near Ruth Campbell residence • On Deaver where brick house is located in flood zone • Develop a storm water drainage Study/Plan for known problem areas (or Citywide). • Develop a plan for the purchasing and installation of emergency barricades for temporary shutdown of roads that have running water across them. Possibly a permanent barricade with censors for high water (esp. on Southmayd Road near Campbell residence). Also, other misc supplies (such as a small water rescue kit).	Low Medium High Low	City Mayor

Southmayd			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Routinely inspect and clear debris from drainage systems. To conduct clearing activities, the city would require purchasing/renting backhoe to help with drainage ditches, retention tanks, etc. • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)		
Wildfires	• Install an elevated storage water tank for filling firefighting equipment in an efficient way. Currently we have flush valves. The firefighters have to fill up the water tanks to take to the fires right now. • Develop/purchase additional water wells as firefighting supply. This may be wells that do not have to have drinkable water, but can be used for the purpose of fire protection only. • Develop a firebreaks and debris removal program. The program could include the purchase of a wood chipper to mitigate the fire hazard by having yards well maintained.	Medium Medium/ High	City Mayor Water Dept Maintenance / City Council
Extreme Temperature	• Purchase electric generator. • Develop/purchase other water well for back up water supply.	High Low	Mayor / Police and Fire Dept. Water Dept.
Windstorm	• Purchase and install (2-3) sirens for city to be located on Simpson Road, by Fire Dept / Police Dept / City Hall area and possibly another near or in the Village of Southmayd. • KTEN & Code Red early warning system maintenance.	Medium High	Police and Fire Dept. City Secretary /Accountant
Lightning	• Purchase & install manual transfer switch between the GCEC & TXU grids in case power went out to help restore the water system • Purchase an emergency power generator as a backup power if electric went off. This would help keep our water pumps working. At this time if the electric is out, our water system is down.	High Low	Water Dept /City Council / Emergency Planning Team Mayor, Police Dept, Fire Dept

Southmayd			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Ground power lines especially near the water department to help prevent lightning from generating power outages.		Mayor/City Council/Water Maintenance
Severe Winter Storm	• Purchase & install manual transfer switch to go between GCEC and TXU to restore the power for water system in case of a power outage. • Purchase Generator for backup power if electric went off. This would help keep our water pumps working. At this time if the electric is out, our water system is down. • Develop an action plan to spread sand or de-icing agents on roads and bridges after severe winter storms. The action plan could include the following options: • 1) Purchase something (like a fertilizer spreader) to be pulled by the city tractor to spread sand on roads, OR • 2) Develop a rental agreement with someone like United Rental to rent truck(s) during storm.	High High Low	Water Dept Maintenance Man / City Council / Emergency Planning Team Mayor / Police and Fire Dept. Water Maintenance Dept.
Tornado	• Purchase and install (2-3) sirens for city to be located on Simpson Road, by Fire Dept / Police Dept / City Hall area and possibly another near or in the Village of Southmayd. • KTEN & Code Red early warning system maintenance. • Retrofit City facilities. This includes the Emergency Command Post and our water system.	Medium High Low	Police and Fire Dept. City Secretary / Accountant Mayor / City Council / Police and Fire Dept.
Dam & Levee Failure	• Improve conditions at the pond/dam located northeast of Donee Drive. Options: • Move road upstream of dam to prevent the road from being affected in case of overflow. • Buy property downstream the dam and raise the damn embankment so that it is safer. • Improve conditions at the pond located east of Katie Rose Lane. Conduct a study to develop options to decrease the erosion and	High Medium	Mayor/City Council Mayor/City Council

Southmayd			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	flooding (?) potential at the roadway crossing.		
Expansive Soils	• Provide soil stabilization methods prior to construction or reconstruction of City roadways. • Control the design and construction of the foundation and foundation spaces for all buildings.	Medium	City Mayor
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Southmayd			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.		

