

Bosque County Hazard Mitigation Plan



Department of Emergency Management
102 North Main - Upstairs
Meridian, Texas 76665
Office: 254-435-2807

EXECUTIVE SUMMARY

Purpose and Process of Development

This mitigation plan is a five-year blueprint for the future, aimed at making communities in Bosque County disaster resistant by reducing or eliminating the long-term risk from a full range of disasters. It meets the requirements of the Disaster Mitigation Act of 2000 (P.L. 106-390); Section 44 of the Code of Federal Regulations, Part 201.6 & Part 206; and the Texas Division of Emergency Management standards. An open public process was established to provide multiple opportunities for all sectors in Bosque County to become involved in the planning process and make input during its drafting stage.

Hazards Facing Bosque County

Mitigation is defined as the effort to reduce the loss of life and property by lessening the impact of disasters. This Bosque County Hazard Mitigation Plan (“hereafter referred to as the Plan”) is aimed at reducing or eliminating the long-term risk of loss of life and property damage from a full range of disasters.

The Plan identifies and assesses the potential impact of eight natural hazards that threaten Bosque County and the participating cities of Clifton, Cranfills Gap, Iredell, Meridian, Morgan, Valley Mills and Walnut Springs.

The hazards include floods, thunderstorms, winter storms, hail, tornadoes, drought, wild fires, and dam failure.

Hazards were identified based on a review of historical records, national data sources, existing plans and reports, and discussions with local, regional, and national experts. Each hazard was profiled based on its severity of impact, frequency of occurrence, seasonal patterns, warning time, cascading potential and existing warning systems.

An inventory of populations, buildings, critical and special facilities, and commercial facilities at potential risk was conducted. The probability of occurrence and potential dollar losses from each hazard were estimated using the Federal Emergency Management Agency’s Hazards U.S. Multi-Hazards Model (HAZUS-MH). The hazards were then ranked based on potential damages in terms of lives lost, dollars lost, and other relevant community factors.

Mitigation Goals

Mitigation goals are general guidelines that articulate a desired end state. The goals of this Plan are to:

- Protect the lives and property of residents within Bosque County;
- Seek funding in order to implement developed mitigation actions; and
- Be “disaster ready” by implementing those mitigation actions when possible.

The Plan is intended to serve as a basis for future funding that may become available from State or Federal grants and technical assistance programs. It will enable the County to take advantage of rapidly developing mitigation grant opportunities as they arise.

Mitigation Actions

Mitigation Actions are the proposed projects or ideas that a jurisdiction may implement in order to lessen or eliminate the impact or severity of disasters on that jurisdiction.

Multiple mitigation actions are presented for each participating jurisdiction to reduce the loss of life and property within their community.

Each action is presented in the Plan along with a description of the action, costs, benefits, responsible organization for overseeing implementation, estimated completion date, potential funding sources, and related objective(s). The mitigation actions are based upon their effect on the overall risk to life and property, ease of implementation, political and community support, and funding.

The County and participating jurisdictions will seek to obtain the necessary funding to implement the mitigation actions set forth when possible. However, in this era of increased demands and constrained resources at all levels of government, the lack of resources, especially from external sources, may hamper the ability of the jurisdictions to implement some mitigation actions identified in the Plan or to implement them within the timeframe specified.

Plan Maintenance

This section discusses how the Plan will be implemented, evaluated and improved over time by the participating jurisdictions and how the public will continue to be involved in the hazard mitigation planning process throughout the next five years.

TABLE OF CONTENTS

Executive Summary	v
Section 1: The Planning Process	8
Preparation of the Plan.....	8
Public Involvement	9
Partners In Planning.....	11
Section 2: Bosque County at a Glance	
Geography	14
People of the Region.....	15
Section 3: Hazards Bosque County Faces.....	19
Risk Assessment Methodologies	19
Disaster Declarations.....	19
Historical Disaster Declarations	19
Hazard Ranking	20
Unique Hazards Faced by Individual Jurisdictions	21
Conclusions.....	21
Section 4: Flooding	24
Why Floods Are a Threat	24
Hazard Profile	25
History of Flooding	25
Location of Flood Hazard Areas	26
NFIP Program Participation.....	27
People and Property at Risk.....	29
Potential Damages and Losses.....	30
Section 5: Drought	37
Why Droughts Are a Threat.....	37
Hazard Profile	38
History of Thunderstorms	39
People and Property at Risk.....	45
Potential Damages and Losses.....	46
Section 6: Wildfire	47
Why Wildfires are a Threat.....	47
Hazard Profile	47
People and Property at Risk.....	48

Potential Damages and Losses.....	57
Section 7: Tornadoes.....	58
Why Tornadoes are a Threat	58
Hazard Profile	58
History of Hailstorms	58
Location of Hazardous Areas	59
People and Property at Risk.....	60
Potential Damages and Losses.....	62
Section 8: Thunderstorms	63
Why Thunderstorms are a Threat	64
Hazard Profile	66
History of Thunderstorms	67
Location of Hazardous Areas	68
People and Property at Risk.....	69
Potential Damages and Losses.....	70
Section 9: Winter Storm	71
Why Winter Storms are a Threat.....	71
Hazard Profile	72
History of Drought	72
People and Property at Risk.....	73
Potential Damages and Losses.....	73
Section 10: Hail.....	74
Why Hail is a Threat.....	74
Hazard Profile	75
History of Hail.....	76
Location of Hazardous Areas.....	77
People and Property at Risk.....	78
Potential Damages and Losses.....	81
Section 11: Dam Failures.....	82
Why Dam Failures Are a Threat.....	82
Hazard Profile	83
History of Dam Failures.....	84
Location of Hazardous Areas	85
People and Property at Risk.....	87
Section 12: Mitigation Vision, Goals and Objectives	88
Introduction	88
Mitigation Goals and Objectives.....	89

Section 13: Mitigation Actions By Jurisdiction	91
Section 14: Plan Maintenance.....	131
Appendix A: Local Hazard Mitigation Team Members	
Appendix B: Critical Facilities	
Appendix C: Resolutions approving the Plan	

Section One: The Planning Process

Preparation of the Plan

The Bosque County Hazard Mitigation Plan covers Bosque County and seven cities that participated throughout the planning process. The Plan identifies and assesses the potential impact of eight natural hazards that threaten human life and property.

The Plan was developed in accordance with the provisions of the Disaster Mitigation Act of 2000 (Public Law 106-390), the Pre-Disaster Mitigation Grant Program, 44 Code of Federal Regulations Part 201.6 and 206, and the planning standards adopted by the Texas Division of Emergency Management.

This mitigation plan was created by the Bosque County Office of Emergency Management, along with their contractor, Larner Consulting. The plan was funded by the Federal Emergency Management Agency (FEMA) under a mitigation planning grant awarded to Bosque County on October 4, 2010.

Ultimately, this Plan is designed to help build a sustainable community that, when confronted by natural or technological disasters, will sustain fewer losses and will be able to recover more quickly. It is also intended to:

- minimize disruption to the region following a disaster;
- streamline the disaster recovery process by having in place pre-identified actions that can be taken to reduce or eliminate future damage;
- provide the basis for the Small Business Administration to make low interest, fixed rate loans to small businesses for the purpose of implementing mitigation measures to protect their commercial real property (buildings) or leasehold improvements or contents from disaster related damage;
- capitalize on Federal funding that may become available after the disaster strikes; and
- ensure that the region maintains its eligibility to the full range of future Federal disaster relief. After November 1, 2004, eligibility to certain forms of Federal mitigation funding to cities and counties is dependent upon having a FEMA-approved Hazard Mitigation Plan in place.

The Plan is intended to serve as a basis for future funding that may become available from State or Federal grants and technical assistance programs. It will enable the County to take advantage of rapidly developing mitigation grant opportunities as they arise.

Potential funding sources for implementation are identified for each proposed action. These include general revenues, bonds, grants and federal grants. The County and participating jurisdictions will seek to obtain the necessary funding to implement the mitigation actions set forth when possible.

Jurisdictional Participation

The jurisdictions within Bosque County participating in this Plan include Bosque County and the cities of Clifton, Cranfills Gap, Iredell, Meridian, Morgan, Valley Mills and Walnut Springs. The jurisdictions all participated equally during the update process. Each jurisdiction contributed during the update process by:

- Forming a new local Hazard Mitigation Team (HMT) with representatives from their jurisdiction.
- Attended kick-off meetings, mitigation workshops and public meetings.
- Reviewed and analyzed each section of the plan, as necessary.
- Provided a detailed risk assessment for their jurisdiction.
- Discussed the status of action items and provided new mitigation actions.
- Devised a way to keep the plan maintained from 2015-2020.

Jurisdictional representatives formed a new local Hazard Mitigation Team (HMT) and attended a Kick-Off Meeting on June 27, 2011 in Meridian, Texas. The stakeholders invited included the Bosque County Judge Cole Word, the Emergency Management Coordinator (EMC) from Bosque County Dewey Ratliff, the EMC from the neighboring jurisdiction of McLennan County Frank Patterson, and the mayors and EMC's from the participating jurisdictions. The Independent School Districts of Clifton, Cranfills Gap, Iredell, Meridian, Morgan, Valley Mills and Walnut Springs were also invited to be participants. Local businesses were also invited to participate in the mitigation planning process. All stakeholders were notified of the opportunity to participate with a public posting on the Bosque County Courthouse Building and on the county website.

The purpose of the workshop was to explain the process for creating the Plan, the respective roles and responsibilities of each participating jurisdiction, and to seek localized information for the plan. In addition, the representatives at the workshop discussed the goals and objectives for the plan, provided input to and review of the risk assessment, and reviewed the previous mitigation actions and discussed new ones. Members of the HMT also identified any unique hazards for their jurisdiction that varied from those hazards affecting Bosque County as a whole.

The Bosque County Office of Emergency Management (OEM) had a central role throughout the planning process. They laid the groundwork for updating the Plan, coordinated the Plan's development, implementation and maintenance, examined risks in the County and helped create and update mitigation actions. The individual jurisdictions assisted in identifying hazards, assessing risks, and developing mitigation actions. Appendix A identifies Hazard Mitigation Team members in greater detail.

Assessing Risks

Eight hazards that have affected and may again affect Bosque County and participating jurisdictions were examined by the HMT based on a review of historical records, national data sources, existing plans and reports, and discussions with local, regional, state, federal, and national experts.

Hazard profiles were prepared and updated to show their severity of impact, frequency of occurrence, seasonal patterns, warning time, cascading potential, and applicable warning systems.

The characteristics and potential consequences of each hazard were assessed to determine how much of the area could be affected and the potential effects on local assets.

An inventory was taken of populations, buildings, infrastructure and facilities classified as "critical" or "special", or housing hazardous materials. Appendix B contains a full list of critical facilities for the participating jurisdictions.

Potential dollar losses from each hazard were estimated using the Federal Emergency Management Agency's Hazards U.S. Multi-Hazards Model (HAZUS-MH). The techniques were applied to examine the impact of various hazards on the built environment, including on the general building stock (e.g., residential, commercial, industrial), critical facilities, lifelines, and infrastructure.

Two distinct assessment methodologies were used. The HAZUS-MH risk-assessment methodology modeled distinct hazard and inventory parameters

(e.g., wind speed and building types) to determine potential damages and losses in the built environment. The second methodology used a statistical approach to model risk by analyzing a hazard's frequency of occurrence and estimated effects based on recorded damage data. Both methodologies use a common, systematic framework developed to provide a factual basis for determining what actions will mitigate risks. The assessments also were used to set priorities for mitigation based on potential dollar losses, loss of lives, and other factors. The hazards in Sections 4 through 11 of this Plan appear generally in priority order, based on risk to the County as a whole, with the greatest hazards appearing first.

Developing Mitigation Actions

Following the workshop, members of the Hazard Mitigation Team created their action plans to implement the mitigation actions set forth. A structured process was used to develop, prioritize and update the mitigation actions for this Plan. It included the following steps:

- Hazard mitigation team members considered the benefits that would result from the mitigation actions versus the cost of those projects. For those actions in which the benefits could be quantified, an economic evaluation was one factor that helped team member's select one mitigation action from among many competing ones. Cost-effectiveness of actions was considered as each team member developed their final list of mitigation actions. Economic considerations were part of the community's analysis of the comprehensive range of specific mitigation actions and projects being considered.
- Hazard mitigation team members then selected mitigation actions and prioritized them. The prioritization method was based on the following criteria: 1) benefits in terms of effect on overall risk to life and property, including the effects on both new and existing buildings and infrastructure; 2) ease of implementation; 3) political and community support; and 4) cost and funding availability. The overall priority is reflected in each action in Section 15.
- In formulating mitigation actions, team members examined potential mitigation actions that address existing and new buildings and infrastructure. Each team member considered mitigation actions addressing new buildings and infrastructure although not all mitigation actions considered were ultimately included in their plans due to limited capabilities, prohibitive costs, low benefit/cost ratio or other concerns.

- Team members developed action plans identifying proposed actions, estimated costs and benefits, the responsible organization(s), implementation schedule, related objective(s) to which the actions relate, priority, and potential funding sources.

Public Participation

An open public process was established to give all areas of Bosque County an opportunity to become involved in the planning process.

A public meeting was held June 27, 2011 in Meridian to give the public an opportunity to learn about the hazards they face and ways to protect themselves and their families. The public was invited to the meeting by a posting at the County Courthouse Building, where all public notices are published. The public meeting also provided an opportunity for the public to make input to the planning process during the drafting stage; however, there was no public input provided as no one from the public spoke up.

A second public meeting will be held after the plan has been reviewed by the Federal Emergency Management Agency. The public will be invited to that meeting by a posting at the County Courthouse Building. In addition, a copy of the draft mitigation plan will be made available on the county website for the public to review and provide comments that may be included in the mitigation plan. Notice of the availability of the draft plan on the county website will be posted at the County Courthouse Building and on the county website itself.

The public will also be consulted again prior to plan adoption by each Governing Body. The public will be notified through a posting at the Bosque County Courthouse and on the county website that each Governing Body is considering the plan and will be given the location where the public can inspect the plan and submit comments. During each Governing Body meeting, a formal opportunity to comment on the plan will be provided in advance of Governing Body action passing resolutions adopting the plan.

The Bosque County Office of Emergency Management (OEM) had a central role throughout the planning process. They laid the groundwork for updating the Plan, coordinated the Plan development, implementation and maintenance, and examined risks in the Region to help create mitigation actions. The individual jurisdictions assisted in identifying hazards, assessing risks, and developing mitigation actions. Appendix A identifies Hazard Mitigation Team members in greater detail.

Partnerships in Planning

In developing the Plan, the County OEM was assisted by federal and state agencies, including the Federal Emergency Management Agency of the Department of Homeland Security, the Texas Division of Emergency Management, the Texas Water Development Board, and the Texas Forest Service.

A variety of existing studies, plans, reports and technical information were reviewed as part of the planning process. Sources of the information included for each jurisdiction include:

Bosque County: Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs), Bosque County Emergency Operations Plan (EOP), National Oceanic and Atmospheric Administration Weather Data, Texas Water Development Board Repetitive Loss and Severe Repetitive Loss list, the Texas Commission on Environmental Quality Dam Safety Program, the Texas Division of Emergency Management State of Texas Mitigation Plan and the Texas Forest Service wildfire maps.

Clifton: Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs), National Oceanic and Atmospheric Administration Weather Data, Texas Water Development Board Repetitive Loss and Severe Repetitive Loss list, the Texas Commission on Environmental Quality Dam Safety Program, the Texas Division of Emergency Management State of Texas Mitigation Plan and the Texas Forest Service wildfire maps.

Cranfills Gap: Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs), National Oceanic and Atmospheric Administration Weather Data, Texas Water Development Board Repetitive Loss and Severe Repetitive Loss list, the Texas Commission on Environmental Quality Dam Safety Program, the Texas Division of Emergency Management State of Texas Mitigation Plan and the Texas Forest Service wildfire maps.

Iredell: Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs), National Oceanic and Atmospheric Administration Weather Data, Texas Water Development Board Repetitive Loss and Severe Repetitive Loss list, the Texas Commission on Environmental Quality Dam Safety Program, the Texas Division of Emergency Management State of Texas Mitigation Plan and the Texas Forest Service wildfire maps.

Meridian: Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs), National Oceanic and Atmospheric Administration Weather Data, Texas Water Development Board Repetitive Loss and Severe Repetitive Loss list, the Texas Commission on Environmental Quality Dam Safety Program, the Texas Division of Emergency Management State of Texas Mitigation Plan and the Texas Forest Service wildfire maps.

Morgan: Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs), National Oceanic and Atmospheric Administration Weather Data, Texas Water Development Board Repetitive Loss and Severe Repetitive Loss list, the Texas Commission on Environmental Quality Dam Safety Program, the Texas Division of Emergency Management State of Texas Mitigation Plan and the Texas Forest Service wildfire maps.

Valley Mills: Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs), National Oceanic and Atmospheric Administration Weather Data, Texas Water Development Board Repetitive Loss and Severe Repetitive Loss list, the Texas Commission on Environmental Quality Dam Safety Program, the Texas Division of Emergency Management State of Texas Mitigation Plan and the Texas Forest Service wildfire maps.

Walnut Springs: Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs), National Oceanic and Atmospheric Administration Weather Data, Texas Water Development Board Repetitive Loss and Severe Repetitive Loss list, the Texas Commission on Environmental Quality Dam Safety Program, the Texas Division of Emergency Management State of Texas Mitigation Plan and the Texas Forest Service wildfire maps.

This information was reviewed during the drafting of the risk assessment and the NFIP maps were incorporated into the Flood section of the risk assessment, while the NOAA weather data was incorporated for previous even histories.

Section Two: Bosque County at a Glance

Geography

Bosque County lies approximately 60 miles south of Dallas/Fort Worth and 40 miles north of Waco. The Brazos River forms the eastern border of the County. In 1951, Lake Whitney was constructed on the Brazos River at the southeastern edge of the County; today it is used for recreation, flood control, and power generation. Throughout the County, with a population of approximately 18, 212, the supply of water is adequate for domestic use, livestock, and irrigation.

It is an agrarian area covering 989 square miles. For many in the County, the soil is considered the most important natural resource since the life of the livestock and the flora and fauna depend heavily upon it. Along the North Bosque River in the southernmost corner of the County, where impermeable bedrock is most widely found, serious floods occur. Since a large part of the survival of the area depends on the soil, government agencies attempt to manage and guard against flooding, erosion, and exhaustion of the soil, which promotes the growth of a variety of trees, from elm to ash to pecan.

Agriculture and manufacturing increased in the County following the Civil War, along with the population. By 1920, however, the County did not sustain this surge of growth. A succession of dry years in the late 1940s and 1950s forced many farmers to abandon their farms. This was on the heels of a local depression from 1910-1920, caused to a great degree by a succession of spring floods, summer droughts, unseasonable weather, and exhausted soil. Fortunately, manufacturing and employment increased after 1970, due to industrial growth in lumber, stone products, limestone, and most significantly, apparel and textiles.

High and low spikes in temperature are not uncommon in the area, accounting for drought periods in the summer with highs above 100 degrees F, and severe winter storms that drop temperatures well below freezing. Rainfall is uniformly distributed throughout the County with an average of 33 inches per year.

Bosque County, located primarily in northern Central Texas, has a total area of over 1,002 square miles, of which 989 square miles is land and 13 square miles is water. The City of Meridian is the county seat and is the second largest jurisdiction within the county. The City of Clifton is the largest jurisdiction within

the county with a population of over 3,800. The County is named after the Bosque River, which runs through the center of the county. The Brazos River makes up the eastern border along with Lake Whitney. The physical features of Bosque County include some Blackland prairie and loam with sandy soils and with rolling hills in the west. Watersheds drain into the Bosque and Brazos Rivers and into Lake Whitney, which is situated on the Brazos River. Figure 2-1 shows the location of Bosque County (shown in red) within Texas. Figure 2-2 (on the following page) provides a map of Bosque County.

Figure 2-1: Location of Bosque County



Figure 2-2: Bosque County



Population

The population of Bosque County in 2013 is approximately 18,212 people. The largest city in Bosque County is Clifton with a population of over 3,800 people.

Land Use

Bosque County has over 2,000 farms comprising over 490,000 acres. The primary crops are corn, wheat, hay, grain, sorghum and soybeans. Livestock plays an important role in the Bosque County economy, with poultry, beef cattle and dairy cattle leading the way.

The major minerals in the county include sand, gravel, oil and gas.

Communities Designated for Special Consideration

The state of Texas requires that hazard mitigation plans identify any Small and Impoverished Communities in the planning area. These communities may receive special consideration in some federal and state grant programs.

According to the established criteria, Small and Impoverished Communities:

- have a population less than 3,000 and are not a remote area within the corporate boundaries of a larger city; and
- are economically disadvantaged, with residents having an average per capita annual income not exceeding 80 percent of the national per capita income and a local unemployment rate that exceeds by one percentage point or more the most recently reported national unemployment rate.

At this time, there are no small and impoverished communities within Bosque County.

Section Three: Hazards Bosque County Faces

A risk assessment evaluated the probability of occurrence of a hazard event and the potential associated losses in Bosque County. The resulting loss estimates are a starting point from which to evaluate mitigation measures if a real hazard event occurs. The loss estimates also are intended to support mitigation decision-making. It is important to note, however, that loss estimates calculated during the risk assessment used available data and methodologies and are approximate. The estimates should be used to understand relative risks from hazards and potential losses and are not intended to predict precise results. Uncertainties are inherent in any loss-estimation methodology and arise, in part, from incomplete scientific knowledge about natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications (such as incomplete or outdated inventory, demographic, or economic parameter data) that are necessarily used during a comprehensive analysis. These data can result in a range of uncertainty in loss estimates, perhaps at a factor of two or more. In addition, a variety of previous studies and reports were reviewed for additional risk data.

Two distinct hazard risk-assessment methodologies were applied during the risk assessment: the Federal Emergency Management Agency's Hazards U.S. Multi-Hazards Model (HAZUS-MH), which is loss-estimation software, and a statistical risk-assessment methodology. Each provided estimates of potential effects.

Hazards of Concern in Bosque County

Based on input such as historical data, public perception, and technical requirements, the following hazards (listed alphabetically) were considered for analysis:

- Dam Failure
- Drought
- Floods
- Hail
- Thunderstorms
- Tornadoes
- Wildfires

- Winter Storms

Historical Disaster Declarations

Presidential disaster declarations and Small Business Administration declarations for Bosque County are identified in Table 3-1.

Table 3-1: Disaster Declarations in Bosque County

County	Year	Disaster Number	Primary Incident Type	Presidential Declaration	SBA Declaration
Bosque County	1978	1480	Flood	No	Yes
Bosque County	1989	828 DR	Flood	Yes	Yes
Bosque County	1990	863 DR	Flood	Yes	Yes
Bosque County	1991	930 DR	Flood	Yes	Yes

Table 3-2 ranks hazard risks for Bosque County at a ten-year return period.

Table 3-2: Hazard Risk Ranking in Bosque County, Ten Year Return Period

1	Flood	5	Thunderstorm
2	Drought	6	Winter Storm
3	Wildfire	7	Hail
4	Tornado	8	Dam Failure

Unique Hazards

This plan is a multi-jurisdictional mitigation plan developed to address common risks faced by all the participating jurisdictions in Bosque County. However, members of the Hazard Mitigation Team also conducted an assessment of risks and identified any unique hazards for their jurisdiction that varied from those hazards affecting Bosque County as a whole. Table 3-3 provides an overall summary of the participating jurisdictions vulnerability to each hazard. The table also reflects any unique hazards for each jurisdiction's risks where they vary from the risks facing the entire planning area.

For all participating jurisdictions, each hazard was given a rating of 'substantial', 'major', 'minor' or 'limited' based on a description of that particular jurisdiction's vulnerability to the hazard. Table 3-3 provides an overall summary of the participating jurisdictions vulnerability to each hazard. These ratings were developed based on the best acceptable data. Definitions of the classifications are as follows:

- **“Substantial”** severity of impact may result in multiple deaths, complete shutdown of facilities for 30 or more days, or more than 50% of property destroyed or with major damage.
- **“Major”** severity of impact may result in injuries or illnesses that result in permanent disability, complete shutdown of critical facilities for at least 2 weeks, or more than 25% of property destroyed or with major damage.
- **“Minor”** severity of impact may result in injuries or illnesses that do not result in permanent disability, a complete shutdown of critical facilities for more than 1 week, or more than 10% of property destroyed or with major damage.
- **“Limited”** severity of impact may result in injuries or illnesses that are treatable with first aid, minor quality of life lost, shutdown of critical facilities and services for 24 hours or less, or less than 10% of property destroyed or with major damage.

The ratings have been abbreviated in order to fit into Table 3-3. The ratings have been shortened to:

- S = Substantial
- Maj = Major
- Min = Minor
- L = Limited

Table 3-3: Overall Summary Descriptions of Jurisdictions' Vulnerability to Hazards in Bosque County

Jurisdiction	Dam Failure	Drought	Flooding	Hail	Thunderstorm	Tornado	Wildfire	Winter Storm
Bosque County	L	Min	Maj	L	Min	Maj	Maj	L
Clifton	L	Min	Maj	Min	Min	Min	Min	L
Cranfills Gap	L	Min	Min	L	L	L	L	L
Iredell	L	Min	Min	L	L	L	L	L
Meridian	L	Min	Maj	Min	Min	Min	Min	L
Morgan	L	Min	Min	L	L	L	L	L
Valley Mills	L	Min	Maj	Min	Min	Min	Min	L
Walnut Springs	L	Min	Min	L	L	Min	L	L

Historical Frequency

Sections 4 through 11 of this plan contain reviews of the historical frequency of occurrence and/or loss and damage estimates, by hazard, in Bosque County and participating jurisdictions.

Information on the expected frequency of occurrence in these sections and will be defined as follows:

- **Highly Likely** means that the event is possible in the next 3 years.
- **Likely** means that the event is possible in the next 5 years.
- **Unlikely** means that the event is possible in the next 10 years.
- **Highly Unlikely** means that the event is possible in the next 20 years.

Conclusions

The hazard-event profiles relevant to Bosque County reveal historic hazard trends and provide a reference point for understanding the potential effects of future hazard events. A review of historic data helps to evaluate hazard-event profiles and answer questions. For example: How often may a particular disaster occur? Who is most likely to be affected? What area is most likely to be affected and how bad can it get?

Sections 4 through 11 of this Plan contain reviews, by hazard, of the historical frequency of occurrence and/or loss and damage estimates in Bosque County. Each section discusses why the hazard is a threat, profiles the hazard, identifies areas at risk to hazards that have distinct geographic boundaries, identifies the people and property at risk, and summarizes the history of hazard events and potential damages and losses.

SECTION 4: FLOOD

Why Floods Are a Threat

Texas consistently outranks other states in deaths and damages from floods, due to its size and location, according to *American Hazardscapes: The Regionalization of Hazards and Disasters*, published by the National Academy Press.

The State's vulnerability is the result of several factors: its miles of Gulf of Mexico coastline; its proximity to the Pacific Ocean off the west coast of Mexico; its geographical location near the Rocky Mountains of Colorado and Arizona and the high-altitude jet stream; and its nearness to the unique West Texas "dry line," a shifting, invisible atmospheric separation of dry desert air from the moist Gulf air. These factors create a breeding ground for the big storms of spring and fall that spawn tornadoes and suck up Gulf or Pacific moisture that feed the heavy rains that cause flash flooding. All these geographic factors cause Texas to experience extensive, annual storms. Flooding takes many forms in Bosque County. Below is more information related to flooding.

Flash Flooding

Most flash flooding is caused by slow-moving thunderstorms, by thunderstorms repeatedly moving over the same area, or by heavy rains from hurricanes and tropical storms. Flash floods can occur within a few minutes or after hours of excessive rainfall. Often there is no warning that flash floods are coming.

Flash flooding can pose a deadly danger to residents of Bosque County. A number of roads run through low-lying areas that are prone to sudden and frequent flooding during heavy rains. Motorists often attempt to drive through barricaded or flooded roadways. It takes only 18-to-24-inches of water moving across a roadway to carry away most vehicles. Floating cars easily get swept downstream, making rescues difficult and dangerous.

Riverine Flooding

Riverine flooding is natural and inevitable. It is the over-bank flooding of rivers and streams, typically resulting from large-scale weather systems that generate prolonged rainfall over a wide geographic area. Some river floods occur seasonally when winter or spring rainfalls fill river basins with too much water, too quickly. Torrential rains from decaying hurricanes or tropical systems can also produce river flooding.

Urban Flooding

Urban flooding occurs as land is converted from fields or woodlands to roads, buildings and parking lots and when the natural land loses its ability to absorb

rainfall. Urbanization changes the natural hydrologic systems of a basin, increasing runoff two to six times over what would occur on natural terrain. During periods of urban flooding, streets can become swift moving rivers, while highway underpasses and underground parking garages can become death traps as they fill with water.

El Niño Phenomenon

Flooding can occur in cycles. The El Niño phenomenon – the cyclical disruption of the ocean-atmosphere system in the tropical Pacific Ocean – has important consequences around the globe and here in Texas. The presence of El Niño is indicated by unusually warm water in the eastern Pacific Ocean, altering wind and ocean currents. El Niño generally brings cooler winters and wetter than normal conditions to Texas. In 1997-1998, El Niño increased surface temperatures in the Eastern equatorial Pacific Ocean by 5-to-7-degrees Fahrenheit warmer than normal, thus contributing to the 1998 flooding.

Tropical Flooding

Hurricanes and tropical storms also bring floods. Between 1900 and 2010, thirty-seven hurricanes made landfall in Texas. Four were a Category 4 on the Saffir-Simpson scale, ten were Category 3, nine were Category 2 and twelve were Category 1.

Bosque County is not immune to the death and destruction that tropical systems can bring, however, it is not expected to be impacted by any major tropical flooding.

Hazard Profile for Bosque County

Major flooding and flash flooding events in Bosque County and the participating jurisdictions can have a minor severity of impact: it may result in injuries or illnesses that do not result in permanent disability, a complete shutdown of critical facilities for more than 1 week, or more than 10% of property destroyed or with major damage.

The frequency of occurrence of flooding is likely within all participating jurisdictions, with an event possible within the next five years.

The extent of flooding in Bosque County, including all participating jurisdictions, can be water depths from between one and six feet deep in structures located in the identified flood hazard area.

The annual probability of observing a 100-year flood is one-percent. The annual probability of observing a 500-year flood event is 0.2 percent.

Flooding occurs in seasonal patterns. Thunderstorms form when warm, moist air collides with cooler, drier air. Since these masses tend to come together during the transition from summer to winter, most thunderstorms and resulting flooding

occur during the spring (April, May and June) and fall (October, November, and December).

History of Flooding

Flood events in Bosque County reported to the National Weather Service at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms> are listed in Table 4-1.

Table 4-1: Flood Events in Bosque County, Texas

4 event(s) were reported between 01/01/2000 and 12/31/2012 (4749 days)

<u>Location</u>	<u>County/Zone</u>	<u>St.</u>	<u>Date</u>	<u>Time</u>	<u>T.Z.</u>	<u>Type</u>	<u>Mag</u>	<u>Dth</u>	<u>Inj</u>	<u>PrD</u>	<u>CrD</u>
Totals:								0	0	130.00K	0.00K
<u>COUNTYWIDE</u>	BOSQUE CO.	TX	09/17/2006	15:44	CST	Flood		0	0	0.00K	0.00K
<u>MERIDIAN</u>	BOSQUE CO.	TX	06/28/2007	21:30	CST-6	Flood		0	0	100.00K	0.00K
<u>CRANFILLS GAP</u>	BOSQUE CO.	TX	10/26/2009	08:00	CST-6	Flood		0	0	30.00K	0.00K
<u>BRAZOS PT</u>	BOSQUE CO.	TX	09/08/2010	12:15	CST-6	Flood		0	0	0.00K	0.00K
Totals:								0	0	130.00K	0.00K

Inj: injuries **Prop D:** property damage **Crop D:** crop damage

Location of Hazardous Areas

Flood-hazard areas are determined using statistical analyses of records of riverflow, storm tides, and rainfall; information obtained through consultation with communities; floodplain topographic surveys; and hydrological and hydraulic analyses. FEMA's Flood Insurance Rate Maps (FIRMs) identify areas subject to flood hazard. These include Special Flood Hazard Areas, which are defined as areas that will be inundated by a flood event having a one-percent chance of being equaled or exceeded in any given year. The one-percent-annual-chance flood is also referred to as the base flood or 100-year flood. Moderate flood-hazard areas are also shown on the FIRM, and are the areas between the limits of the base flood and the two-tenths of a percent-annual-chance (or 500-year) flood. Figures 4-1 through 4-8 depicts the flood zones where there is potential for damage to property and loss of life in Bosque County and surrounding areas.

Figure 4-1: Riverine Flooding Potential, Bosque County

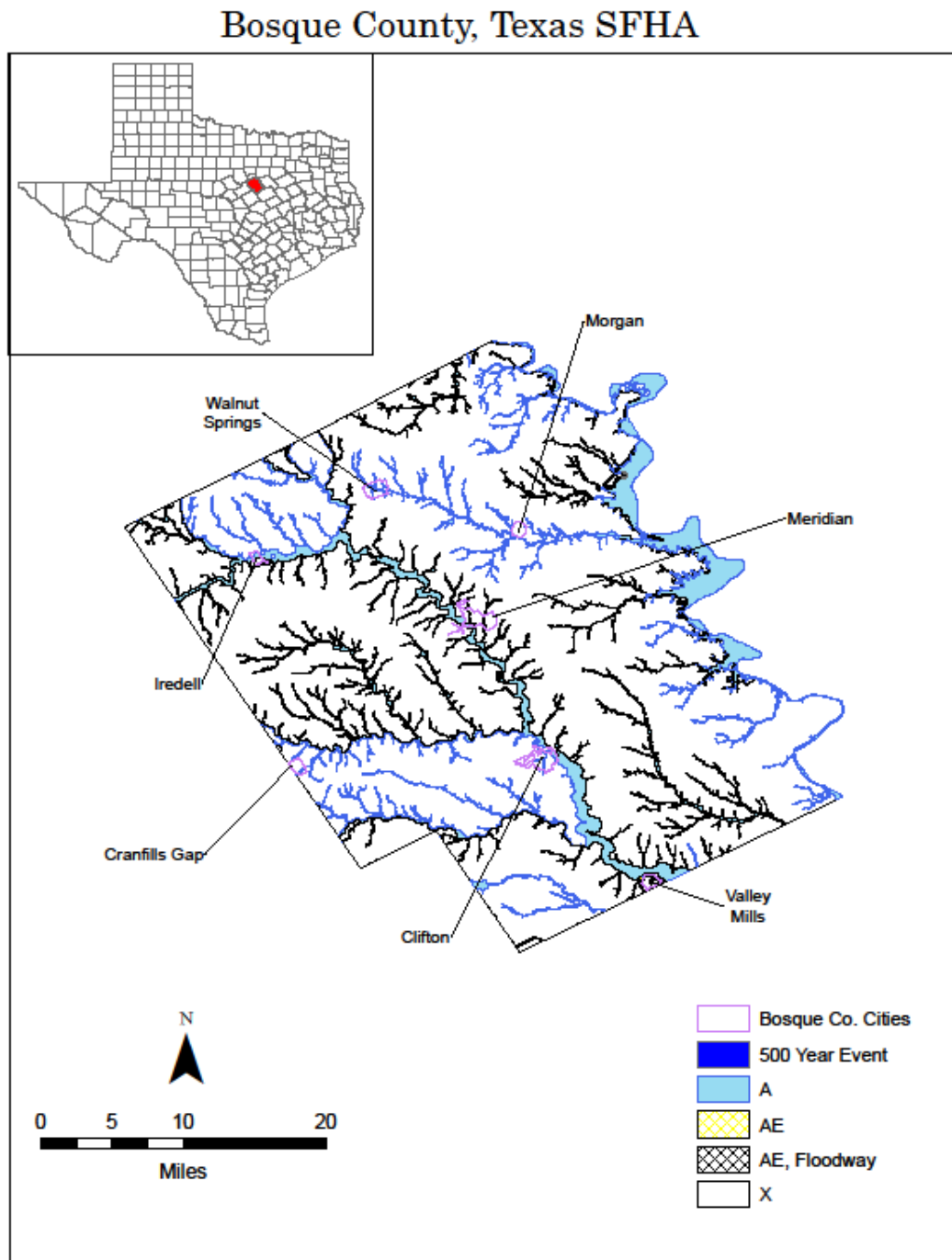


Figure 4-2: City of Clifton Riverine Flooding Potential

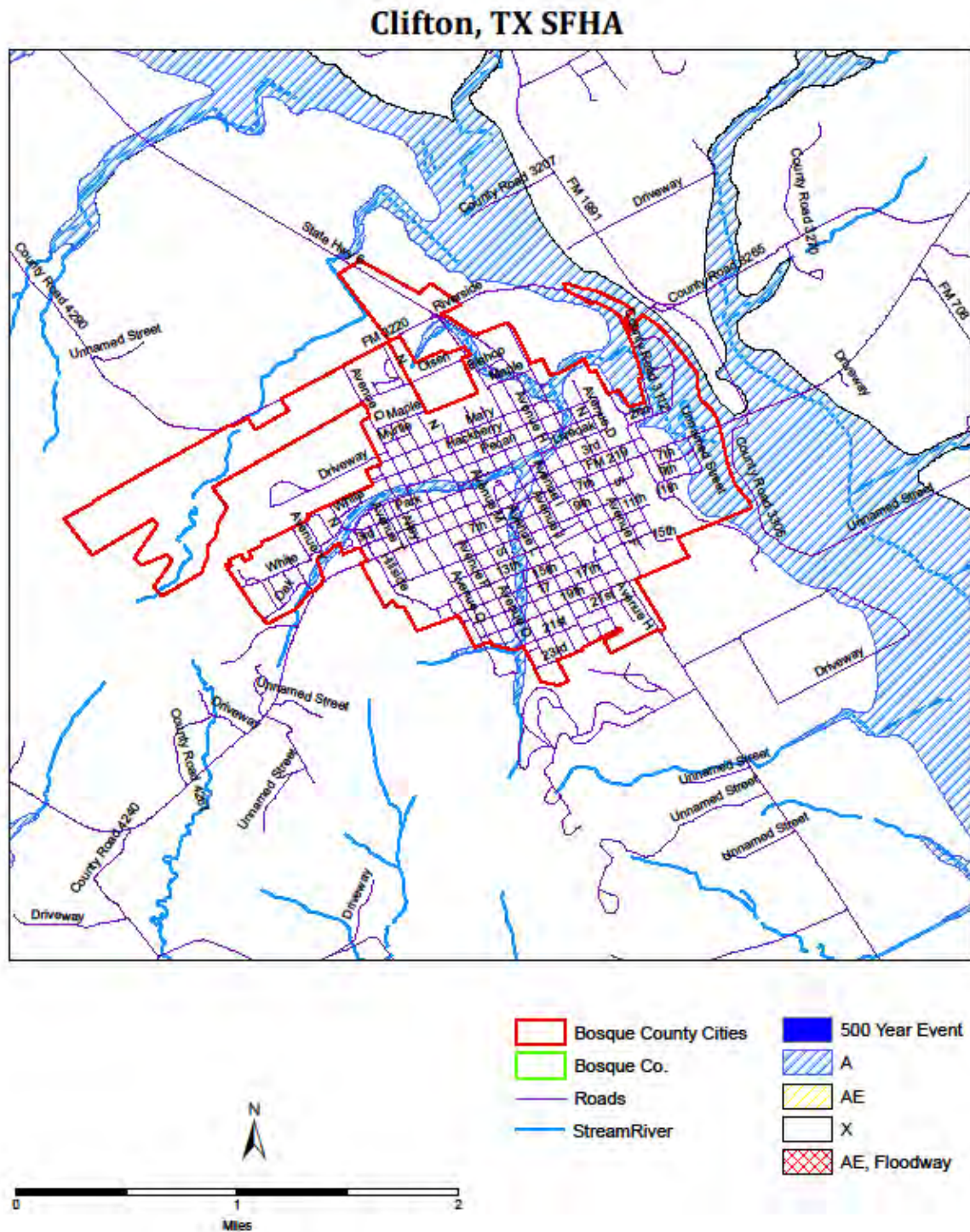
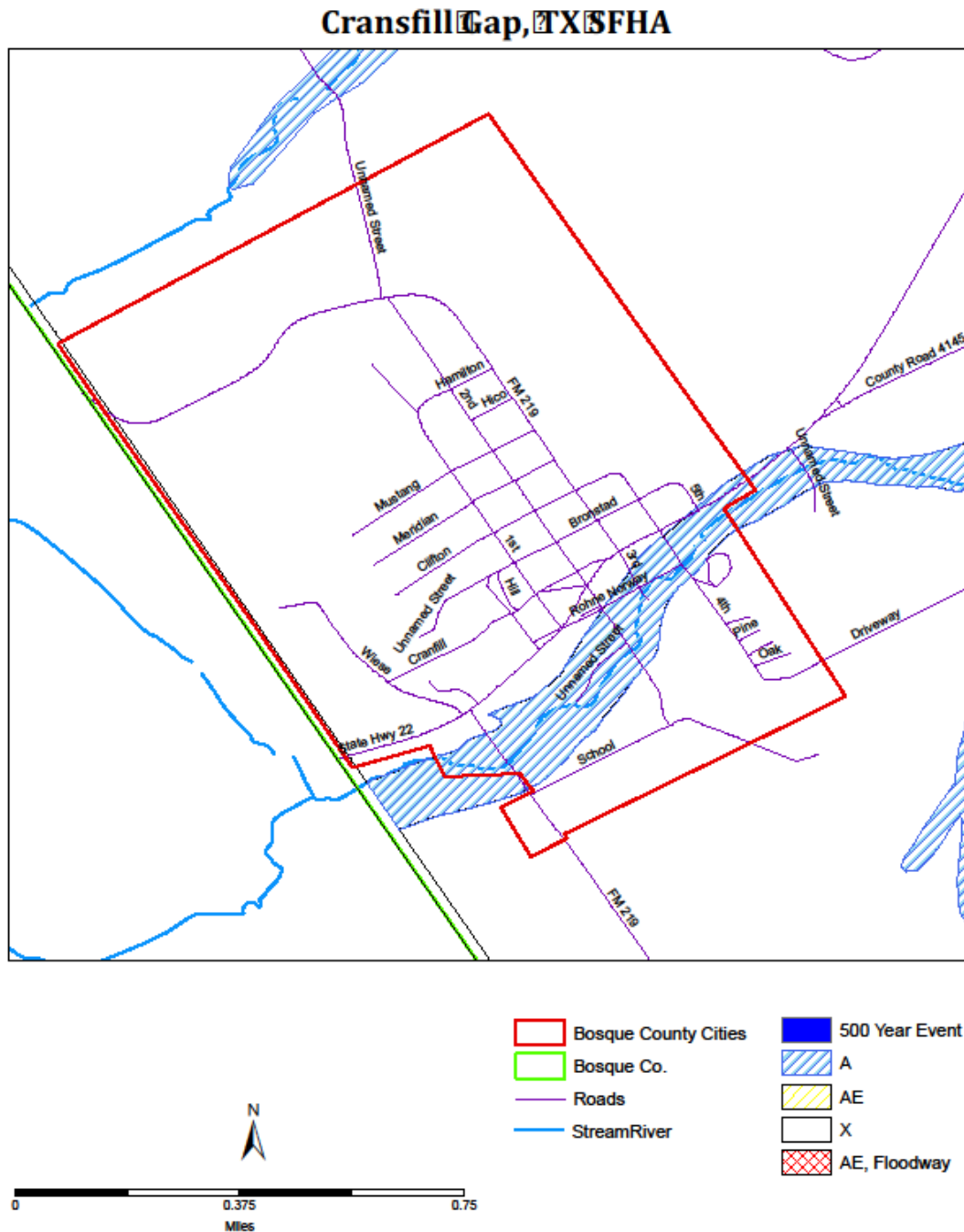