5.15 SUMMARY OF TIOGA MITIGATION ACTIONS

Tioga			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Protect city-owned vehicles and other assets in the event of a hailstorm. • Retrofit water and wastewater facilities with alternative power sources in the event of power loss during a hailstorm. Includes generators and hard wiring of equipment to prepare for power outage.	High	City Mayor and Public Works Director
Flooding	• Clearing and re-channelization of water runoff from the Tejas North addition allowing it to drain south (east of Lamar) and under Lamar to existing ditch that ties into 377 culvert and on to Lake Ray Roberts • Improve drainage for storm water run-off along Florence street south to Buck Creek Road and Lake Ray Roberts watershed area • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)	High	City Mayor and Public Works Director
Wildfires	• Provide community wide education programs to help reduce the risk of wildfires. • Develop printed educational materials to help reduce risk of wildfires.	Medium	Fire Chief
Extreme Temperature	• Initiate a routine vehicle and equipment maintenance schedule to insure city-owned property is capable of withstanding extreme temperature changes. • Provide public information materials to citizens including helpful safety tips, public assistance availability from governmental agencies and other services that may be available to handle extreme temperature situations.	Medium Medium	Public Works Director City Mayor
Windstorm	• Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during windstorms. Report any identified potential problem areas to local power company for mitigation. • Sponsor a citizen education program to inform	Medium	Public Works Director

Tioga			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	public of the benefits of inspecting their property for overhanging tress limbs on aerial power lines and reporting potential problems to power company to avoid loss of power due to broken limbs pulling down power lines during windstorms.		
Lightning	• Retrofit wastewater facilities including plant and lift stations with alternative power source in the event of lightning strikes. Includes generators and hard wiring of equipment to prepare for power outage. • Retrofit water facilities including well sites, pump stations, SCADA system and storage facilities with alternative power source in the event of lightning strikes. Includes generators and hard wiring of equipment to prepare for power outage.	Medium	City Mayor and Public Works Director
Severe Winter Storm	• Retrofit water and wastewater facilities with alternative power sources in the event of a severe winter storm including power loss. Includes generators and hard wiring of equipment to prepare for power outage • Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during severe winter storms. Report any identified potential problem areas to local power company for mitigation.	Medium	City Mayor and Public Works Director Public Works Director
Tornado	• Retrofit water and wastewater facilities with alternative power sources in the event of a tornado. Includes generators and hard wiring of equipment to prepare for power outage. • Increase citizen advanced warning/notification capabilities and interagency communications between fire and police departments as well as other county agencies.	High	City Mayor and Public Works Director City Mayor and Public Works Director, and Fire and Police Chiefs
Dam & Levee Failure	• There is presently one dam in the city limits of Tioga that is subject to possible failure. Dam is privately owned and spillway is too	Low	City Mayor and Public Works

Tioga			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	high. Spillway needs to be lowered to promote better drainage in areas the feed the dammed up lake. Failure of dam will destroy adjacent roadway, which is the only entrance and egress from several homes as well as Corps of Engineers access to Lake Ray Roberts. • There are no dams or levees in the Tioga area that would create a hazard if they were to fail.		Director
Expansive Soils	• Provide soil stabilization methods prior to construction or reconstruction of city roadways within the city limits area • Provide soil stabilization methods prior to construction of residences and/or commercial facilities within city limits area.	Medium	City Mayor and Public Works Director City Mayor and Public Works Director Buildings Inspector
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC.	High/ Medium	EMC Fire Chief

Tioga			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.		Police Chief City Manager City Council

5.16 SUMMARY OF TOM BEAN MITIGATION

Tom Bean			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Protect city-owned vehicles and other assets in the event of a hailstorm by relocating vehicles to roofed areas and constructing additional parking areas for police cruisers. • Retrofit water and wastewater facilities with alternative power sources in the event of power loss during a hailstorm (includes generators and hard wiring of equipment to prepare for power outage).	High	Major
Drought	• Incorporate drought tolerant or xeriscape practices into landscape ordinances to reduce dependence on irrigation • Enforce mandatory water usage restrictions • Educate Public in water conservation	Medium	Mayor
Flooding	• Pursue fulfillment of requirement for city to participate in NFIP. • Coordinate local activities with federal, state, and regional programs. • Public Awareness of problem areas if any. Have a place for people to go in case of flooded house.	High	Mayor
Wildfires	• Public awareness of apparent fuel around private structures. • Burn bans	Medium	Mayor
Extreme Temperature	• Initiate a routine vehicle and equipment maintenance schedule to insure city-owned property is capable of withstanding extreme temperature changes. • Provide public information materials to citizens including helpful safety tips, public assistance availability from governmental agencies and other services that may be available to handle extreme temperature situations.	Medium	Mayor