Figure 4-3: City of Cranfills Gap Riverine Flooding Potential



Iredell, TX SFHA

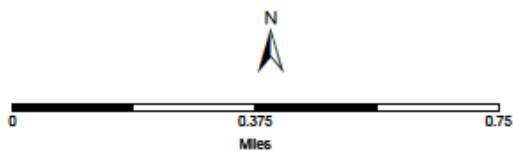
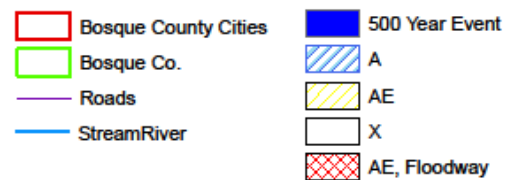


Figure 4-5: City of Meridian Riverine Flooding Potential

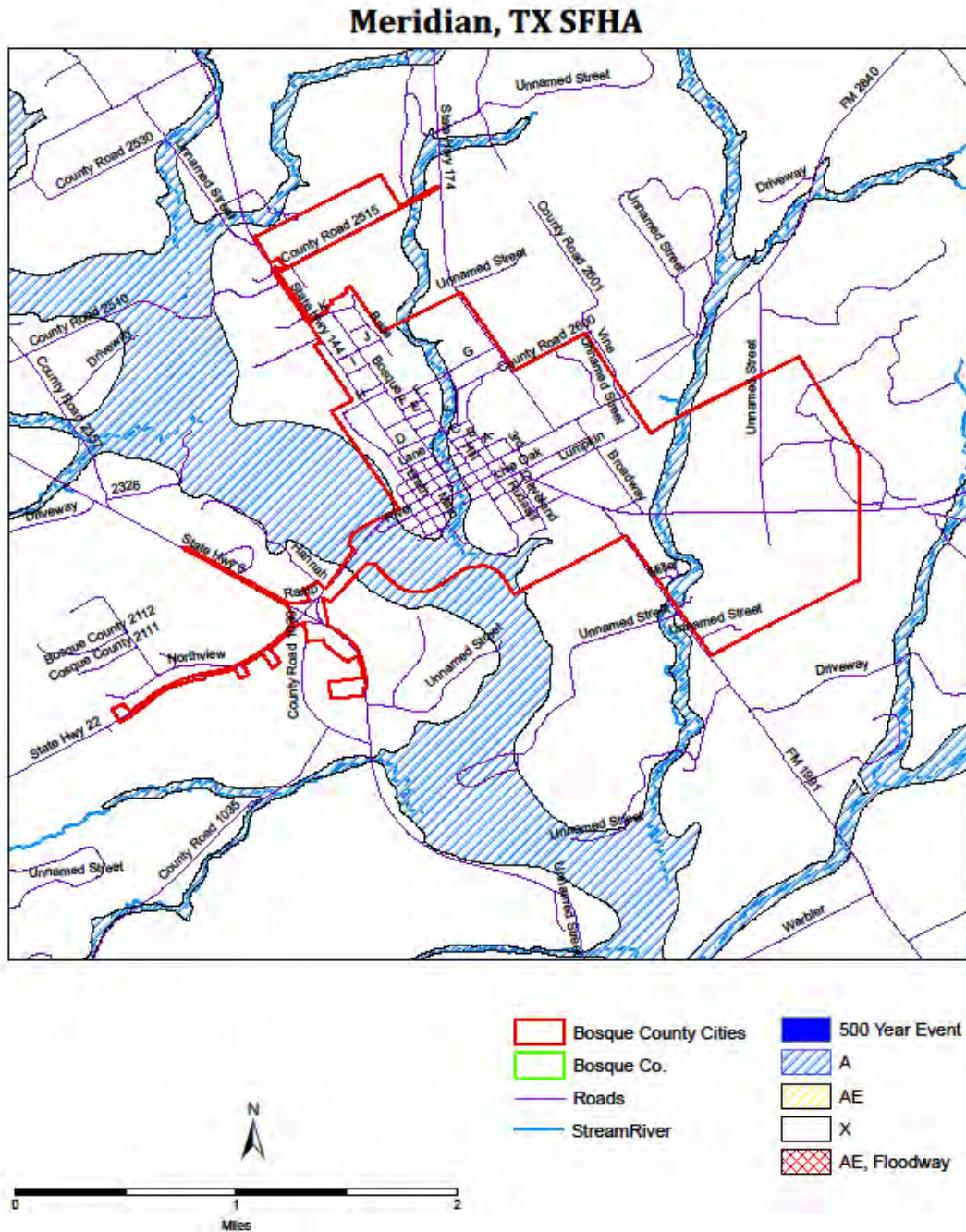


Figure 4-6: City of Morgan Riverine Flooding Potential

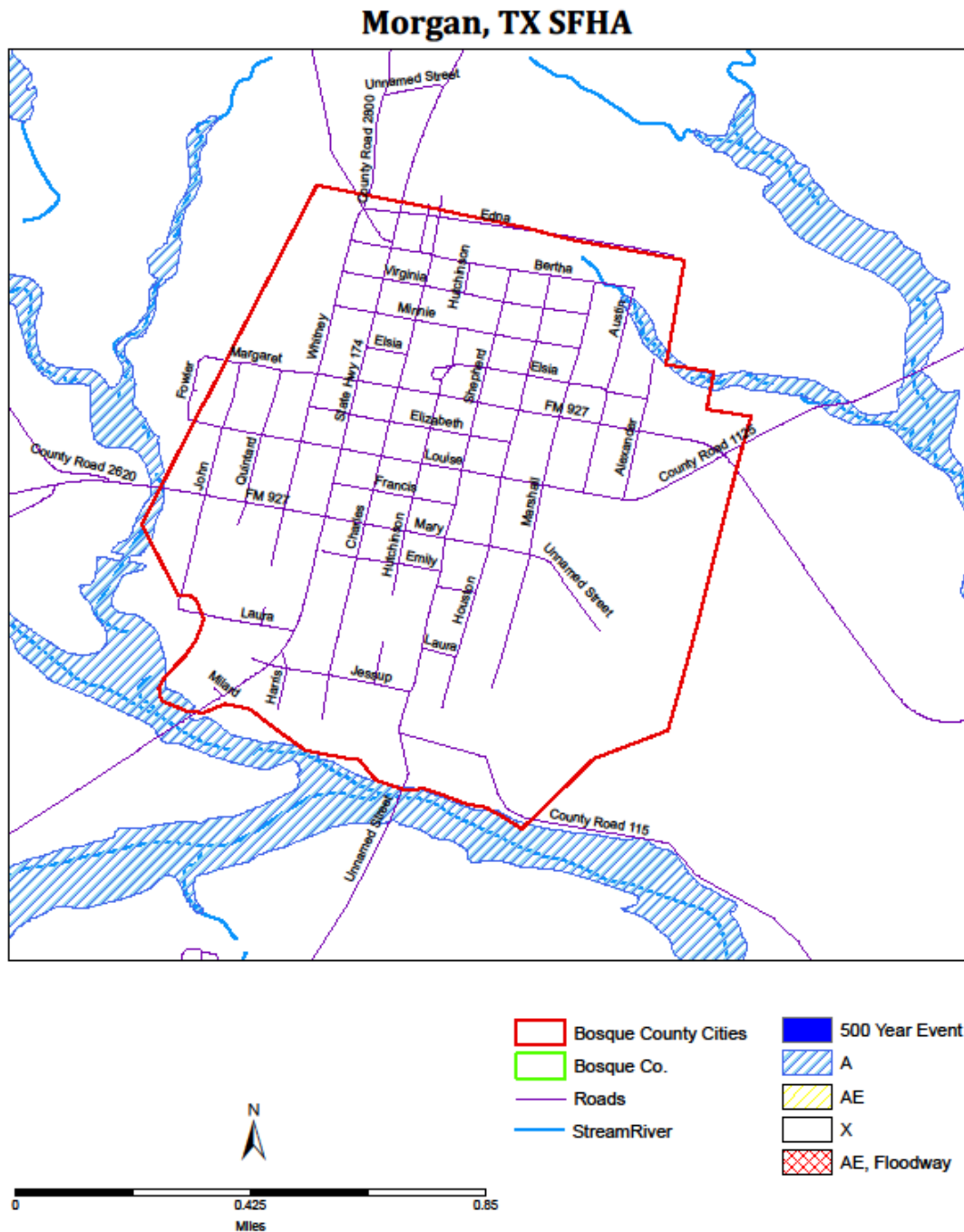


Figure 4-7: City of Valley Mills Riverine Flooding Potential

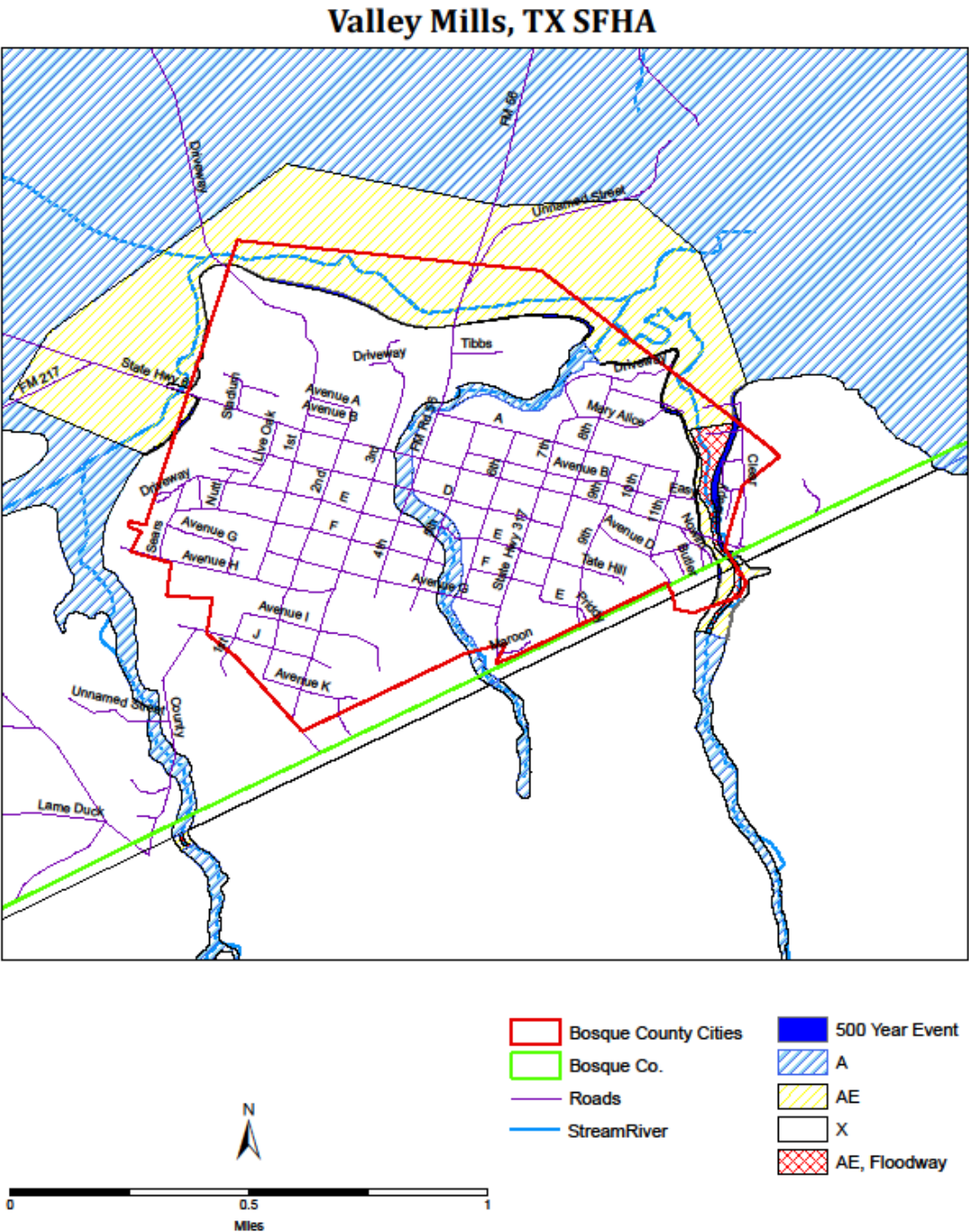
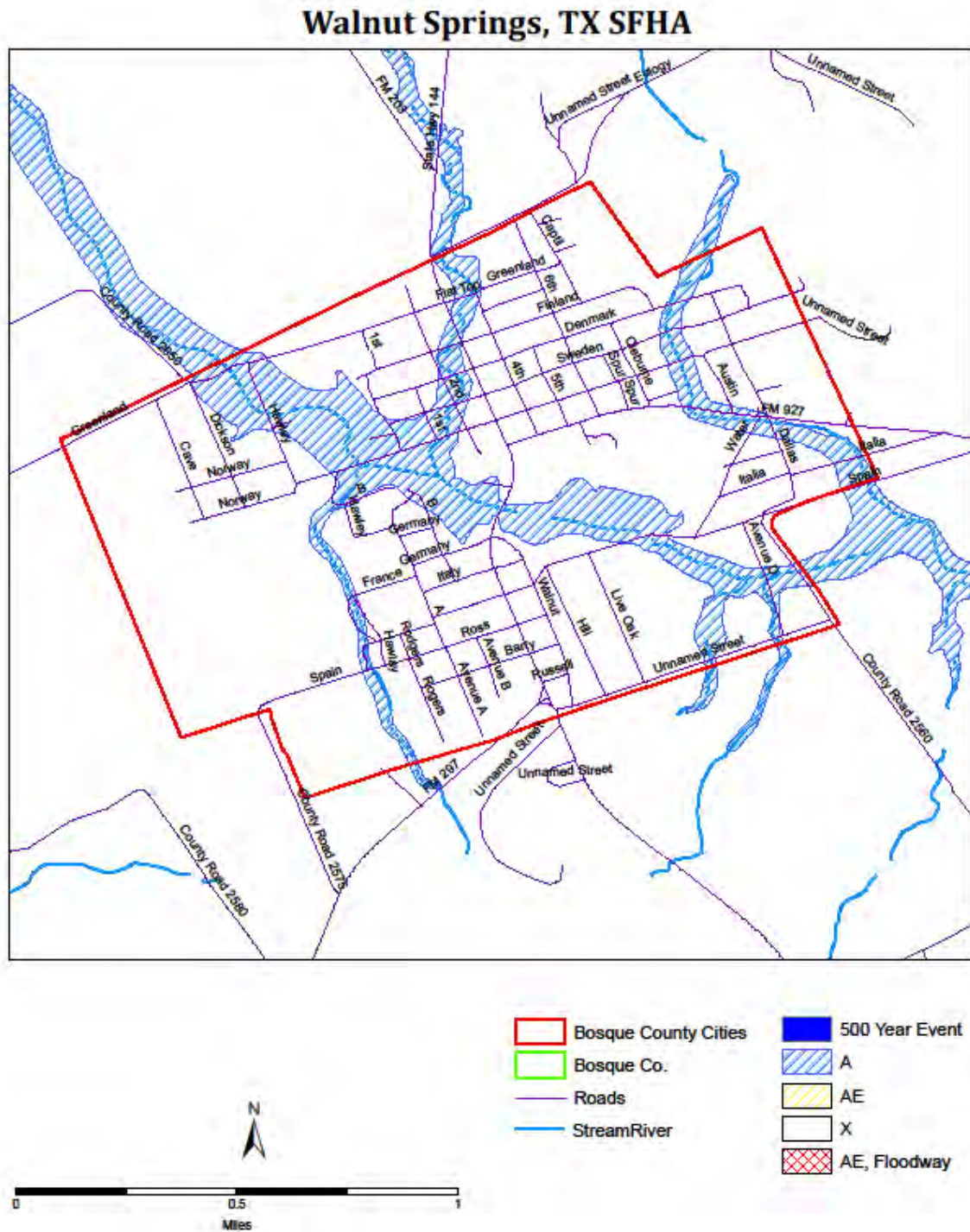


Figure 4-8: City of Walnut Springs Riverine Flooding Potential



NFIP Program Participation

Flood insurance offered through the National Flood Insurance Program (NFIP) is the best way for home and business owners to protect themselves financially against the ravages of flooding. There are currently over 40 flood insurance policies in force in participating Bosque County communities. The jurisdictions of Cranfills Gap, Morgan and Walnut Springs do not participate in the NFIP because it is a voluntary program and they do not have the budget to hire staff to participate in the required permitting process.

Table 4-2: National Flood Insurance Program, Policies and Losses for Bosque County

Community	Policies in Effect	Total Coverage (\$1,000)	Total Losses	Dollars Paid, Historical
Bosque County	17	\$1,671	12	\$131,517
Clifton	13	\$1,327	9	\$176,186
Iredell	1	\$87	0	NA
Meridian	5	\$786	20	\$190,263
Valley Mills	7	\$507	0	NA

Continued compliance in the NFIP for those jurisdictions that do participate in the program is maintained by; permitting all new structures built in the identified flood hazard area; requiring the first floor to be built above the base flood elevation; conducting NFIP community workshops to provide information and incentives for property owners to acquire flood insurance; and completing and maintaining FEMA elevation certificates for pre-FIRM and or post-FIRM buildings.

Repetitive Flood Losses

A Repetitive Loss (RL) property is defined by FEMA as a property that is currently insured through the National Flood Insurance Program (NFIP) that has experienced two or more losses from floods of \$1,000 or more in any rolling 10-year period since 1978. Properties on the Target Repetitive Loss list are those that have experienced two losses within a 10-year period that exceed the value of the structure; three losses within the life of the structure that exceed the value of the structure; or four or more losses. A Severe Repetitive Loss (SRL) structure is defined as having at least four NFIP claim payments (including building and

contents) over \$5,000 each, and the cumulative amount of such claims payments exceeds \$20,000. Table 4-3 lists the number of RL structures located in Bosque County. The RL structures are residential and not commercial.

Table 4-3: Repetitive Losses in Bosque County

Location	Number of RL structures	Number of SRL structures
Bosque County	4	0

SECTION 5: DROUGHT

Why Drought Is a Threat

According to the Texas Parks and Wildlife Department, “Drought is one of the most complex, and least understood, of all natural hazards, affecting more people than do other natural hazards, but differing from them in important ways. Unlike earthquakes, hurricanes and tornadoes, drought unfolds at an almost imperceptible pace with beginning and ending times that are difficult to determine, and with effects that often are spread over vast regions. Drought is the most costly of all natural disasters, and because of the famines it causes, it is the most deadly. ”

Drought is a period of time without substantial rainfall that persists from one year to the next.

Drought is a normal part of virtually all-climatic regimes, including areas with high and low average rainfall. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. Droughts can be classified as meteorological, hydrologic, agricultural, and socioeconomic. Figure 5-1 provides the definitions of drought classifications.

Figure 5-1: Drought Classification Definitions

Meteorological Drought	The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
Hydrologic Drought	The effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
Agricultural Drought	Soil moisture deficiencies relative to water demands of plant life, usually crops.
Socioeconomic Drought	The effect of demands for water exceeding the supply as a result of a weather-related supply shortfall.

Source: Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy, FEMA

Over time, droughts can have very damaging effects on crops, municipal water supplies, recreational uses, and wildlife. If droughts extend over a number of years, the direct and indirect economic impact can be significant.

Droughts can affect a large area and range in size from a couple of counties to several states. Their impact on wildlife and area farming is enormous. Droughts can kill crops, grazing land, edible plants and even in severe cases, trees. Agricultural losses in Texas from the 1996 drought are estimated at \$2 billion, and losses from the 1998 drought estimated at \$2.1 billion, with some estimates much higher. Estimates of overall state losses from both droughts exceed \$11 billion. Dying vegetation also serves as a prime ignition source for wildfires.

A heat wave combined with a drought is a very dangerous situation. Although drought can occur in any season, when extreme heat combines with drought conditions, the result can be a community disaster.

Droughts occur regularly in Texas and are a normal condition. They can vary greatly, however, in their intensity and duration. On average, a yearlong drought takes place somewhere in Texas once every 3 years and a major drought every 20 years. Major droughts can last for years.

Below is a map showing the location of Bosque County.



In the summer of 2011, all of Bosque County, including participating jurisdictions, was experiencing a “severe” drought event.

U.S. Drought Monitor

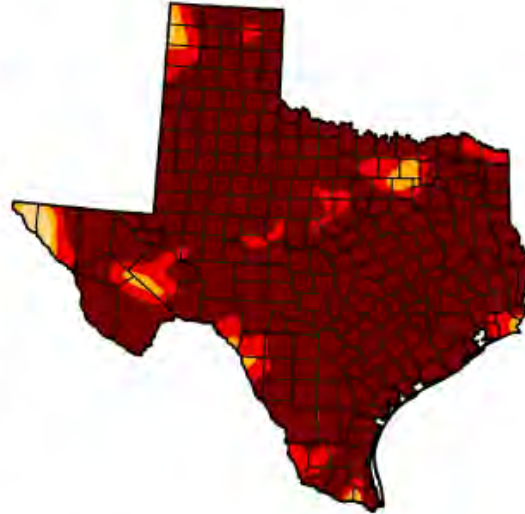
Texas

October 4, 2011
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	99.16	96.99	87.99
Last Week (09/27/2011 map)	0.00	100.00	100.00	99.16	96.65	85.75
3 Months Ago (07/05/2011 map)	2.41	97.59	95.73	94.39	90.21	71.30
Start of Calendar Year (12/28/2010 map)	7.89	92.11	69.43	37.46	9.59	0.00
Start of Water Year (09/27/2011 map)	0.00	100.00	100.00	99.16	96.65	85.75
One Year Ago (09/28/2010 map)	75.57	24.43	2.43	0.99	0.00	0.00

Intensity:

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



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

<http://droughtmonitor.unl.edu>



Released Thursday, October 6, 2011

By the spring of 2012, conditions in Bosque County, including participating jurisdictions, had improved as the region received some much needed rain. The county was then rated as “moderate” on the drought monitor.

U.S. Drought Monitor

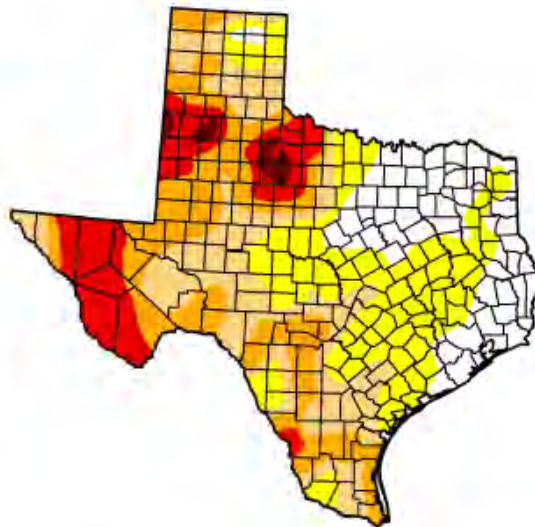
Texas

May 15, 2012
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	18.50	81.50	56.79	33.55	13.54	1.40
Last Week (05/08/2012 map)	17.80	82.20	65.93	48.16	23.57	7.38
3 Months Ago (02/14/2012 map)	4.93	95.07	89.08	76.46	53.27	20.41
Start of Calendar Year (12/27/2011 map)	0.01	99.99	97.83	84.81	67.32	32.36
Start of Water Year (09/27/2011 map)	0.00	100.00	100.00	99.16	96.65	85.75
One Year Ago (05/10/2011 map)	0.00	100.00	97.78	93.89	82.06	47.55

Intensity:

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



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

<http://droughtmonitor.unl.edu>



Released Thursday, May 17, 2012
Brad Rippey, U.S. Department of Agriculture

By the spring of 2013, conditions in Bosque County, including participating jurisdictions, were rated as “severe” on the drought monitor.

U.S. Drought Monitor

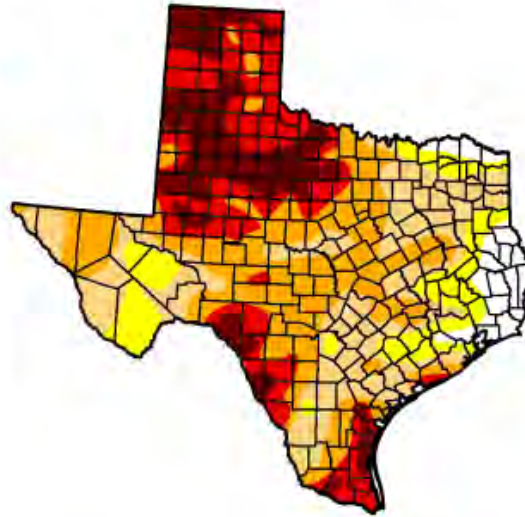
Texas

June 11, 2013
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	5.44	94.56	84.18	59.45	32.36	14.85
Last Week (06/04/2013 map)	4.66	95.34	87.38	59.59	33.12	16.47
3 Months Ago (03/12/2013 map)	11.53	88.47	76.80	54.04	23.41	8.57
Start of Calendar Year (01/01/2013 map)	3.04	96.96	87.00	65.39	35.03	11.96
Start of Water Year (09/25/2012 map)	9.13	90.87	78.73	57.41	24.91	5.18
One Year Ago (06/05/2012 map)	2.45	97.55	65.58	26.86	9.24	0.38

Intensity:

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



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

<http://droughtmonitor.unl.edu>



Released Thursday, June 13, 2013
David Simeral, Western Regional Climate Center

By the fall of 2014, conditions in Bosque County, including participating jurisdictions, were rated as “severe” on the drought monitor.






U.S. Drought Monitor

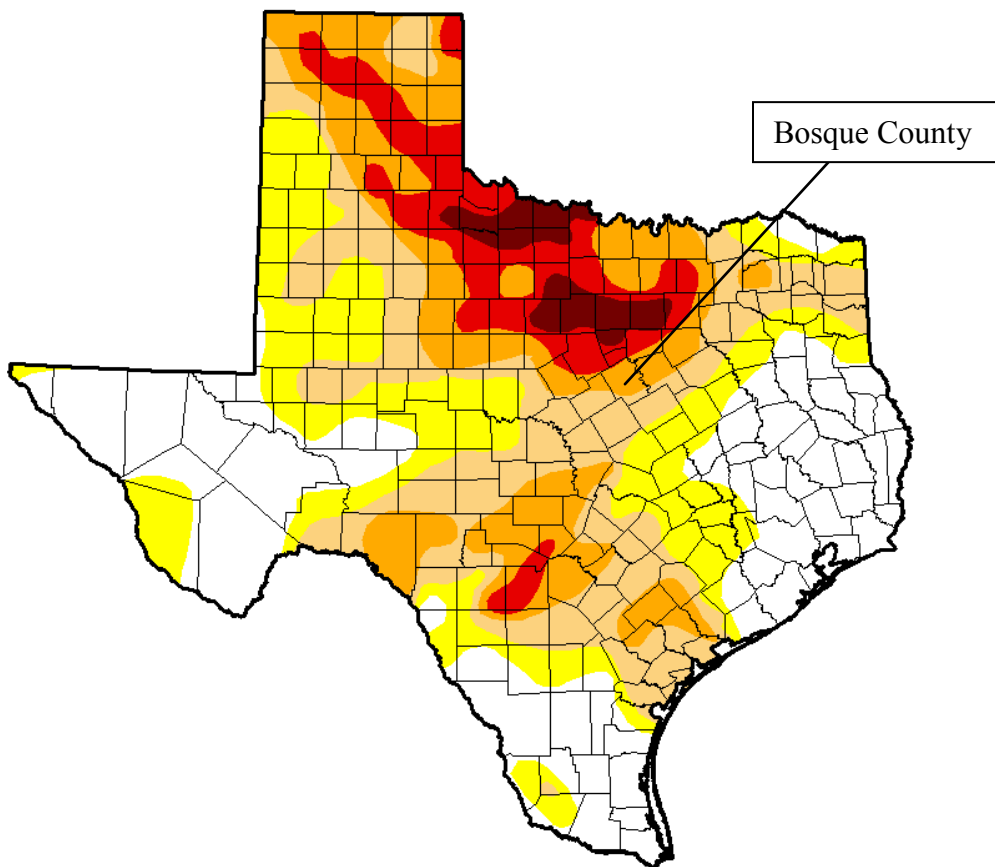
Texas October 21, 2014

(Released Thursday October 23, 2014)

Valid 8 a.m. EDT

Intensity:

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



Hazard Profile

The potential severity of impact of droughts in Bosque County and participating jurisdictions is minor: severity of impact may result in injuries or illnesses that do not result in permanent disability, a complete shutdown of critical facilities for more than 1 week, or more than 10% of property destroyed or with major damage.

There are no defined geographic boundaries for drought and all areas of Bosque County and participating jurisdictions can be affected equally.

The frequency of occurrence of drought in Bosque County and participating jurisdictions is likely, with an event possible in the next five years.

According to the Palmer Drought Index, shown in Table 5.3, the extent of droughts can range from minor or moderate to extreme or exceptional. The maximum extent of drought that can affect Bosque County would be exceptional. This occurred during the summer and fall of 2011. The minimum extent of drought that can affect Bosque County would be moderate. This occurred during the spring 2012 after some much needed rain.

Droughts are slow onset hazards. Warning time for drought is long, since drought events take place over long periods of time. Drought warnings are issued by the State Drought Preparedness Council, as directed by H.B. 2660, based upon input from NOAA, the Office of the State Climatologist, the U.S. Geological Service, the Texas Water Development Board, Texas Commission on Environmental Quality, and the Texas Agricultural Statistics Service. Warnings utilize five “levels of concern” and take into account assessments of climatology, agriculture, and water availability for each of 10 climatic regions of the State.

History of Drought

Drought events in Bosque County reported to the National Weather Service at <http://www4.ncdc.noaa.gov/cgi-win/wwcqi.dll?wwevent~storms> are listed in Table 5-1.

Table 5-1: Exposure to Droughts in Bosque County as reported to the National Weather Service, 01/01/1996 to 04/30/2013

<http://www4.ncdc.noaa.gov/cgi-win/wwcqi.dll?wwevent~storms>

Dth: deaths **Inj:** injuries **PrD:** property damage **CrD:** crop damage

Date	Dth	Inj	PrD	CrD	Notes
------	-----	-----	-----	-----	-------

Date	Dth	Inj	PrD	CrD	Notes
8/1/1996	0	0	0	0	Entire county affected
7/1/1998	0	0	0	0	Entire county affected
8/1/2000	0	0	0	0	Entire county affected
9/1/2000	0	0	0	0	Entire county affected
7/1/2005	0	0	0	60.0M	Entire county affected
11/1/2005	0	0	0	120.0M	Entire county affected
12/1/2005	0	0	0	120.0M	Entire county affected
1/1/2006	0	0	0	1.0B	Entire county affected
2/1/2006	0	0	0	300.0M	Entire county affected
3/1/2006	0	0	0	200.0M	Entire county affected
4/1/2006	0	0	100M	0	Entire county affected
5/1/2006	0	0	0	100.0M	Entire county affected
6/6/2006	0	0	0	100.0M	Entire county affected
7/1/2006	0	0	0	100.0M	Entire county affected
8/1/2006	0	0	0	100.0M	Entire county affected

Date	Dth	Inj	PrD	CrD	Notes
9/1/2006	0	0	0	80.0M	Entire county affected
10/1/2006	0	0	500K	500K	Entire county affected
11/1/2006	0	0	0	800K	Entire county affected
6/24/2008	0	0	0	0	Entire county affected
7/1/2008	0	0	0	25K	Entire county affected
8/1/2008	0	0	0	5K	Entire county affected
3/10/2009	0	0	0	10K	Entire county affected
4/1/2009	0	0	0	25K	Entire county affected
3/25/2011	0	0	0	5K	Entire county affected
4/1/2011	0	0	0	20K	Entire county affected

People and Property at Risk

Droughts have no geographic boundaries and the entire planning area could potentially be impacted.

Potential Damages and Losses

In order to analyze the risk of Bosque County and participating jurisdictions to drought and estimate potential losses, 100 years of statistical data from the University of Nebraska was used (this data was developed by the University based on Palmer Drought and Crop Severity Indices) as well as 1997 USDA agriculture data. A drought event frequency-impact was then developed to determine a drought impact profile on non-irrigated agriculture products and estimate potential losses due to drought in the area. Table 5-2 shows annualized expected exposure by county.

Table 5-2: Annualized Expected Agricultural Product Market Value Exposed to Drought in Bosque County

County	Annualized Expected Exposure (\$1,000)
Bosque	10,530

The Palmer Drought Severity Index is shown below in Table 5-3 to demonstrate the extent that drought can reach in Bosque County.

Table 5-3: Palmer Drought Severity Index

Drought Severity	Return Period (years)	Description of Possible Impacts	Drought Monitoring Indices		
			Standardized Precipitation Index (SPI)	NDMC* Drought Category	Palmer Drought Index
Minor Drought	3 to 4	Going into drought; short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.	-0.5 to -0.7	D0	-1.0 to -1.9
Moderate Drought	5 to 9	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-0.8 to -1.2	D1	-2.0 to -2.9
Severe Drought	10 to 17	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-1.3 to -1.5	D2	-3.0 to -3.9
Extreme Drought	18 to 43	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions.	-1.6 to -1.9	D3	-4.0 to -4.9
Exceptional Drought	44 +	Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies.	less than -2	D4	-5.0 or less

*NDMC - National Drought Mitigation Center

SECTION 6: WILDFIRES

Why Wildfires Are a Threat

This Plan addresses only major wildfires. For purposes of this plan, major wildfire events are those that were greater than or equal to two-alarm fires. A wildfire may be defined as a sweeping and destructive conflagration especially in a wilderness or a rural area.

A wildfire is any fire occurring on grassland, forest, or prairie, regardless of ignition source, damages, or benefits. According to the National Fire Plan, 2000, the wildfire risk is now considered by authorities as “the most significant fire service problem of the Century.

The National Fire Plan was issued by the U.S. departments of Agriculture and Interior. It defines the urban/wildland interface as “the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.” The interface problem has grown dramatically over the last twenty years, spawned by increases in population, urban expansion, land-management decisions that place neighborhoods adjacent to wildland preserves, parks, and greenbelts, and the ever-present desire to intermingle with nature.

More and more people are building their homes in woodland settings in or near forests, rural areas, or remote mountain sites. Many of these homes are nestled along ridgelines, cliff-edges, and other classic fire-interface hazard zones. There, homeowners enjoy the beauty of the environment but they also face the very real danger of wildfire.

Years of fire suppression have significantly disturbed natural fire occurrences—nature’s renewal process. The result has been the gradual accumulation of understory and canopy fuels to levels of density that can feed high-energy, intense wildfires and further increase the hazards from and exposure to interface problems.

Wildfires can occur at any time of the year. Climatic conditions such as severe freezes and drought can significantly increase the intensity of wildfires since these conditions kill vegetation, creating a prime fuel source for these types of fires. The intensity of fires and the rate at which they spread are directly related to wind speed, temperature, and relative humidity.

Three different classes of wildfires exist. A “surface fire” is the most common type and burns along the floor of a forest, moving slowly and killing or damaging trees. A “ground fire” is usually started by lightning and burns on or below the forest floor in the humus layer down to the mineral soil. “Crown fires” spread rapidly by wind and move quickly by jumping along the tops of trees.

Hazard Profile

Wildfire events can have a major severity of impact for rural Bosque County. Fires can completely shut down facilities for at least two weeks and cause more than 25 percent of affected properties to be destroyed or incur major damage.

Major wildfire events in Bosque County are likely, with an event is possible in the next five years.

The extent of wildfire in Bosque County and participating jurisdictions can include thousands of acres burned, dozens of homes damaged, and possible loss of life. Table 6-1 shows the extent of wildfire for each participating jurisdiction.

Table 6-1: Potential Wildfire Extent in Bosque County

Jurisdiction	Potential Structures Impacted	Potential Acreage Impacted
Bosque County	36	550
Clifton	12	26
Cranfills Gap	6	20
Iredell	6	25
Meridian	14	33
Morgan	2	10
Valley Mills	4	15
Walnut Springs	2	10

Location of Hazardous Areas

Figures 6-1 through 6-7 shows the possible location of wildfires in Bosque County, based on the Texas Forest Service wildfire ignition density measures. Bosque County falls mostly into the moderate risk category in the map below.

This overall hazard rating by the Texas Forest Service is descriptive and not predictive, based on wide-ranging parameters.