Tom Bean			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Windstorm	• Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during windstorms. Report any identified potential problem areas to local power company for mitigation. • Sponsor a citizen education program to inform public of the benefits of inspecting their property for overhanging tress limbs on aerial power lines and reporting potential problems to power company to avoid loss of power due to broken limbs pulling down power lines during windstorms.	Medium	Mayor
Lightning	• Retrofit wastewater facilities including plant and lift stations with alternative power source in the event of lightning strikes. (Includes generators and hard wiring of equipment to prepare for power outage.) • Retrofit water facilities including well sites, pump stations, SCADA system, and storage facilities with alternative power source in the event of lightning strikes (includes generators and hard wiring of equipment to prepare for power outage).	Medium	Mayor Public Works Director
Severe Winter Storm	• Retrofit water and wastewater facilities with alternative power sources in the event of a severe winter storm including power loss (includes generators and hard wiring of equipment to prepare for power outage). • Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during severe winter storms. Report any identified potential problem areas to local power company for mitigation.	Medium	Mayor
Tornado	• Review and update current alert and warning procedures. • Increase citizen advanced warning/notification capabilities. • Retrofit water and wastewater facilities with alternative power sources in the event of a tornado (includes generators and hard wiring of equipment to prepare for power outage).	High	Mayor

Tom Bean			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Expansive Soils	• Provide soil stabilization methods prior to construction or reconstruction of City roadways. • Control the design and construction of the foundation and foundation spaces for all buildings.	Medium	Mayor
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Tom Bean			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.		

5.17 SUMMARY OF VAN ALSTYNE MITIGATION ACTIONS

Van Alstyne			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Protect city-owned vehicles and other assets in the event of a hailstorm by relocating vehicles to roofed areas and constructing additional parking areas for police cruisers. • Encourage citizens to inspect and report tree limbs above their properties or over hanging close to power lines to avoid power outage during hailstorms.	Low Low	Mayor City Mayor
Drought	• Water conservation plan • Water storage • Safe drinking water	Low	City Manager
Flooding	• Van Alstyne continue to maintain necessary actions to participate in the NFIP and continue to make flood insurance available for residents • Maintain, evaluate, and monitor city codes to reflect new flood provisions requirements • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)	Medium Medium	Mayor/Council Mayor/Council
Wildfires	• Training Fire personnel as well as the public. • Implement burn bans. • Acquire proper equipment. • Continue the fireworks ban. • Continue the mutual aid taskforce with surrounding cities.	High	Fire Chief
Extreme Temperature	• Educate People through the use of news media and handouts • Local charities (donation/education through local charities). • Burn ban • Water conservation	Medium	City Mayor
Windstorm	• Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during windstorms. Report any identified potential problem areas to local power company for mitigation. • Sponsor a citizen education program to inform public of the benefits of inspecting their property for overhanging tress limbs on aerial power lines	Low	Mayor City Administrator and Electrical Superintendent

Van Alstyne			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	and reporting potential problems to power company to avoid loss of power due to broken limbs pulling down power lines during windstorms.		
Lightning	• Grounding of facilities • Educate citizens on safe places to be during lightning events • Back-up power sources.	Medium	Fire Chief
Severe Winter Storm	• Send for Radar • Tree trimming • Food & Water storage • Generators (back up) • List of elderly/handicapped • Articles in newspaper	Low	Public Safety
Tornado	• Training of City personnel and citizens. • Storm watches. • Early warning. • Back-up equipment. • Safe houses. • Shelters. • Emergency Management Plan. • Mutual Aid Agreement. • Command Center. • EDC	High	City Mayor
Expansive Soils	• Educate your public on watering your structures etc with equipment such as soaker hoses. Gutter homes. • Foundation education • Provide with stabilization prior construction or reconstruction	Low	Mayor
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place.	High/ Medium	EMC Fire Chief Police Chief City Manager

Van Alstyne			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.		City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