Figure 6-1: Potential Wildfire Location in Bosque County

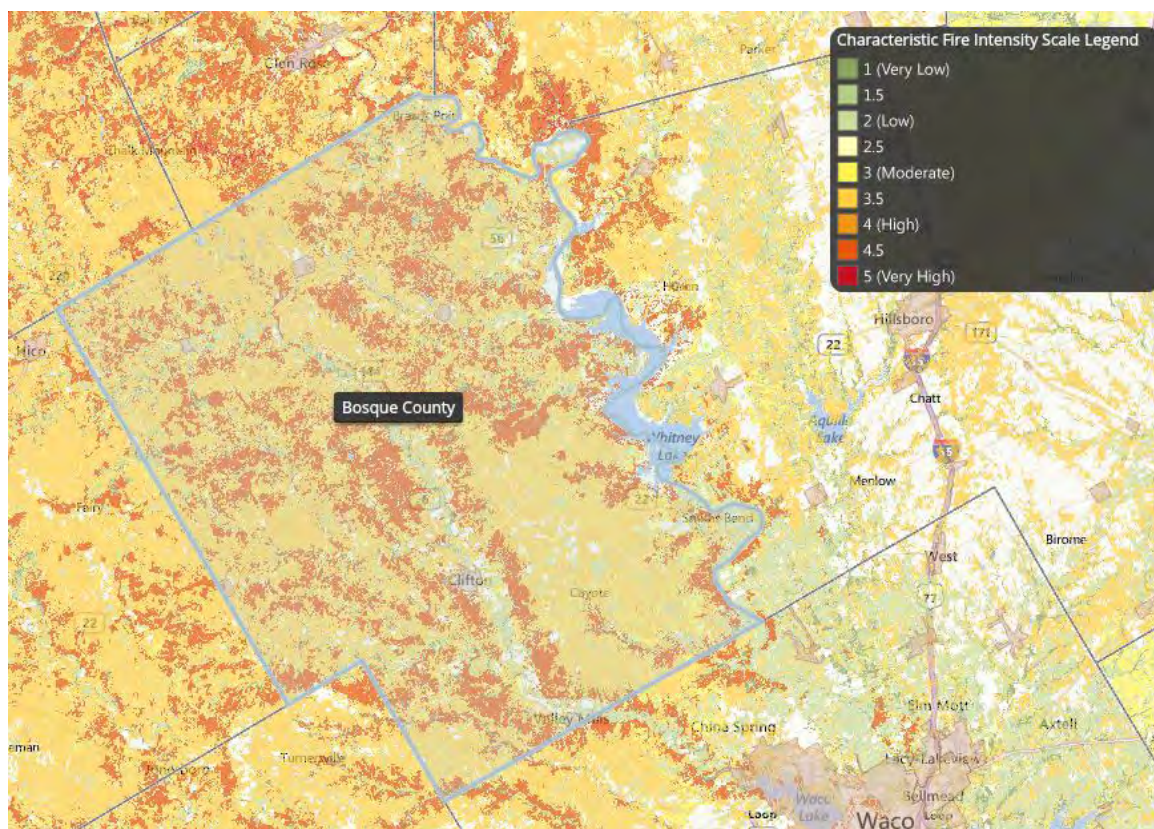


Figure 6-2: Potential Wildfire Location for Clifton

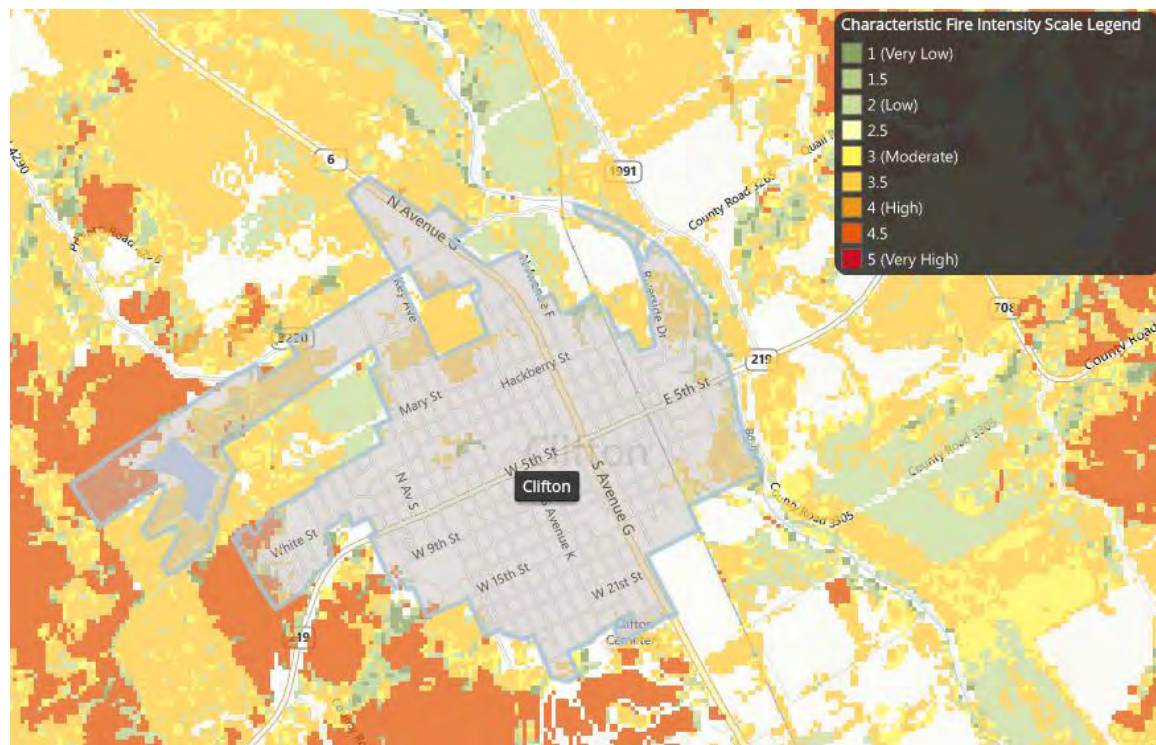


Figure 6-3: Potential Wildfire Location for Cranfills Gap

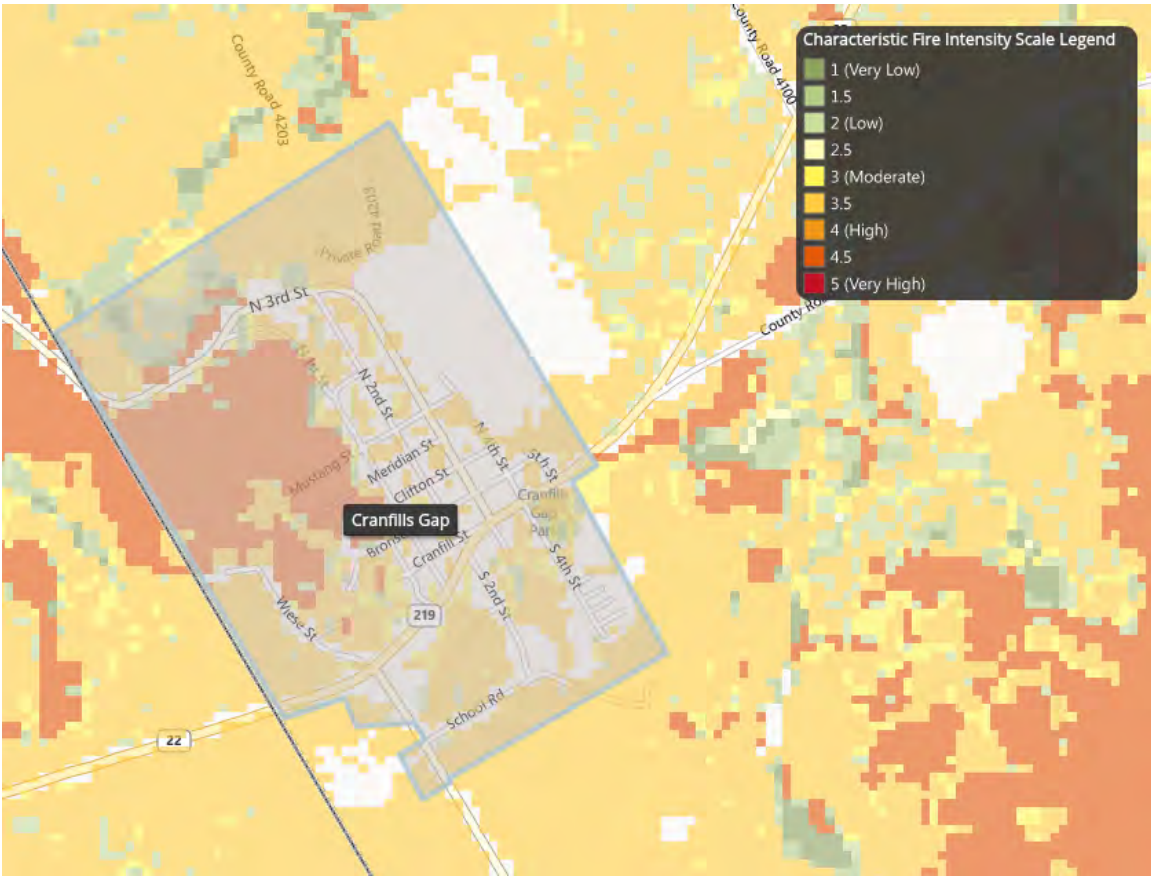


Figure 6-4: Potential Wildfire Location for Iredell



Figure 6-5: Potential Wildfire Location for Meridian

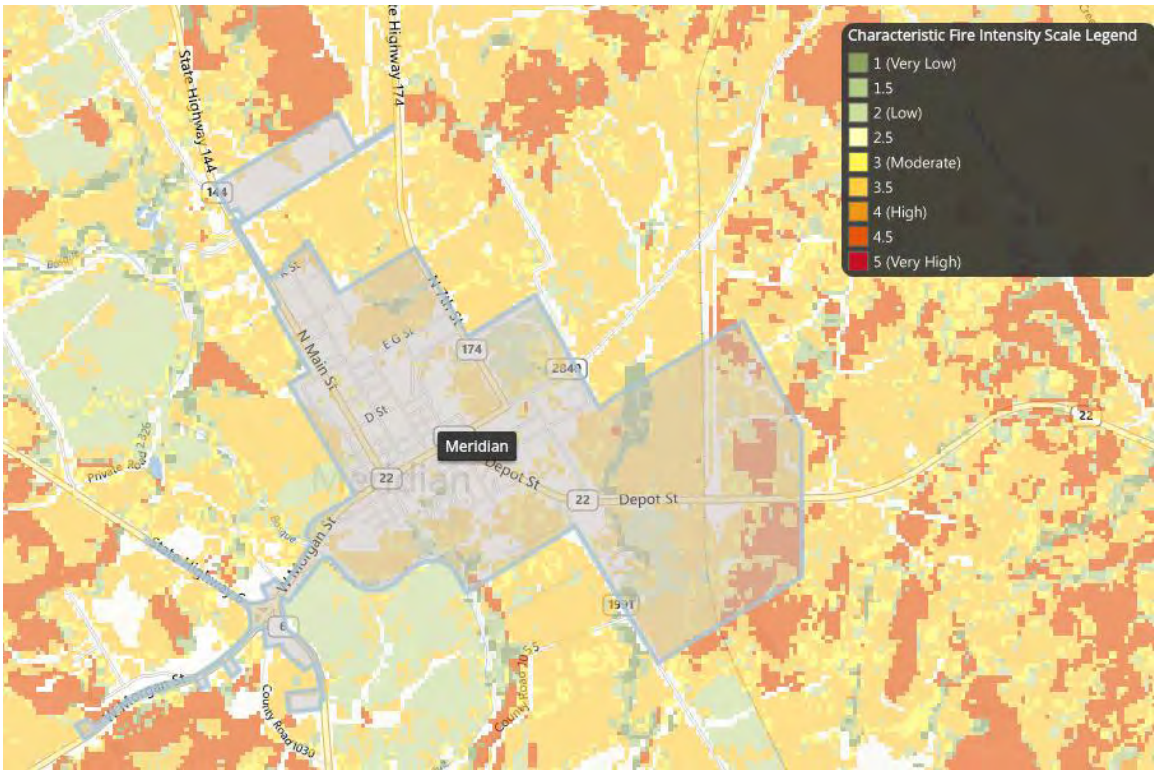


Figure 6-6: Potential Wildfire Location for Morgan

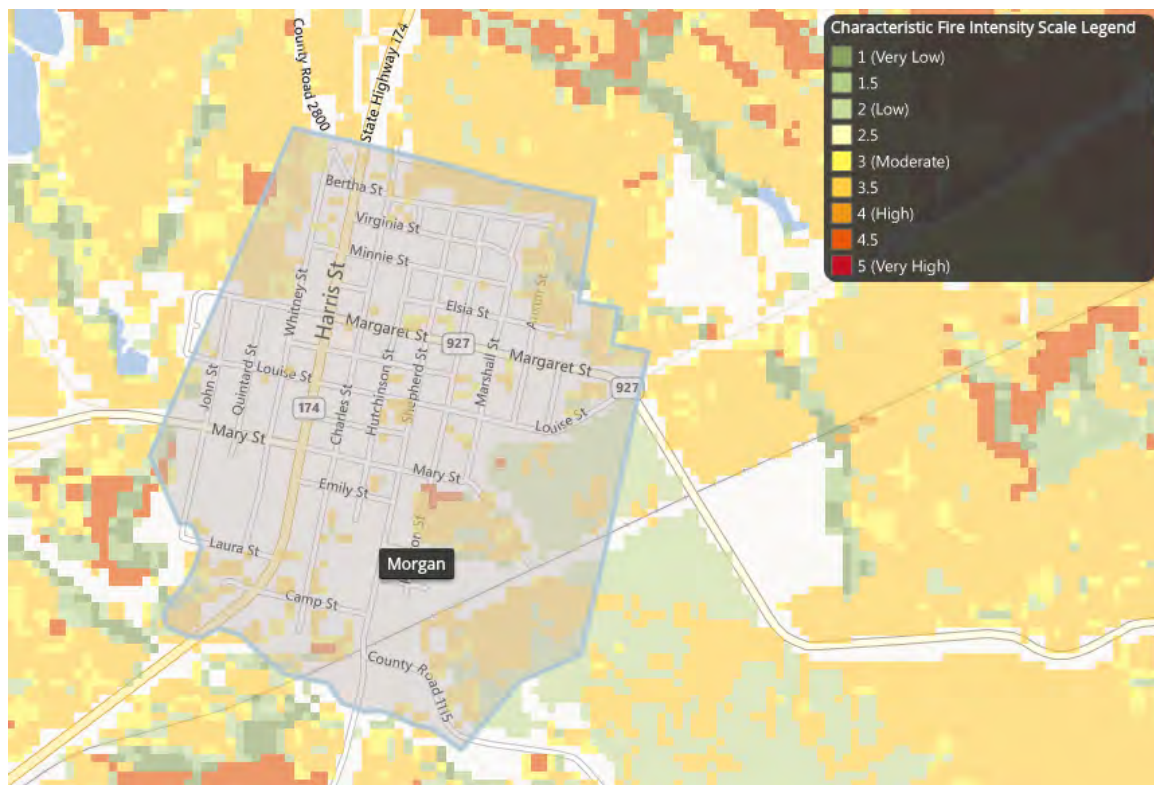


Figure 6-7: Potential Wildfire Location for Valley Mills

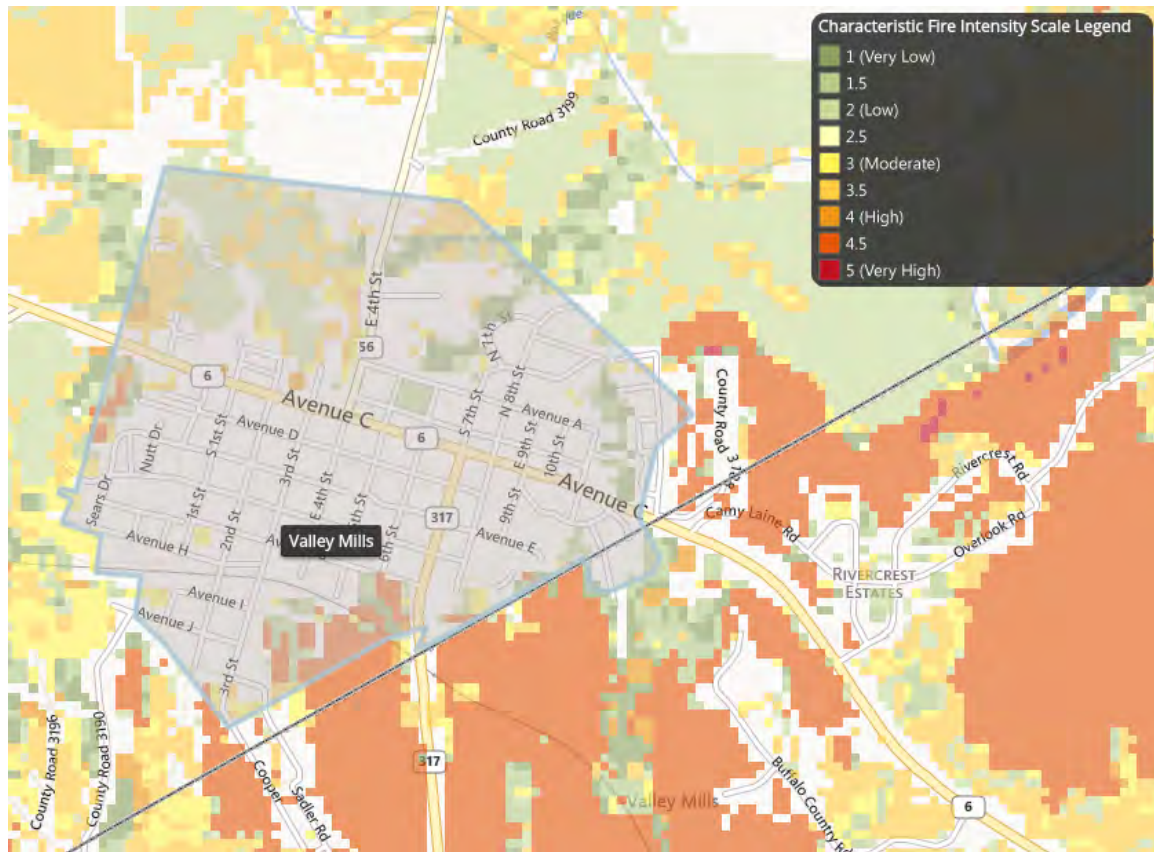
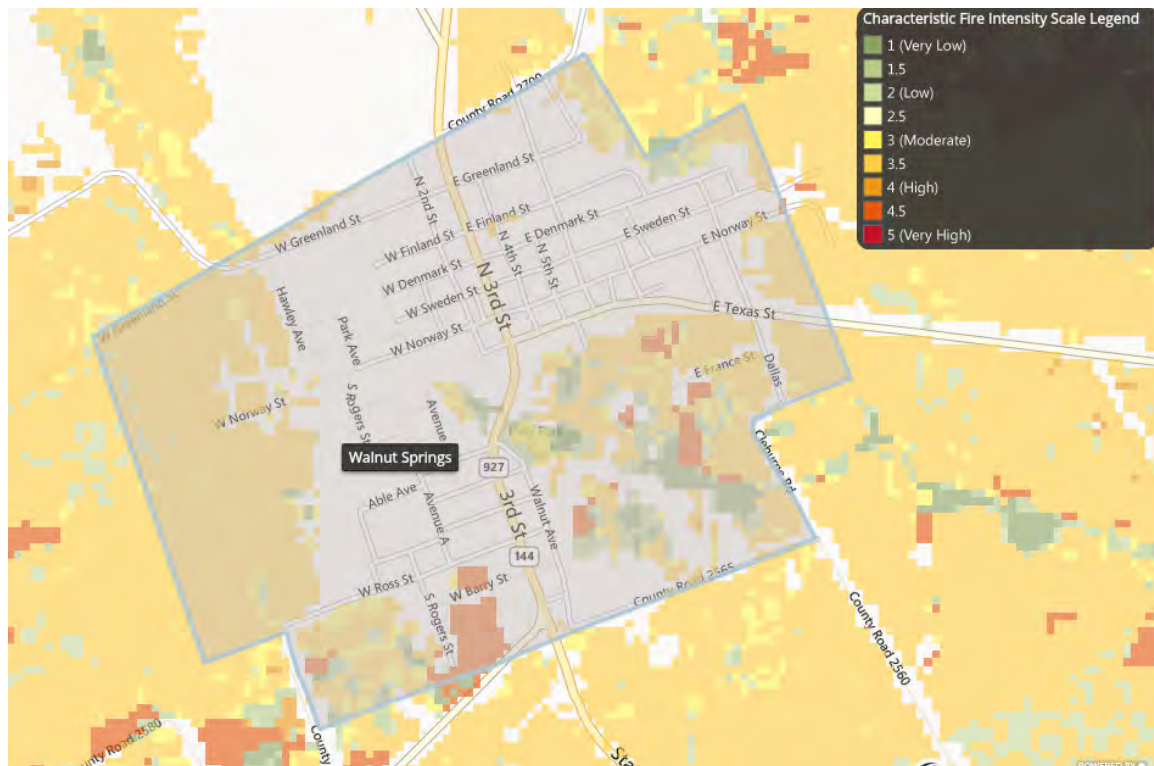


Figure 6-8: Potential Wildfire Location for Walnut Springs



History of Fire

Table 6-2 shows the number of wildfire incidents and the total acreage burned in Bosque County. There are been no previous reports of wildfires within the city limits of jurisdictions participated in this plan.

Table 6-2: Wildfire Incidents and Losses in Bosque County, 1989-2014

Location	Date	Acreage Burned
Bosque County	July 1998	25
Bosque County	September 2002	110
Bosque County	February 2006	36
Bosque County	April 2011	300

People and Property at Risk

There is no defined geographic hazard boundary for wildfires. All people, buildings, critical facilities, infrastructure and lifelines, and hazardous materials facilities within Bosque County and participating jurisdictions are considered exposed to the wildfire hazard and could potentially be impacted. However, it is not expected that a fire event would impact a large area.

SECTION 7: TORNADOES

Why Tornadoes Are a Threat

Tornadoes are unquestionably the most violent storms on the planet. A tornado is a violently rotating column of air extending between, and in contact with, a cloud and the surface of the earth. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 miles per hour or more. In extreme cases, winds may approach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long.

The most powerful tornadoes are spawned by “super-cell thunderstorms.” These storms are affected by horizontal wind shears (winds moving in different directions at different altitudes) that begin to rotate the storm. This horizontal rotation can be tilted vertically by violent updrafts, and the rotation radius can shrink, forming a vertical column of very quickly swirling air. This rotating air can eventually reach the ground, forming a tornado.