5.18 SUMMARY OF WHITESBORO MITIGATION ACTIONS

Whitesboro			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Preservation of equipment and safety of personnel through the use of construction of roofed areas during a hailstorm. • Require high quality metal roof systems on new City facilities and repairs when possible.	Medium	City Administrator and Head of each department City Administrator
Drought	• Prepare a drought and water conservation plan. • Incorporate drought tolerant or xeriscape practices into landscape ordinances to reduce dependence on irrigation •	High	City Administrator
Flooding	• Maintaining and clearing existing storm drainage infrastructure and waterways. • Improve drainage for storm water runoff on West South Street. • Extension of Fourth Street to improve traffic and drainage capabilities East of Union Street.	Low Medium	City Administrator
Wildfires	• Enforcement of existing ordinances and building codes minimizes the potential for wildfire hazards within' the City of Whitesboro. • Provide education programs to help reduce the risk of wildfires	Low	Code Enforcement, Building Inspector, Police Chief Police Chief
Extreme Temperature	• Vehicles and equipment are maintained or conditioned for anticipated extreme weather conditions. • Provide public information materials to citizens including helpful safety tips, public assistance availability from governmental agencies and other services that may be available to handle extreme temperature situations.	High Medium	Mechanic, Heads of departments City Administrator
Windstorm	• Proactive tree trimming and clearing program throughout the City of Whitesboro • Sponsor a citizen education program to	High	City Administrator and Electrical Superintendent

Whitesboro			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	inform public of the benefits of inspecting their property for overhanging tress limbs on aerial power lines and reporting potential problems to power company to avoid loss of power due to broken limbs pulling down power lines during windstorms.		
Lightning	• Provide alternate sources of electrical power to critical infrastructure (i.e. Wells, Lift Stations, and Public Safety Facilities). • Promote grounding of electrical power lines for critical facilities and infrastructure.	Medium	City Administrator
Severe Winter Storm	• Proactive tree trimming and clearing program throughout the City of Whitesboro. • Precipitation clearing and granular material applications to primary road surfaces. • Provide alternate sources of electrical power to critical infrastructure (i.e. Wells, Lift Stations, and Public Safety Facilities).	High High Medium	City Administrator and Electrical Superintendent City Administrator, Police Chief and Street Superintendent City Administrator
Tornado	• Expand warning and notification capabilities • Retrofit water and wastewater facilities with alternative power sources in the event of a tornado. • Construct a shelter.	Medium	City Administrator and Police and Fire Chiefs City Administrator
Expansive Soils	• Materials analysis and sound engineering practices to minimize potential movement in all construction. • Provide with stabilization methods prior construction or reconstruction	High	City Administrator City Engineer

Whitesboro			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit • Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Whitesboro			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.		

5.19 SUMMARY OF WHITEWRIGHT MITIGATION ACTIONS

Whitewright			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
Hailstorms	• Construct covered parking areas to protect City-owned vehicles and other assets. • Encourage citizens to inspect and report tree limbs above their properties or over hanging close to power lines to avoid power outage during hailstorms.	Medium	City Mayor and Public Works Director
Flooding	• Clearing and rechannelization existing creeks that flow from west to east. Areas impacted include subdivision privately owned properties along a line from Highway 160 to Highway 11 • Continue efforts to apply for the NFIPs Community Rating System Program. (NFIP) • Take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP. (NFIP)	High	City Mayor and Public Works Director
Wildfires	• Provide community with wide education programs to help reduce the risk to wildfires • Establish and maintain burn bans	Medium	City Mayor and Fire Chief
Extreme Temperature	• Ensure that City-owned property (such as EMS vehicles) is capable of withstanding extreme temperature. • Provide public information materials to citizens including helpful safety tips, public assistance availability from governmental agencies and other services that may be available to handle extreme temperature situations.	Medium	Public Works Director City Manager
Windstorm	• Overhanging trees on power lines. Report any identified potential problem areas to local power company for mitigation • Sponsor a citizen education program to inform public of the benefits of inspecting their property for overhanging tress limbs on aerial power lines and reporting potential problems to power company to avoid loss of power due to broken limbs pulling down power lines during windstorms.	Medium	City Mayor and Public Works Director
Lightning	• Provide wastewater facilities including plant	Medium	City Mayor