Table 7-1: Enhanced Fujita Tornado Scale implemented February 1, 2007

EF-Scale Number	Intensity	Wind Speed (mph)	Type of Damage Done
EF0	Gale tornado	65-85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
EF1	Moderate tornado	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 roads; attached garages may be destroyed.
EF2	Significant tornado	111-135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	Severe tornado	136-165	Roof and some walls torn off well constructed houses; trains overturned;

			most trees in forest uprooted.
EF4	Devastating tornado	166-200	Well-constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	Incredible tornado	Over 200	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles flying through the air in excess of 100 meters; trees debarked; steel reinforced concrete badly damaged.

Bosque County is known for frequent severe weather and thunderstorms. Thunderstorms form when warm, moist air collides with cooler, drier air. Since these masses tend to come together during the transition from summer to winter, most thunderstorms occur during the spring and fall months. Severe thunderstorms can produce tornadoes, high winds, and hail—any of which can cause extensive property damage and loss of life.

Tornadoes occasionally accompany tropical storms and hurricanes that move over land. Tornadoes are the most common to the right and ahead of the path of the storm center as it comes ashore.

Tornadoes vary in terms of duration, wind speed and the toll that they take, as shown in Table 7-2.

Table 7-2: Variations among Tornadoes

Weak Tornadoes	Strong Tornadoes	Violent Tornadoes
69% of all tornadoes	29% of all tornadoes	2% of all tornadoes
Less than 5% of tornado deaths	Nearly 30% of all tornado deaths	70% of all tornado deaths
Lifetime 1-10+ minutes	May last 20 minutes or longer	Lifetime can exceed one hour
Winds less than 110 mph	Winds 110 – 205 mph	Winds greater than 205 mph

Hazard Profile

The impact of tornadoes in Bosque County and participating jurisdictions can be major: severity of impact may result in injuries or illnesses that result in permanent disability, complete shutdown of critical facilities for at least 2 weeks, or more than 25% of property destroyed or with major damage.

Seasonal patterns are relevant to tornadoes. Thunderstorms form when warm, moist air collides with cooler, drier air. Since these masses tend to come together during the transition from summer to winter, most thunderstorms and resulting tornadoes occur during the spring (March, April, May and June) and, at a lesser intensity, during the fall (September, October, and November). Warning time for tornadoes is minimal.

History of Tornadoes

Historical evidence, as reflected in Table 7-3 (next page), shows that most of Bosque County is vulnerable to tornado activity. There is no defined hazard boundary for tornadoes. Since the Enhanced Fujita Scale was not implemented until 2007, the original Fujita Scale is included here to help understand the History of Tornado Events scale in Table 7-3.

ORIGINAL FUJITA SCALE		ENHANCED FUJITA SCALE	
F5	261-318 mph	EF5	+200 mph
F4	207-260 mph	EF4	166-200 mph
F3	158-206 mph	EF3	136-165 mph
F2	113-157 mph	EF2	111-135 mph
F1	73-112 mph	EF1	86-110 mph
F0	<73 mph	EF0	65-85 mph

Table 7-3: Historical Tornado Events for Bosque County as Reported to the National Weather Service, 01/01/1950 to 04/30/2011

Storm Events Database

Search Results for BOSQUE (County), (TEXAS)

7 event(s) were reported between 01/01/1996 and 03/31/2013 (6300 days)

Summary Info:

Number of County/Zone areas affected:	1
Number of Days with Event:	6
Number of Days with Event and Death:	1
Number of Days with Event and Death or Injury:	1
Number of Days with Event and Property Damage:	3
Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1

Column Definitions:

'Mag': Magnitude, 'Dth': Deaths, 'Inj': Injuries, 'PrD': Property Damage, 'CrD': Crop Damage

<u>Location</u>	<u>County/Zone</u>	<u>St.</u>	<u>Date</u>	<u>Time</u>	<u>T.Z.</u>	<u>Type</u>	<u>Ma</u> <u>g</u>	<u>Dt</u> <u>h</u>	<u>In</u> <u>i</u>	<u>PrD</u>	<u>CrD</u>
Totals:								2	0	3.050 M	0.00 K
KOPPERL	BOSQUE CO.	T X	10/21/1996	14: 30	CS T	Tornado	F0	0	0	0.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	03/16/1998	16: 53	CS T	Tornado	F0	0	0	0.00K	0.00 K
MERIDIA N	BOSQUE CO.	T X	03/08/1999	09: 37	CS T	Tornado	F0	0	0	0.00K	0.00 K
LAGUNA PARK	BOSQUE CO.	T X	05/12/2000	16: 10	CS T	Tornado	F3	2	0	3.000 M	0.00 K
KOPPERL	BOSQUE	T	05/05/2001	15:	CS	Tornado	F0	0	0	20.00K	0.00

	CO.	X		05	T	o					K
VALLEY MILLS	BOSQUE CO.	T X	10/12/2001	19:54	CS T	Tornad o	F1	0	0	30.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	10/12/2001	20:00	CS T	Tornad o	F0	0	0	0.00K	0.00 K
Totals:								2	0	3.050 M	0.00 K

Table 7-4 summarizes the number of tornado events in Bosque County and provides the maximum extent has become.

Table 7-4: Overall Historical Impact of Tornadoes in Bosque County

County	Number of events	Maximum Extent On the F-Scale
Bosque	7	F-3

People and Property at Risk

Because it cannot be predicted where a tornado will touch down, all buildings and facilities in Bosque County and participating jurisdictions are considered to be exposed to the tornado hazard and could potentially be impacted. All the population, buildings, infrastructure and lifelines are considered exposed to the hazard and could potentially be impacted.

Potential Damages and Losses

Table 7-5 shows potential annualized expected property losses Bosque County.

Table 7-5: Potential Annualized Losses from Tornadoes in Bosque County

County	Annualized Expected Property Losses (\$)
Bosque	\$62,000

SECTION 8: THUNDERSTORMS

Why Thunderstorms Are a Threat

According to the National Weather Service (NWS), a thunderstorm occurs when an observer hears thunder, Radar observers use the intensity of the radar echo to distinguish between rain showers and thunderstorms. Lightning detection networks routinely track cloud-to-ground flashes, and therefore thunderstorms. Thunderstorms form when clouds develop sufficient upward motion and are cold enough to provide the ingredients (ice and super-cooled water) to generate and separate electrical charges within the cloud. The cumulonimbus cloud is the perfect lightning and thunder factory, earning its nickname, "thunderhead."

Thunderstorms are like nature's heat pumps. At the very top of giant thunderstorms, air temperatures can sometimes drop to below -100 degrees F. Sometimes, on a hot summer day, this air originates near the ground at 100 degrees F. Thunderstorms carry the sun's energy from the surface into the cooler reaches of the atmosphere. Without this convective heat transport it is estimated that the mean temperature of the planet would increase by over 20 degrees F, making many areas uninhabitable.

By definition, the National Weather Service classifies a thunderstorm as severe if it contains hail of three-quarter inches or larger, and/or wind gusts of 58 mph or higher, and/or a tornado. Severe thunderstorm watches, meaning conditions are suitable for severe thunderstorm development during the next several hours, are issued for areas several hundred miles on a side by the National Weather Service Storm Prediction Center in Norman, Oklahoma. A severe thunderstorm warning is issued by the local NWS office, usually for a county or several counties over an hour or so, based on spotter reports or radar indications of conditions exceeding severe levels. If there is a distinct threat or actual observation of a tornado, a tornado warning is issued. Tornadoic storms also produce hail, downbursts, and lightning.

Hazard Profile

Thunderstorms are generally localized events. The severity of impact of thunderstorms in Bosque County and participating jurisdictions is considered to be limited; since they generally result in injuries treatable with first aid, shut down critical facilities and services for 24 hours or less, and less than ten percent of affected properties are destroyed or suffer major damage.

Most thunderstorms occur during the spring (March, April and May) and the fall, during the month of September.

Warning times for thunderstorms are generally minimal or no warning.

History of Thunderstorms

Table 8-1 gives aggregated historical thunderstorm information for Bosque County and participating jurisdictions. Historical thunderstorm events are detailed in Table 8-2. It is important to note that only thunderstorms that have been reported are recorded in these tables. It is likely that a higher number of occurrences have not been reported.

The frequency of thunderstorms (or probability of occurrence) in Bosque County and participating jurisdictions is highly likely as indicated in Figure 8-1.

Table 8-1: Thunderstorms in Bosque County, 1996-2013

Storm Events Database

Search Results for BOSQUE (County), (TEXAS)

52 event(s) were reported between 01/01/1996 and 03/31/2013 (6300 days)

Summary Info:

Number of County/Zone areas affected:	1
Number of Days with Event:	43
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	27
Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1

Column Definitions:

'Mag': Magnitude, 'Dth': Deaths, 'Inj': Injuries, 'PrD': Property Damage, 'CrD': Crop Damage

Select:

Sort By:

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	0	663.50 K	0.00 K
MOSHIEM	BOSQUE CO.	TX	04/13/1996	22:05	CST	Thunderstorm Wind		0	0	2.00K	0.00 K
WOMACK	BOSQUE CO.	TX	05/28/1996	17:45	CST	Thunderstorm Wind	52 kts	0	0	0.00K	0.00 K

							.				
CRANFIL LS GAP	BOSQUE CO.	T X	05/29/19 96	23:5 0	CST	Thunderstor m Wind	52 kts .	0	0	0.00K	0.00 K
MOSHIEM	BOSQUE CO.	T X	05/30/19 96	21:4 0	CST	Thunderstor m Wind		0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	08/31/19 96	15:3 0	CST	Thunderstor m Wind		0	0	0.00K	0.00 K
MERIDIA N	BOSQUE CO.	T X	11/07/19 96	00:2 0	CST	Thunderstor m Wind	52 kts .	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	11/24/19 96	03:0 0	CST	Thunderstor m Wind		0	0	100.00 K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	05/30/19 97	14:3 0	CST	Thunderstor m Wind		0	0	0.00K	0.00 K
KOPPERL	BOSQUE CO.	T X	06/22/19 97	12:4 5	CST	Thunderstor m Wind		0	0	0.00K	0.00 K
MORGAN	BOSQUE CO.	T X	07/15/19 97	16:3 6	CST	Thunderstor m Wind		0	0	0.00K	0.00 K
MERIDIA N	BOSQUE CO.	T X	10/23/19 97	14:5 5	CST	Thunderstor m Wind	61 kts .	0	0	0.00K	0.00 K
MERIDIA N	BOSQUE CO.	T X	07/17/19 98	13:0 0	CST	Thunderstor m Wind		0	0	0.50K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	05/27/20 00	18:5 1	CST	Thunderstor m Wind	52 kts . E	0	0	0.00K	0.00 K
MORGAN	BOSQUE CO.	T X	06/15/20 00	07:4 9	CST	Thunderstor m Wind		0	0	15.00K	0.00 K
MERIDIA N	BOSQUE CO.	T X	04/11/20 01	03:5 0	CST	Thunderstor m Wind	52 kts . E	0	0	0.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	10/12/20 01	21:0 4	CST	Thunderstor m Wind		0	0	25.00K	0.00 K
MERIDIA N	BOSQUE CO.	T X	04/07/20 02	18:4 5	CST	Thunderstor m Wind	52 kts . E	0	0	2.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	04/16/20 02	16:0 0	CST	Thunderstor m Wind	52 kts	0	0	0.00K	0.00 K

							. E				
MERIDIAN	BOSQUE CO.	T X	06/16/20 02	00:0 0	CST	Thunderstor m Wind	52 kts . E	0	0	2.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	08/14/20 02	17:0 0	CST	Thunderstor m Wind	52 kts . E	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	06/11/20 03	22:3 0	CST	Thunderstor m Wind	52 kts . ES	0	0	0.00K	0.00 K
MORGAN	BOSQUE CO.	T X	06/15/20 03	00:4 5	CST	Thunderstor m Wind	52 kts . ES	0	0	2.00K	0.00 K
IREDELL	BOSQUE CO.	T X	08/27/20 03	16:0 5	CST	Thunderstor m Wind	52 kts . ES	0	0	1.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	03/04/20 04	14:1 0	CST	Thunderstor m Wind	52 kts . ES	0	0	5.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	03/04/20 04	14:1 5	CST	Thunderstor m Wind	52 kts . ES	0	0	5.00K	0.00 K
LAGUNA PARK	BOSQUE CO.	T X	03/04/20 04	14:2 0	CST	Thunderstor m Wind	52 kts . ES	0	0	2.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	03/04/20 04	14:3 9	CST	Thunderstor m Wind	52 kts . M S	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	07/13/20 05	14:0 0	CST	Thunderstor m Wind	50 kts . ES	0	0	0.00K	0.00 K
WALNUT	BOSQUE CO.	T	04/28/20	14:1	CST	Thunderstor	78	0	0	5.00K	0.00

SPGS	CO.	X	06	7		m Wind	kts					K
							ES					
							50 kts					
MERIDIAN	BOSQUE CO.	T X	03/29/20 07	15:2 5	CST -6	Thunderstorm Wind	EG	0	0	20.00K		0.00 K
							78 kts					
MERIDIAN	BOSQUE CO.	T X	04/24/20 07	20:0 0	CST -6	Thunderstorm Wind	EG	0	0	20.00K		0.00 K
							70 kts					
WALNUT SPGS	BOSQUE CO.	T X	05/02/20 07	16:2 5	CST -6	Thunderstorm Wind	EG	0	0	70.00K		0.00 K
							50 kts					
CLIFTON	BOSQUE CO.	T X	08/17/20 07	18:2 0	CST -6	Thunderstorm Wind	EG	0	0	5.00K		0.00 K
							50 kts					
CLIFTON	BOSQUE CO.	T X	04/10/20 08	02:1 0	CST -6	Thunderstorm Wind	EG	0	0	1.00K		0.00 K
							61 kts					
CRANFILLS GAP	BOSQUE CO.	T X	04/23/20 08	19:2 5	CST -6	Thunderstorm Wind	EG	0	0	100.00K		0.00 K
							52 kts					
MOSHIEM	BOSQUE CO.	T X	04/23/20 08	21:3 0	CST -6	Thunderstorm Wind	EG	0	0	15.00K		0.00 K
							50 kts					
VALLEY MILLS	BOSQUE CO.	T X	08/03/20 08	20:0 0	CST -6	Thunderstorm Wind	EG	0	0	1.00K		0.00 K

							G				
							50 kts				
WALNUT SPGS	BOSQUE CO.	T X	10/06/20 08	17:2 8	CST -6	Thunderstor m Wind	E G	0	0	10.00K	0.00 K
							70 kts				
LAGUNA PARK	BOSQUE CO.	T X	02/10/20 09	21:1 5	CST -6	Thunderstor m Wind	E G	0	0	100.00 K	0.00 K
							70 kts				
WALNUT SPGS	BOSQUE CO.	T X	04/27/20 09	04:2 5	CST -6	Thunderstor m Wind	E G	0	0	5.00K	0.00 K
							61 kts				
WALNUT SPGS	BOSQUE CO.	T X	08/25/20 09	15:4 5	CST -6	Thunderstor m Wind	E G	0	0	5.00K	0.00 K
							50 kts				
WALNUT SPGS	BOSQUE CO.	T X	05/16/20 10	18:0 5	CST -6	Thunderstor m Wind	E G	0	0	3.00K	0.00 K
							70 kts				
CRANFIL LS GAP	BOSQUE CO.	T X	04/10/20 11	23:5 4	CST -6	Thunderstor m Wind	E G	0	0	10.00K	0.00 K
							70 kts				
CRANFIL LS GAP	BOSQUE CO.	T X	04/10/20 11	23:5 4	CST -6	Thunderstor m Wind	E G	0	0	30.00K	0.00 K
							65 kts				
KOPPERL	BOSQUE CO.	T X	04/10/20 11	23:5 5	CST -6	Thunderstor m Wind	E G	0	0	10.00K	0.00 K

MERIDIAN	BOSQUE CO.	T X	04/10/2011	23:55	CST-6	Thunderstorm Wind	65 kts · E G	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	04/10/2011	23:56	CST-6	Thunderstorm Wind	70 kts · E G	0	0	50.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	04/11/2011	00:00	CST-6	Thunderstorm Wind	65 kts · E G	0	0	2.00K	0.00 K
BOSQUE CO.	BOSQUE CO.	T X	06/21/2011	21:09	CST-6	Thunderstorm Wind	52 kts · E G	0	0	0.00K	0.00 K
BOSQUE CO.	BOSQUE CO.	T X	06/21/2011	21:45	CST-6	Thunderstorm Wind	61 kts · E G	0	0	25.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	09/18/2011	21:00	CST-6	Thunderstorm Wind	50 kts · E G	0	0	0.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	10/08/2011	16:50	CST-6	Thunderstorm Wind	52 kts · E G	0	0	15.00K	0.00 K
Totals:								0	0	663.50 K	0.00 K

People and Property at Risk

There is no defined geographic boundary for thunderstorm events. Thunderstorms usually impact large geographical areas; thus, all the population, buildings, infrastructure and lifelines in Bosque County and participating jurisdictions are considered exposed to the hazard and could potentially be impacted.

SECTION 9: WINTER STORMS

Why Winter Storms Are a Threat

A severe winter storm event includes a storm with snow, ice or freezing rain—all of which can cause significant problems for area residents. Winter storms that threaten Texas usually start out as powerful cold fronts that push south from central Canada.

Most of the precipitation seen in Bosque County from severe winter storms takes the form of ice or sleet. Freezing rain occurs when rain developing in a relatively warm (above freezing) layer of air falls through a layer of air that is below freezing (25-32° F). The rain is “supercooled” as it falls through the cold layer near the surface of the earth. When the supercooled but still liquid raindrops strike the ground or an object already below freezing, they freeze on contact. The resulting coating of ice is commonly known as glaze.

A heavy accumulation of ice can topple power and telephone lines, television towers, and trees. Highways become impossible to travel on, and even stepping outdoors can be extremely risky. The severity of an ice storm and the amount of damage caused by the storm depends on the amount of rain and thus the amount of icing taking place, the strength of the wind, and whether or not the storm strikes an urban or rural area. Urban areas tend to suffer more damage than rural areas because of the concentration of utilities and transportation systems (aircraft, trains, buses, trucks, and cars), all of which may be affected to a great degree by the icing.

Hazard Profile

The severity of impact of winter storms in Bosque County and participating jurisdictions is minor. Winter storms can cause injuries and completely shut down facilities for more than one week, and cause more than ten percent of affected properties to be destroyed or suffer major damage. The frequency of severe winter storm (or probability of occurrence) is highly likely as indicated in Figure 10-1.

A heavy accumulation of ice can topple power and telephone lines, television towers, and trees. Highways become impossible to travel on, and even stepping outdoors can be an extremely risky undertaking. Utility disruptions from winter storms can severely impact the delivery of services. Water pipes can freeze and crack in sub-freezing temperatures. Ice can build up on power lines and cause them to break under the weight, or ice on trees can cause tree limbs to fall on the lines. These events can disrupt electric service for long periods.

Warning time for winter storms is generally six to twelve hours.

Table 9-1: Winter Weather Alerts

Winter weather advisory	This alert may be issued for a variety of severe conditions. Weather advisories may be announced for snow, blowing or drifting snow, freezing drizzle, freezing rain, or a combination of weather events.
Winter storm watch	Severe winter weather conditions may affect your area (freezing rain, sleet or heavy snow may occur separately or in combination).
Winter storm warning	Severe winter weather conditions are imminent.
Freezing rain or freezing drizzle	Rain or drizzle is likely to freeze upon impact, resulting in a coating of ice glaze on roads and all other exposed objects.
Sleet	Small particles of ice, usually mixed with rain. If enough sleet accumulates on the ground, it makes travel hazardous.
Blizzard warning	Sustained wind speeds of at least 35 mph are accompanied by considerable falling or blowing snow. This alert is the most perilous winter storm with visibility dangerously restricted.
Frost/freeze warning	Below freezing temperatures are expected and may cause significant damage to plants, crops and fruit trees.
Wind chill	A strong wind combined with a temperature slightly below freezing can have the same chilling effect as a temperature nearly 50 degrees lower in a calm atmosphere. The combined cooling power of the wind and temperature on exposed flesh is called the wind-chill factor.

History of Severe Winter Storms

Winter storm events that have occurred in Bosque County and participating jurisdictions from 2000 to 2014 are presented in Table 9-2, along with reported injuries, deaths and damages.

Table 9-2: Severe Winter Storms, Bosque County, 2000–2014

<http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>

Type	Location	Date	Deaths	Injuries	Property Damage	Crop Damage
Winter storm	Bosque	1/25/2000	4	0	0	0
Winter Storm	Bosque	12/12/2000	0	0	0	0
Winter storm	Bosque	12/25/2000	0	0	0	0
Winter storm	Bosque	12/31/2000	0	0	0	0

People and Property at Risk

Winter storms usually impact large geographical areas; thus, all the population, buildings, infrastructure and lifelines in Bosque County and participating jurisdictions are considered exposed to the hazard and could potentially be impacted.