Whitewright			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	and lift stations with alternative power in the event of lightning strikes (generators) • Promote grounding of electrical power lines for critical facilities and infrastructure.		and Public Works Director
Severe Winter Storm	• Provide water and wastewater facility alternative power (generators). • Inspect overhanging tress limbs on all aerial power line routes to eliminate loss of power due to broken limbs pulling down power lines during severe winter storms. Report any identified potential problem areas to local power company for mitigation.	Medium	City Mayor and Public Works Director
Tornado	• Provide water and wastewater facilities with alternative power generators, hard wiring to prepare for power outage. • Review and update current alert and warning procedures and systems.	High	City Manager, Public Works Director, Fire and Police Chiefs
Expansive Soils	• Provide with lime stabilization for road construction • Control the design and construction of the foundation and foundation spaces for all buildings	Medium	City Mayor and Public Works Director City Manager, Building Inspection
Terrorism	• Encourage residents to participate in Grayson County CERT training program. • Obtain funding for improved communications and equipment to support CERT activities. • Recruit new trainees. • Encourage local employers and housing developments to work with Grayson County CERT. • Educate and empower residents through the Homeland Security Ready Campaign. • Inform public on how to Shelter in Place. • Inform local PSA's about what to have in Emergency Supply Kit	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

Whitewright			
Hazard	**Mitigation Actions**	**Priority**	**Responsible Party**
	• Coordinate with and support public health preparedness program of Grayson County Health Department to include work to mitigate the impact of pandemic and bioterrorism public health events.		
Hazardous Materials	• Apply for assistance to install auxiliary air, water and air, water and power sources for critical facilities, governmental centers, and emergency operation centers • Encourage participation of local business in the Grayson County LEPC. • Enhance and improve emergency notification system with predefined warning areas related to area of greatest hazard around industry with significant hazardous materials on site. • Apply for funding to increase warning systems. • Apply for assistance for public awareness campaigns to educate the people about hazardous materials and appropriate emergency protective actions. • Apply for funding to develop, implement and maintain enhanced emergency notification systems for mission critical emergency response teams and mobile data systems to support CBRNE response units. • Increase enforcement of hazardous material and other illegal dumping Activities. • Identify and publish hazardous materials disposal guides. • Apply for funding for countywide hazardous materials disposal event. • Apply for funding for development of hazardous materials transportation routes around areas of greatest population density in County.	High/ Medium	EMC Fire Chief Police Chief City Manager City Council

5.20 CONTINUED PARTICIPATION IN THE NFIP

In compliance with Requirement 201.6(c)(3)(ii), the jurisdictions discussed and addressed the jurisdiction's participation in the National Flood Insurance Program, and continued compliance with the National Flood Insurance Program requirements. The federal program enables homeowners, renters, and business owners in participating communities to purchase insurance as protection against flood losses. The program requires compliance with state and community floodplain management regulations that reduce future flood damages. Participant communities agree to adopt and enforce floodplain management ordinances that meet or exceed the Federal Emergency Management Agency's requirements to reduce the risk of flooding. Flood insurance is designed to provide an alternative to disaster assistance reducing the escalating costs of repairing damage to buildings and their contents caused by floods.

Due to stream and river basin topography and physiography, precipitation and weather patterns, and typical soil moisture conditions, flood events will remain of very frequent occurrence in Grayson County. The National Climatic Data Center reports 51 recorded flood events in Grayson County since 1993. According to historical data obtained from the National Climatic Data Center, Grayson County can expect $425,000 in total property losses each year as a result of flooding. Approximately $3,899,543 has been paid in repetitive loss property from the years 1981-2007. These claims occurred in Sherman, Gunter, and Howe, and unincorporated areas of Grayson County. Section 3 provides a more detailed profile on flood occurrences and repetitive losses in Grayson County. *Table 5.2* provides a general description of the participation on the National Flood Insurance Program per Jurisdiction.