Potential Damages and Losses

Table 9-3 presents annualized expected property losses due to winter storms in Bosque County.

Table 9-3: Potential Annualized Losses due to Winter Storms in Bosque County

County	Annualized Expected Property Losses (\$)
Bosque	\$1,450.00

SECTION 10: HAIL

Why Hailstorms Are a Threat

Large hail results in nearly \$1 billion in damage annually to property and crops in the United States. Hail is made up of spherical balls of ice. It is a product of thunderstorms or intense showers. It is generally white and translucent, consisting of liquid or snow particles encased with layers of ice. Hail is formed within the high tops of a well organized thunderstorm. An updraft will sometimes throw rain droplets high up into the tops of a cloud, where the temperature is well below freezing. The droplet freezes, then falls and can become caught in another updraft. This time, a second coating of ice is added, making the hail stone larger. This cycle continues until the hailstone is too heavy to be lifted again and falls to the ground as hail. The stronger the updraft, the longer the hail develops and the bigger the hailstone is when it falls.

Hail is not to be confused with sleet, which consists of frozen raindrops that fall during winter storms. Hail can be smaller than a pea or as large as a softball and can be very destructive to plants, cars, homes, buildings and crops.

The development and maturation of hailstones are very complex processes. Numerous factors impact the resultant size of the hailstone including updraft strength, storm scale wind profile, height of the freezing level, and the mean temperature and relative humidity of downdraft air. The complexities of hail formation and sub-cloud processes make utilizing Doppler radar data to forecast the occurrence of large hail difficult. Verification of hail events is also important, but is a cumbersome process due to the limited temporal and spatial distribution of the event.

Large hailstones fall at speeds faster than 100 mph. Large falling balls of ice can be very dangerous. Large hail can do significant damage to automobiles, windows, roofs, crops and animals. When caught in a hailstorm, it is important to seek shelter immediately. Pets and livestock are particularly vulnerable to hail, and should be brought into a shelter.

Hazard Profile

Hailstorms are generally localized and their impact in Bosque County and participating jurisdictions is considered limited since the injuries they cause are generally treatable with first aid, they shut down critical facilities and services for 24 hours or less, and less than ten percent of affected properties are destroyed or suffer major damage.

Hail events in Bosque County and participating jurisdictions are highly likely. Most hailstorms occur during the spring (March, April and May) and the fall, during the month of September.

Warning time for a hailstorms is generally minimal or no warning. The National Weather Service classifies a storm as severe if hail of ¾ of an inch in diameter (approximately the size of a penny) or greater is imminent based on radar intensities or observed by a spotter or other people.

History of Hailstorms

Historical hail events in Bosque County and participating jurisdictions with hailstone size one inch or greater are listed in Table 10-1.

**Table 10-1: Overall Historical Hail Impact for Bosque County
(National Climatic Data Center), 1996-2014**

Storm Events Database

Search Results for BOSQUE (County), (TEXAS)

87 event(s) were reported between 01/01/1996 and 03/31/2013 (6300 days)

Summary Info:

Number of County/Zone areas affected:	1
Number of Days with Event:	48
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	5
Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1

Column Definitions:

'Mag': Magnitude, 'Dth': Deaths, 'Inj': Injuries, 'PrD': Property Damage, 'CrD': Crop Damage

Select:

Sort By:

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dt h	In i	PrD	CrD
Totals:								0	0	68.00 K	0.00 K
CRANFILL S GAP	BOSQUE CO.	T X	03/24/199 6	13:5 8	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K

MERIDIAN	BOSQUE CO.	T X	03/24/1996	14:13	CST	Hail	0.8 8 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	04/13/1996	21:15	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
WOMACK	BOSQUE CO.	T X	05/28/1996	17:29	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
LAGUNA PARK	BOSQUE CO.	T X	09/20/1996	15:35	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	09/20/1996	17:00	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
MORGAN	BOSQUE CO.	T X	10/21/1996	13:30	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
MORGAN	BOSQUE CO.	T X	10/21/1996	14:30	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	10/21/1996	14:33	CST	Hail	2.2 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	10/21/1996	15:10	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	01/04/1998	20:00	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
KOPPERL	BOSQUE CO.	T X	01/05/1998	19:35	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	04/07/1998	22:05	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	05/02/1998	18:00	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
CRANFILL S GAP	BOSQUE CO.	T X	05/17/1999	11:53	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	05/17/1999	12:47	CST	Hail	0.8 8 in.	0	0	0.00K	0.00 K
IREDELL	BOSQUE CO.	T X	05/17/1999	16:19	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
IREDELL	BOSQUE CO.	T X	05/17/1999	17:30	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	05/17/1999	18:03	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	05/27/1999	21:25	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K

VALLEY MILLS	BOSQUE CO.	T X	03/02/200 0	20:0 0	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	03/10/200 0	16:2 0	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	03/10/200 0	17:0 0	CST	Hail	0.8 8 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	03/16/200 0	18:2 8	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
CRANFILL S GAP	BOSQUE CO.	T X	03/16/200 0	18:4 5	CST	Hail	0.8 8 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	03/16/200 0	19:1 4	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
KOPPERL	BOSQUE CO.	T X	03/28/200 0	18:4 5	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	05/04/200 0	07:5 1	CST	Hail	1.5 0 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	05/12/200 0	16:5 0	CST	Hail	2.7 5 in.	0	0	0.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	05/12/200 0	17:3 1	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
CRANFILL S GAP	BOSQUE CO.	T X	03/11/200 1	19:3 0	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	03/11/200 1	19:5 5	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
LAKESIDE VLG	BOSQUE CO.	T X	03/11/200 1	23:0 0	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	05/05/200 1	14:2 4	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	05/05/200 1	15:1 0	CST	Hail	2.0 0 in.	0	0	0.00K	0.00 K
IREDELL	BOSQUE CO.	T X	01/24/200 2	06:0 2	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	01/24/200 2	06:0 8	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	03/30/200 2	16:3 9	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	04/16/200 2	15:3 0	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K

WALNUT SPGS	BOSQUE CO.	T X	04/16/200 2	18:0 1	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	04/16/200 2	18:0 1	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	04/16/200 2	20:1 6	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	04/16/200 2	21:4 0	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	04/24/200 2	17:5 2	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	05/09/200 2	21:1 0	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
MORGAN	BOSQUE CO.	T X	05/09/200 2	21:4 5	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
IREDELL	BOSQUE CO.	T X	12/23/200 2	17:5 5	CST	Hail	0.8 8 in.	0	0	0.00K	0.00 K
MORGAN	BOSQUE CO.	T X	12/23/200 2	18:2 0	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	12/23/200 2	19:2 5	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	12/30/200 2	15:0 3	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	02/21/200 3	13:4 0	CST	Hail	0.8 8 in.	0	0	0.00K	0.00 K
KOPPERL	BOSQUE CO.	T X	05/01/200 3	16:3 0	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
LAGUNA PARK	BOSQUE CO.	T X	05/01/200 3	18:0 8	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	05/01/200 3	19:1 6	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
MORGAN	BOSQUE CO.	T X	05/02/200 3	16:4 5	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	05/02/200 3	17:0 8	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
IREDELL	BOSQUE CO.	T X	06/12/200 3	20:5 5	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
IREDELL	BOSQUE CO.	T X	06/12/200 3	21:5 5	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K

MERIDIAN	BOSQUE CO.	T X	06/12/200 3	23:1 0	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
IREDELL	BOSQUE CO.	T X	04/30/200 4	20:2 5	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
IREDELL	BOSQUE CO.	T X	04/30/200 4	20:3 8	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
CLIFTON	BOSQUE CO.	T X	11/23/200 4	09:3 9	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	11/23/200 4	18:2 8	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
LAKESIDE VLG	BOSQUE CO.	T X	04/05/200 5	16:3 5	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	05/09/200 5	18:1 9	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	05/09/200 5	18:2 2	CST	Hail	2.7 5 in.	0	0	0.00K	0.00 K
KOPPERL	BOSQUE CO.	T X	05/09/200 5	18:5 5	CST	Hail	1.5 0 in.	0	0	0.00K	0.00 K
KOPPERL	BOSQUE CO.	T X	05/09/200 5	19:0 5	CST	Hail	1.7 5 in.	0	0	0.00K	0.00 K
BRAZOS PT	BOSQUE CO.	T X	03/18/200 6	11:3 1	CST	Hail	1.0 0 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	04/25/200 6	16:1 5	CST	Hail	0.7 5 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	04/28/200 6	14:1 7	CST	Hail	0.8 8 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	05/01/200 6	23:3 8	CST	Hail	1.7 5 in.	0	0	5.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	05/04/200 6	04:1 5	CST	Hail	0.8 8 in.	0	0	0.00K	0.00 K
MERIDIAN	BOSQUE CO.	T X	05/04/200 6	19:2 2	CST	Hail	1.7 5 in.	0	0	5.00K	0.00 K
LAGUNA PARK	BOSQUE CO.	T X	04/13/200 7	18:2 6	CST -6	Hail	0.8 8 in.	0	0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	04/23/200 8	19:3 0	CST -6	Hail	2.7 5 in.	0	0	25.00 K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	04/23/200 8	19:3 7	CST -6	Hail	1.7 5 in.	0	0	5.00K	0.00 K

WALNUT SPGS	BOSQUE CO.	T X	04/23/200 8	20:4 0	CST -6	Hail	2.7 5 in.	0 0	0 0	20.00 K	0.00 K
LAKESIDE VLG	BOSQUE CO.	T X	04/27/200 8	00:5 5	CST -6	Hail	0.7 5 in.	0 0	0 0	0.00K	0.00 K
LAGUNA PARK	BOSQUE CO.	T X	06/12/200 9	20:3 3	CST -6	Hail	0.8 8 in.	0 0	0 0	0.00K	0.00 K
LAKESIDE VLG	BOSQUE CO.	T X	04/23/201 0	22:5 8	CST -6	Hail	0.7 5 in.	0 0	0 0	0.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	05/16/201 0	18:1 1	CST -6	Hail	1.7 5 in.	0 0	0 0	4.00K	0.00 K
WALNUT SPGS	BOSQUE CO.	T X	05/16/201 0	18:1 5	CST -6	Hail	0.8 8 in.	0 0	0 0	0.00K	0.00 K
MORGAN	BOSQUE CO.	T X	05/16/201 0	18:1 5	CST -6	Hail	1.0 0 in.	0 0	0 0	0.00K	0.00 K
VALLEY MILLS	BOSQUE CO.	T X	05/20/201 0	19:3 7	CST -6	Hail	1.7 5 in.	0 0	0 0	4.00K	0.00 K
LAGUNA PARK	BOSQUE CO.	T X	09/26/201 1	19:5 1	CST -6	Hail	1.0 0 in.	0 0	0 0	0.00K	0.00 K
KOPPERL	BOSQUE CO.	T X	04/03/201 2	13:0 5	CST -6	Hail	0.7 5 in.	0 0	0 0	0.00K	0.00 K
Totals:								0 0	0 0	68.00 K	0.00 K

Table 10-2. Overall Historical Hail Impact in Bosque County (National Climatic Data Center)

County	Number of Events	Maximum Diameter (inches)
Bosque	87	2.75

People and Property at Risk

Because it cannot be predicted where hail may fall, all buildings and facilities in Bosque County and participating jurisdictions are considered to be exposed to this hazard and could potentially be impacted, so estimated annualized losses cannot be broken down into further categories (residential, commercial, etc.). It is important to note that only hail that has been reported has been factored into this risk assessment.

Potential Damages and Losses

To estimate losses due to hail, the county used NOAA historical hail loss data to develop a hail stochastic model. In this model:

Losses were scaled to account for inflation;

Average historic hail damageability was used to generate losses for historical hail events where losses were not reported;

Expected annualized losses were calculated through a non-linear regression of historical data; and

Probabilistic losses were scaled to account for would-be losses where no exposure/instrument was present at the time of the event.

Table 10-3 shows potential annualized losses in Bosque County.

**Table 10-3: Overall Historical Hail Impact for Bosque County
(National Climatic Data Center)**

County	Annualized Expected Property Damage (\$)
Bosque	\$68,000

SECTION 11: DAM FAILURE

Why Dam Failure Is a Threat

Dams are water storage, control, or diversion barriers that impound water upstream in reservoirs. Dams provide many benefits and are an important part of our public works infrastructure. They are built for a variety of reasons, including maintenance of lake levels, flood control, power production, and water supply.

Although dams have many benefits, the risk that a dam could fail still exists. Dams can pose a risk to communities if not designed, operated and maintained properly. Dam failure is a collapse or breach in the structure. While most dams have storage volumes small enough that failures have little or no repercussions, dams with large storage amounts can cause significant flooding downstream. Dam failures can result from any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding, which cause most failures;

- Inadequate spillway capacity, resulting in excess overtopping flows;

- Internal erosion caused by embankment or foundation leakage or piping;

- Improper maintenance, including failure to remove trees, repair internal problems, or maintain gates, valves, and other operational components;

- Improper design, such as use of improper construction materials;

- Failure of upstream dams in the same drainage basin;

- Landslides into reservoirs, which cause surges that result in overtopping;

- High winds, which can cause significant wave action and result in substantial erosion;

- Earthquakes, which typically cause longitudinal cracks at the tops of the embankments, leading to structural failure.

Dam failures may result in the quick release of all the water in the lake. In the event of a dam failure, the energy of the water stored behind the dam is capable of causing rapid and unexpected flooding downstream, which could result in loss of life and property damage downstream of the dam, in some circumstances.

Hazard Profile

Failure of a major dam is an unlikely event. If a major dam should fail, however, the severity of impact to rural Bosque County could be limited. It could cause injuries or illnesses that are treatable with first aid, minor quality of life lost, shutdown of critical facilities and services for 24 hours or less, or less than 10% of property destroyed or with major damage.

The frequency of dam failure or probability of its occurrence in Bosque County and participating jurisdictions is unlikely.

Flooding-related dam failure would most likely occur in months when floods are most likely -- during the spring (April, May and June) and fall (October, November, and December). Warning time for dam failure, or the potential speed of onset, varies with the causes but is estimated to be three to six hours.

TCEQ defines a “high hazard” dam as one that could expect to have some loss of life and property damage if the dam should fail.

Bosque County and participating jurisdictions have no information concerning the off Channel Dam and Lake Whitney Kopperl Levee. These are on private property and are not owned or maintained by the participating jurisdictions.

Lake Whitney Dam in Bosque County is classified as a “high hazard” dam. Lake Whitney is on the Brazos River and shares a border with Hill County.

The map in Figure 11-1 shows the location of Lake Whitney.

Figures 11-2 and 11-3 on the following pages show the expected dam failure inundation zone for Lake Whitney Dam.