Table 5.2 National Flood Insurance Program Participation per Jurisdiction

Jurisdiction	Participant in the National Flood Insurance Program	Description (Management Actions/Reasons for not participating)
Grayson County*	Y	• The County has adopted FEMA Floodplain Mapping and floodplain management regulations are reflected in the county subdivision regulations. • Grayson County residents are eligible for the National Flood Insurance Program. • Grayson County plans to inform residents better of mitigation activities that they can implement in their homes to reduce flood damages. The information would be provided by publications and booths at community events and would be made available to all jurisdictions that participate in the NFIP. • Grayson County plans to provide education of the public on the importance of Flood Insurance by working with local insurance agents to notify homeowners located within jurisdictions participating in the NFIP.
Bells	N	• The Town of Bells is not currently a participant in the NFIP. Participation will be pursued as part of the mitigation actions to make flood insurance available to residents.
Collinsville	Y	• The City has adopted FEMA Floodplain Mapping and floodplain management regulations are reflected in the building codes and subdivision development ordinances. • City residents are eligible for the National Flood Insurance Program. • Collinsville plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.
Denison	Y	• The City has adopted FEMA Floodplain Mapping and floodplain management regulations are reflected in the building codes and subdivision development ordinances. • Denison residents are eligible for the National Flood Insurance Program. • Denison plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.
Dorchester	N	• The Town of Dorchester is not currently a participant in the NFIP. Participation will be pursued as part of

Jurisdiction	Participant in the National Flood Insurance Program	Description (Management Actions/Reasons for not participating)
		the mitigation actions to make flood insurance available to residents. • Subdivision regulations address flood areas, national flood maps used for reference in studying plats. • Researching in the near future when City adopted FEMA flood maps. • Dorchester plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP after acceptance into the program.
Gunter	Y	• The City of Gunter has an ordinance in place to implement actions to minimize losses from flooding. The ordinance is in compliance with the NFIP program and city residents are eligible for flood insurance. • Gunter plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.
Howe	Y	• The City of Howe has an ordinance in place to implement actions to minimize losses from flooding. The ordinance is in compliance with the NFIP program and city residents are eligible for flood insurance. • Howe plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.
Knollwood	N	• Based on experience on flooding issues, it has not been considered needed.
Pottsboro	Y	• The city requested a compliance review of existing ordinances (article 3.11) by FEMA. • The ordinances were found to be in compliance for the next couple of years. • Pottsboro plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.
Sadler	N	• Based on experience with flooding issues, participation in NFIP has not been necessary.
Sherman	Y	• The City has adopted FEMA Floodplain Mapping and floodplain management regulations are reflected in the building codes and subdivision development ordinances. • Sherman residents are eligible for the National Flood

Jurisdiction	Participant in the National Flood Insurance Program	Description (Management Actions/Reasons for not participating)
		Insurance Program. • The City has requested re-studies of areas known to be in error on the FEMA floodplain maps. • The City has requested FEMA Floodplain mapping for additional areas of the city to reflect the impact of the city's new flood control lakes. • The City plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.
Southmayd	Y	• In 2007, implementation of resolution has been set into place and approved by city members. • Southmayd plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.
Tioga	Y	• The City continues to use 100-year floodplain maps as well as study the area to ensure that any actions current or future are done to minimize flood related damage. • Consideration is being given to requesting a community assistance visit to ensure that any planning actions are appropriate. • Tioga plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.
Tom Bean	N	• The City of Tom Bean is not currently a participant in the NFIP. Participation will be pursued as part of the mitigation actions to make flood insurance available to residents.
Van Alstyne	Y	• The City of Van Alstyne has an ordinance in place to implement actions to minimize losses from flooding. The ordinance is in compliance with the NFIP program and city residents are eligible for flood insurance. • Van Alstyne plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.
Whitesboro	N	• The City of Whitesboro is not prone to flooding. Flood zones within' the City Limits are minimal and located at the bottoms of intermittent creeks. The storm water issues the City of Whitesboro deals with

Jurisdiction	Participant in the National Flood Insurance Program	Description (Management Actions/Reasons for not participating)
		are related to runoff water and not rising water.
Whitewright	Y	• The City Council adopted Ordinance #459 Flood Damage Prevention to comply with Texas Water Code, Section 16.315 to help minimize flood losses. • To review and update ordinance with State Law and review areas in the City of Whitewright that have a potential hazard. • Requesting assistance from TWDP-NFIP Field Service Office and/or applying for NFIPs Community Rating System Program. • Whitewright plans to take advantage of County-provided educational material on the NFIP and actively promote city residents to participate in the NFIP.

*unincorporated areas of Grayson County

6 PLAN MAINTENANCE PROCESS

In Compliance with requirement *§ 201.6(c)(4)(i),* Grayson County has developed a plan maintenance process which is described in the following paragraphs. Grayson County, along with participating jurisdictions, is responsible for monitoring implementation of the plan, executing a yearly evaluation of its effectiveness, and updating the plan within a 5-year cycle.

Following formal adoption by Grayson County Commissioners Court, and formal adoption of the plan by City Council by each participating jurisdiction, the actions outlined in the Grayson County Hazard Mitigation Plan would be implemented by the County and participating jurisdictions as described throughout this document.

6.1 MONITORING, EVALUATING AND UPDATING THE PLAN

The Grayson County Emergency Management Coordinator, working in conjunction with the respective jurisdictions, will be responsible for ensuring the Mitigation Plan is monitored, evaluated, and reviewed on an annual basis. This will be accomplished by calling an annual meeting of the Planning Committee, whose members will provide assistance and expertise for plan review, evaluating, updating, and monitoring. This meeting will be open to the public and public notices will encourage community participation. During this annual meeting, Grayson County will provide information on the implementation status of each action included in the plan. As part of the annual monitoring, review and evaluation process, Grayson County will provide reports regarding implementation actions and action completion dates for the plan. Also, as part of the evaluation, the Planning Committee will assess whether goals and objectives address current and expected conditions, whether the nature and/or magnitude of the risks have changed, if current resources are appropriate for implementing the plan, whether outcomes have occurred as expected, and if agencies and other partners participated as originally proposed.

At least once every five (5) years, or more frequently, if such a need is determined by the participating jurisdiction, the multi-jurisdictional plan will undergo a major update. During this process, all sections of the plan will be updated with current information and analyses and new and/or modified mitigation action plans will be developed. The revised plan will be submitted for state and federal review and approval and presented to the Grayson County Commissioner's Court and the respective incorporated cities included in the Grayson County Plan City Council for approval. Likewise, each participating jurisdiction will undergo the same process for reviewing, revising and updating their respective plans and submitting same for state, federal and jurisdiction's respective local governing body approval. The plan will be updated every five years in accordance.

6.2 INCORPORATION INTO EXISTING PLANNING MECHANISMS

Based on the requirements set forth in § *201.6(c)(4(ii)*, the State of Texas Mitigation Plan, the vulnerability and capabilities assessment for each jurisdictions were carefully reviewed and considered when developing the mitigation actions for this plan. The Hazard Mitigation team will establish a process in which the mitigation strategy, goals, objectives and actions outlined in this plan be incorporated into the existing regional and local planning strategies.

Local and regional planning committees currently use comprehensive land use planning, capital improvements planning, and building code ordinances to guide development. The mitigation strategy, goals, objectives and actions outlined in this plan will be integrated in to these existing mechanisms as applicable. Those mechanisms include the following:

- Floodplain ordinances
- Capital improvement plans
- Building codes and subdivision development (requirements for soils stabilization, siren requirements, drainage requirements, warning siren systems, etc.)
- Enact and/or enforce burn bans Grayson County has put into affect
- Water restriction plans
- Watershed plans
- FEMA floodplain mapping

Once the plan is adopted the Hazard Mitigation team will coordinate implementation with the engineering and planning and emergency management departments for the county, participating jurisdictions, river authorities, and drainage districts.

6.3 CONTINUED PUBLIC INVOLVEMENT

As stated in requirement § *201.6(c)(4)(iii)* The plan maintenance process shall include a discussion on how the community will continue public participation in the plan maintenance process.

To address this requirement, ongoing public participation will be encouraged throughout the entire planning and implementation process. A copy of the plan will be provided on the Grayson County website, and all public notifications and educational material developed for this program will include the website address and will encourage the public to use the website to obtain additional updated information. Additionally, the local news media will be encouraged to provide the website address in news coverage for any ongoing hazard event as a source of additional information.

The planning committee will continue meeting on a weekly basis to ensure the successful implementation of the plan and to discuss any additional issues regarding the emergency management of Grayson County. The annual meetings for monitoring, evaluating, and updating the plan will be open to the public and public notices will encourage community participation.

Copies of the Grayson County Hazard mitigation plan will be posted at the following location:

Sarah Somers
Emergency Management Coordinator
Grayson County, 100 W. Houston, Sherman, TX 75090
Phone: 903.813.4217
Fax: 903.893.5207
Somerss@co.grayson.tx.us