Location of Hazardous Areas

Figure 11-1: Location of Lake Whitney Dam in Bosque County

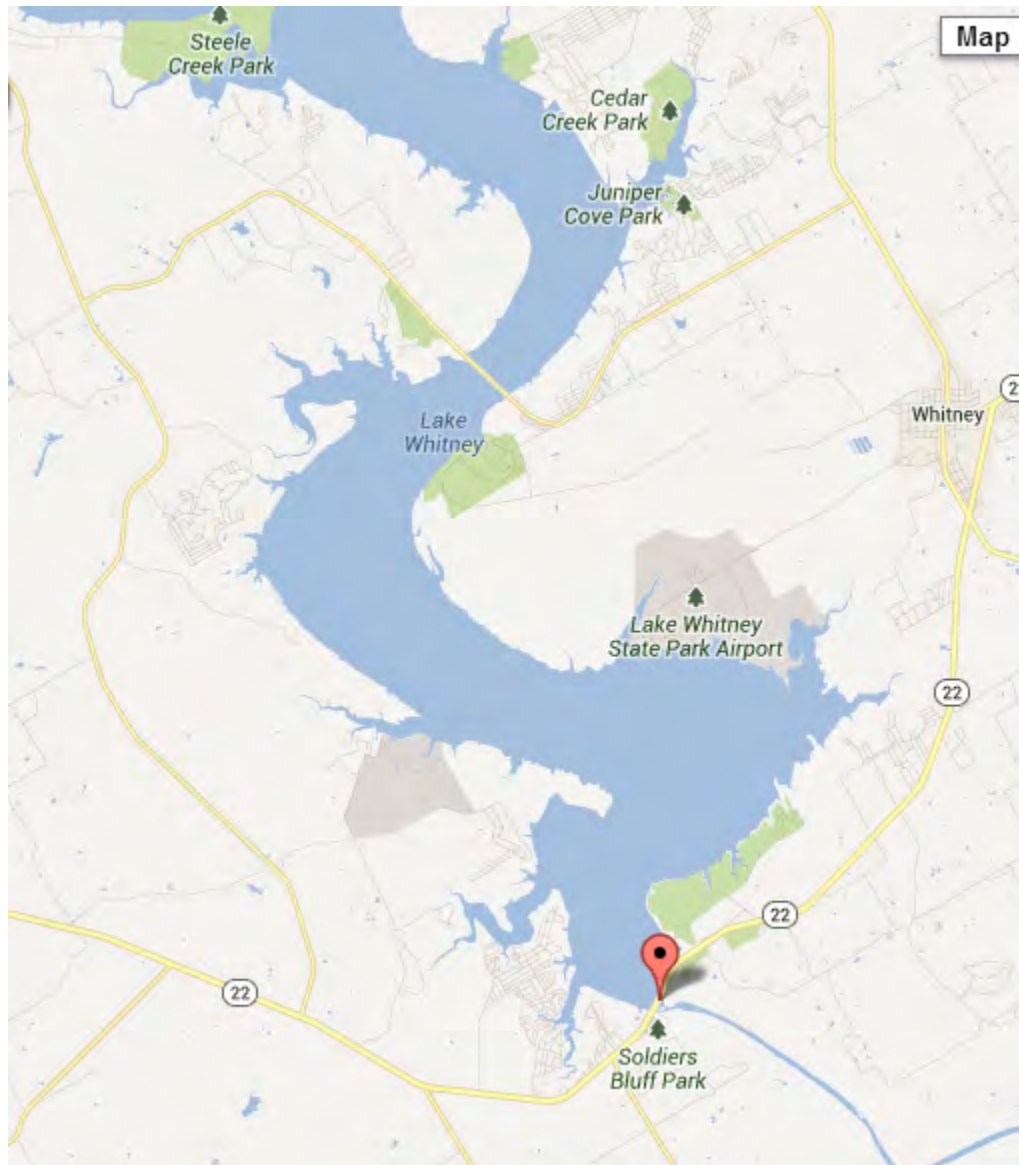


Figure 11-2: Location of Dam Failure Inundation Zone for Lake Whitney Dam

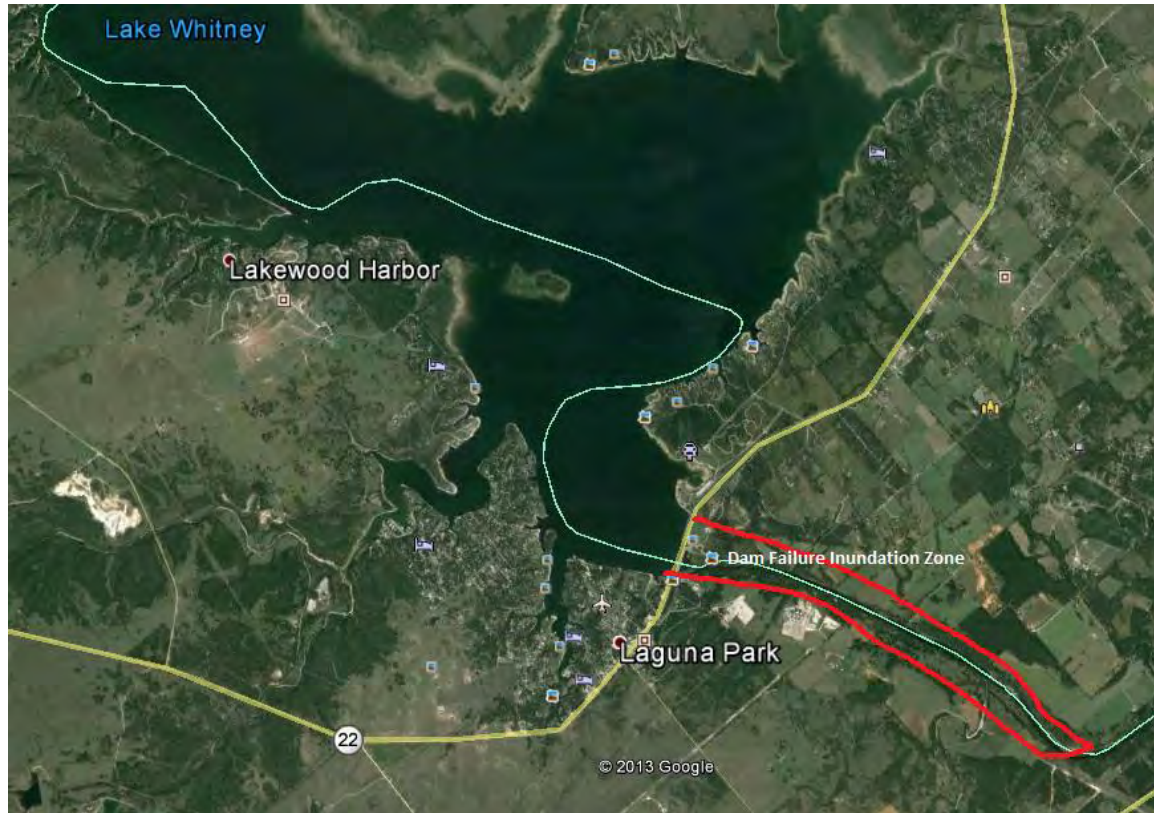
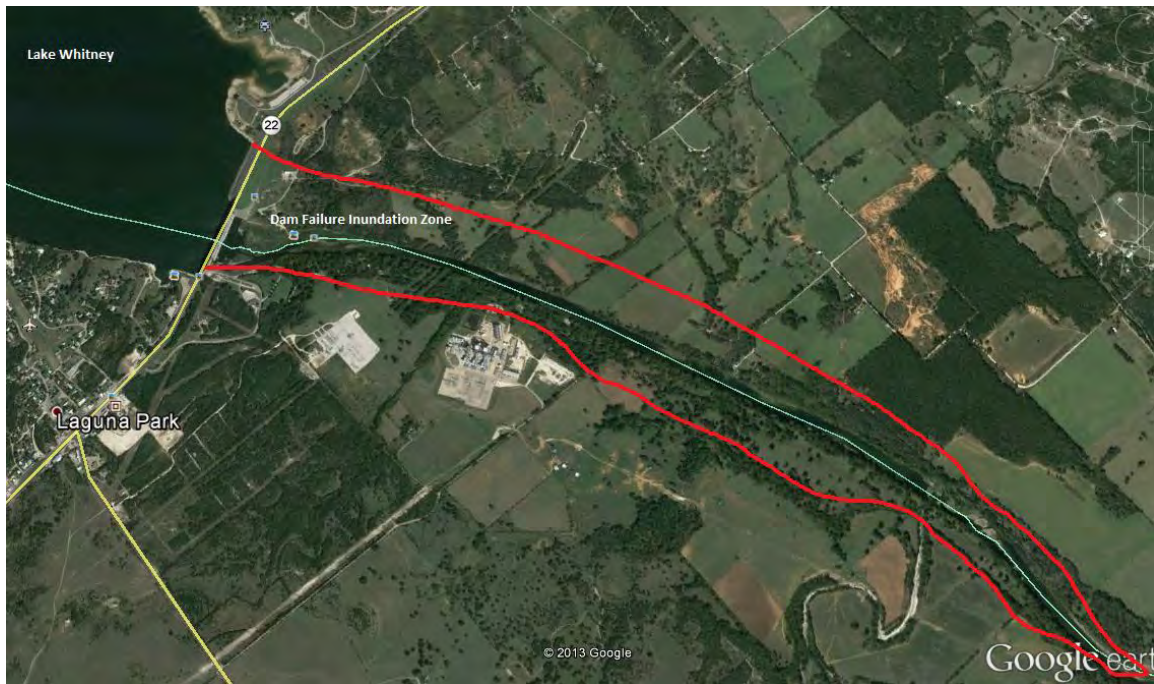


Figure 11-3: A close-up of the Dam Failure Inundation Zone for Lake Whitney Dam



People and Property at Risk

The failure of a high hazard dam would probably cause the loss of human life and the destruction of some structures or property damage within rural Bosque County. The cities of Clifton, Cransfills Gap, Iredell, Meridian, Morgan, Valley Mills and Walnut Springs are not located downstream of or near to any high hazard dams, and therefore, are not vulnerable to the affects of dam failure. Therefore, the communities of Clifton, Cransfills Gap, Iredell, Meridian, Morgan, Valley Mills and Walnut Springs will not present any action items for the hazard of dam failure.

The Lake Whitney Dam is classified as a high hazard dam. Table 11-1 below shows the extent of damage expected from a dam failure at Lake Whitney.

Table 11-1: Extent of Dam Failure in Bosque County

Location	Dam	Hazard	People Impacted	Structures Impacted	Depth of Water
Bosque County	Lake Whitney Dam	High	24	36	13 feet deep nearest to the dam

SECTION 12: GOALS & OBJECTIVES

Overall Goal

To reduce or eliminate the long-term risks to loss of life and property damage in Bosque County from a range of disasters.

Goal 1 Increase public understanding, support and demand for hazard mitigation.

Objective 1.1 Heighten public awareness of a range of natural and man-caused hazards they face.

Objective 1.2 Educate the public on actions they can take to prevent or reduce the loss of life or property from all hazards.

Objective 1.3 Publicize and encourage the adoption of appropriate hazard mitigation measures.

Goal 2 Protect public health and safety.

Objective 2.1 Advise the public about health and safety precautions to guard against injury and loss of life from hazards.

Objective 2.2 Maximize the utilization of the latest technology to provide adequate warning, communication, and mitigation of hazard events.

Objective 2.3 Reduce the danger to, and enhance protection of, dangerous areas during hazard events.

Objective 2.4 Protect critical facilities and services.

Goal 3 Protect existing and new properties.

- Objective 3.1 Reduce repetitive losses to the National Flood Insurance Program.
- Objective 3.2 Use the most cost-effective approaches to protect existing buildings and public infrastructure from hazards.
- Objective 3.3 Enact and enforce regulatory measures to ensure that development will not put people in harm's way or increase threats to existing properties.

Goal 4 Build and support local capacity and commitment to continuously become less vulnerable to hazards.

- Objective 4.1 Build and support local partnerships to continuously become less vulnerable to hazards.
- Objective 4.2 Build a cadre of committed volunteers to safeguard the community before, during, and after a disaster.
- Objective 4.3 Build hazard mitigation concerns into planning and budgeting processes.

Goal 5 Promote growth in a sustainable manner.

- Objective 5.1 Incorporate hazard mitigation into the long-range planning and development activities.
- Objective 5.2 Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.
- Objective 5.3 Utilize regulatory approaches to prevent creation of future hazards to life and property.

Goal 6 Maximize the resources for investment in hazard mitigation.

- Objective 6.1 Maximize the use of outside sources of funding.
- Objective 6.2 Maximize participation of property owners in protecting their properties.

- Objective 6.3 Maximize insurance coverage to provide financial protection against hazard events.
- Objective 6.4 Prioritize mitigation projects, based on cost-effectiveness and starting with those sites facing the greatest threat to life, health and property.

SECTION 13: PREVIOUS & FUTURE ACTION ITEMS

Planning efforts previously completed by participating jurisdictions within Bosque County include the development of hazard analyses, Annex P, comprehensive plans, capital improvement plans, drainage and stormwater plans, long-range growth plans and flood mitigation plans. Table 13-1 details these previous planning efforts.

Table 13-1: Previous Planning Efforts for Bosque County Jurisdictions

Jurisdiction	Received EM Grant Funds?	Planning Documents Completed for State Department of Emergency Management		Other Planning Efforts Undertaken (list)
		Basic Plan	Annexes**	
Bosque County				
Bosque County	Y	Y	All annexes	Long-range growth plan (1992) DOJ/DPA ¹
City of Clifton	N	Y	None	Federal Emergency Management Agency (FEMA) Flood Mitigation Assistance plan DOJ/DPA
City of Cranfills Gap	N	Y	None	Long-range growth plan Master drainage and stormwater plans Capital Improvement plan DOJ/DPA
City of Iredell	N	Y	Annexes G, H, L, and R	Watershed Protection plan Master drainage and stormwater plans DOJ/DPA
City of Meridian	N	Y	None	DOJ/DPA
City of Morgan	N	Y	None	DOJ/DPA

¹ Department of Justice Terrorism Vulnerability Assessment/Texas Domestic Preparedness Assessment

Jurisdiction	Received EM Grant Funds?	Planning Documents Completed for State Department of Emergency Management		Other Planning Efforts Undertaken (list)
		Basic Plan	Annexes**	
City of Valley Mills	N	Y	Annexes B, E, F, G, Q, and R	Capital Improvement plan
City of Walnut Springs	N	Y	Annexes A, B, F, and P	FEMA Hazard Mitigation Grant Program plan Long-range growth plan Watershed Protection plan Master drainage and stormwater plans (as needed) DOJ/DPA

Annex A	Warning
Annex B	Communications
Annex C	Shelter and Mass Care Donations Management
Annex D	Radiological Protection
Annex E	Evacuation
Annex F	Firefighting and Fire/Rescue
Annex G	Law Enforcement
Annex H	Health and Medical Services
Annex I	Emergency Public Information
Annex J	Damage Assessment/Recovery
Annex K	Public Works and Engineering
Annex L	Utilities
Annex M	Resource Management
Annex N	Direction and Control
Annex O	Human Services
Annex P	Hazard Mitigation
Annex Q	Hazardous Materials and Oil Spill Response
Annex R	Search and Rescue
Annex S	Transport
Annex T	Donations
Annex U	Legal
Annex V	Terrorist Incident

Table 13-2 shows the effective date of each jurisdiction’s building code, the name of the code, the type of code on which it is based, and whether any amendments have been made. Only the cities have the authority to adopt building codes; counties in Texas do not have this authority.

Table 13-2: Bosque County Building Codes

	Current Building Code							
	Effective Date ²	Name	Type					Amend-ments made (Y /N)
			UBC	NBC	SBC	IBC	Other	
Bosque County								
Bosque County	NA							
City of Clifton	Aug. 1995	Standard Building Code – 1995 Standard Plumbing Code – 1995 National Electric Code – 1999			X			N
City of Cranfills Gap	NA							
City of Iredell	NA							
City of Meridian	- ³	Southern Standard Building Codes			X			N
City of Morgan	NA							
City of Valley Mills	12-10-73	Southern Standard Building Codes			X			N
City of Walnut Springs	-	Southern Standard Building Codes			X			N

² “NA” in this column indicates that the jurisdiction responded but has no building code.

³ A dash (-) indicates that no response was provided.

Table 13-3 shows the effective date of each jurisdiction's fire code, the name of the code, the type of code on which it is based, and whether any amendments have been made. As with building codes, participating cities have the authority to adopt fire codes, whereas counties do not.

Table 13-3: Fire Codes of Bosque County Jurisdictions

Jurisdiction	Current Fire Code					
	Effective Date ⁴	Name	Type			
			UFC	IFC	SFC	Other
Bosque County						
Bosque County	NA					
City of Clifton	NA					
City of Cranfills Gap	NA					
City of Iredell	NA					
City of Meridian	NA					
City of Morgan	NA					
City of Valley Mills	12-10-73	National Electric Code and National Electrical Safety Code				X
City of Walnut Springs	NA					

⁴ "NA" in this column indicates that the jurisdiction responded but has no fire code.

FUTURE MITIGATION ACTIONS

The following mitigation actions are ideas proposed by Bosque County and the participating jurisdictions to attempt to mitigate the known hazards that can have negative effects on the county and participating jurisdictions.

Each mitigation action table includes a description of the action, the estimated costs (if available), and the benefits derived if the project is ever funded and completed. Each table also includes the responsible organization for completing the action, an implementation schedule, objective(s) to which it is to achieve, the priority status of each action, and the potential funding sources.

Priority status of each action is defined as:

- High – should be implemented within two years
- Medium – should be implemented within three years
- Low – should be implemented within four years

When prioritizing the hazard mitigation actions, Bosque County and the participating jurisdictions considered the benefits versus the costs of implementing the actions. For example, the beneficial values were weighed against the financial costs of each project. If a project was worth twice its financial costs in beneficial values, then the project passed the cost benefit review and was selected for inclusion in this mitigation plan.

Bosque County and the participating jurisdictions will seek to obtain the necessary funding to implement the mitigation actions set forth when possible.

However, in this era of increased demands and constrained resources at all levels of government, the lack of resources, especially from external sources, may hamper the ability of the jurisdictions to implement some mitigation actions identified in the plan or to implement them within the timeframe specified.

Since mitigation grants generally do not pay for 100% of the necessary funds to complete the action, each participating jurisdiction will consider economic factors before deciding whether or not to apply for any of these grants.

Jurisdiction: Bosque County

ACTION: Public Outreach and Education

<i>Hazard</i>	Floods, Wildfire, Tornadoes, Thunderstorm, Winter Storm, Hail, Drought
<i>Background</i>	Public Outreach and Education is important in notifying the public about the dangers of natural hazards.
<i>Benefits</i>	Can save lives by educating the public on how to find safe shelter.
<i>Priority</i>	High
<i>Estimated cost</i>	\$2,500
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	Grants

ACTION: Improve emergency management radio coverage and reception.

<i>Hazard</i>	Floods, Wildfire, Tornadoes, Thunderstorm, Winter Storm, Hail
<i>Background</i>	Communication is critical to response and recovery. Current radio warning systems are out-of-date.
<i>Benefits</i>	Improved response and recovery; less loss of life and property damage.
<i>Priority</i>	High
<i>Estimated cost</i>	\$50,000 to \$100,000
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	Grants

ACTION: Implement program for clearing debris from drains and culverts to protect existing buildings.

<i>Hazard</i>	Flood
<i>Background</i>	Watershed flooding and storm drainage flooding is negatively impacted if culverts are not kept clear.
<i>Benefits</i>	To stop water coming over road.
<i>Priority</i>	High
<i>Estimated cost</i>	\$11,000
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	<i>Grants and general revenues</i>

ACTION: Implement a tree-trimming program that routinely clears tree limbs hanging in right-of-way of existing structures.

<i>Hazard</i>	Tornado, Winter Storm, Thunderstorm, Hail
<i>Background</i>	Maintaining clear right-of-way hazards will minimize loss of life and property.
<i>Benefits</i>	Keep roads clear; minimize loss of life and property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$5,000
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	<i>Grants and general revenue</i>

ACTION: Reinforce the roof of the Emergency Operations Center (EOC).

<i>Hazard</i>	Tornado, Winter Storm, Thunderstorm, Hail
---------------	---

<i>Background</i>	The roof of the County EOC is vulnerable to certain natural disasters. Reinforcing the roof can strengthen it from hazards.
<i>Benefits</i>	Keeping the EOC operational during a disaster is critical to saving lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$50,000
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Four years
<i>Funding sources</i>	<i>FEMA HMGP Mitigation Grants</i>

ACTION: Implement a backup plan for storing public records and digital copies offsite in a non-hazard area.

<i>Hazard</i>	Floods, Wildfire, Tornadoes, Thunderstorm, Winter Storm, Hail
<i>Background</i>	Maintenance and preservation of public records is critical to the ongoing continuity of government for the public good.
<i>Benefits</i>	Preservation of public records
<i>Priority</i>	High
<i>Estimated cost</i>	\$50,000 per year
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Four years
<i>Funding sources</i>	<i>Federal Grants, but ineligible for FEMA Mitigation Grants</i>

ACTION: Burn Bans

<i>Hazard</i>	Wildfire , Drought
<i>Background</i>	Wildfires can destroy structures, damage property and kill people
<i>Benefits</i>	Create and implement Burn Ban Ordinance to prevent wildfire and during drought periods to help conserve water.
<i>Priority</i>	High
<i>Estimated cost</i>	No Cost

<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	No costs

ACTION: Create a web-based GIS map locating all low-water crossings in the County, and include a system to monitor the water levels at each low-water crossing and automatically close roads when water reaches a certain level.

<i>Hazard</i>	Flood, Dam Failure
<i>Background</i>	Bosque County has many low water crossings, which flood during storm water runoff. Locating and automatically closing of the roads to passing vehicles during floods can prevent loss of life.
<i>Benefits</i>	Minimize loss of life and property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$50,000
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	Grants

ACTION: Establish an inspection program for all dams.

<i>Hazard</i>	Flood, Dam Failure
<i>Background</i>	Bosque County has a high hazard dam on Lake Whitney, which could have disastrous effects if it were to fail.
<i>Benefits</i>	To stop flooding above and below the dam.
<i>Priority</i>	High
<i>Estimated cost</i>	\$2,000
<i>Responsible organization</i>	Brazos River Authority, Bosque County, Corps of Engineers

<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>Grants and general revenue</i>

ACTION: Acquire structures located in the flood plain downstream of Lake Whitney.

<i>Hazard</i>	Flood, Dam Failure
<i>Background</i>	Bosque County has a high hazard dam on Lake Whitney, which could have disastrous effects if it were to fail. Acquisition of homes downstream of Lake Whitney could save lives and prevent property damage, should the dam fail.
<i>Benefits</i>	Can save lives and prevent property damage.
<i>Priority</i>	Low
<i>Estimated cost</i>	\$200,000
<i>Responsible organization</i>	Brazos River Authority, Bosque County OEM, Corps of Engineers
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>FEMA HMGP Mitigation Grants and SRL Mitigation Grants</i>

ACTION: Identify sites where stream and rain gauges need to be added or upgraded and coordinate installation requests with USGS and river authority.

<i>Hazard</i>	Flood
<i>Background</i>	Bosque County's main flooding problems occur during rainfall/storm water runoff. Collecting historic data can help mitigate future disastrous events.
<i>Benefits</i>	To stop people from driving into high water and study runoff effects in the County.
<i>Priority</i>	High
<i>Estimated cost</i>	\$1,000
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)

<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	Grants

ACTION: Establish and implement burning standards and develop public education program.

<i>Hazard</i>	Wildfire
<i>Background</i>	Unsafe burning practices can cause untold losses in crops, environmental damage, and potential loss of homes as well as many associated costs for fire suppression.
<i>Benefits</i>	Education to stop unsafe burning.
<i>Priority</i>	High
<i>Estimated cost</i>	\$2,500
<i>Responsible organization</i>	Bosque County Fire departments and Office of Emergency Management
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	Grants

ACTION: Install a network of dry hydrants in creeks and in small lakes.

<i>Hazard</i>	Wildfire
<i>Background</i>	Bosque County has at least 45 small lakes and many seasonal creeks that can be used as a water source during wildfire suppression. Sources for water close to the fire are critical to mitigate damage.
<i>Benefits</i>	Water supply increases during droughts, reduced damage from wildfires.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$25,000
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Four years

<i>Funding sources</i>	Grants
------------------------	---------------

ACTION: Educate community on the dangers of low water crossings (turn around, don't drown – education campaign).

<i>Hazard</i>	Flood
<i>Background</i>	Bosque County has many low water crossings that flood during storm-water runoff.
<i>Benefits</i>	Saving lives by preventing people from entering dangerous flood areas.
<i>Priority</i>	High
<i>Estimated cost</i>	\$1,000
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	Grant

ACTION: Public education on water conservation

<i>Hazard</i>	Drought
<i>Background</i>	Educating the public, through community outreach, on how to conserve water during periods of drought.
<i>Benefits</i>	Provides extra water during droughts for drinking or putting out wildfires.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	Grant

ACTION: **Require any future structures to be elevated 6 inches above Base Flood Elevation (BFE).**

<i>Hazard</i>	Floods, Thunderstorms
<i>Background</i>	Amend the floodplain ordinance to require any future structures built in the special flood hazard area to have the first floor raised 6 inches above the established BFE.
<i>Benefits</i>	Reduced loss of life and property damage by elevating structures in the 100 year floodplain
<i>Priority</i>	Medium
<i>Estimated cost</i>	No Cost
<i>Responsible organization</i>	Bosque County Office of Emergency Management (OEM)
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	No Costs

Jurisdiction: City of Clifton

ACTION: **Public Outreach and Education**

<i>Hazard</i>	Floods, Wildfire, Tornadoes, Thunderstorm, Winter Storm, Hail, Drought
<i>Background</i>	Public Outreach and Education is important in notifying the public about the dangers of natural hazards.
<i>Benefits</i>	Can save lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Clifton Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	Grants

ACTION: **Acquire homes located in the identified flood hazard area.**

<i>Hazard</i>	Flood
---------------	-------

<i>Background</i>	Some low lying areas are prone to flooding
<i>Benefits</i>	Save lives and prevents property damage by permanently removing the structures from the flood plain
<i>Priority</i>	High
<i>Estimated cost</i>	\$100,000 per structures
<i>Responsible organization</i>	City of Clifton Office of Emergency Management
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>FEMA HMGP grants</i>

ACTION: Elevate homes located in the identified flood hazard area.

<i>Hazard</i>	Floods
<i>Background</i>	Some low lying areas are prone to flooding
<i>Benefits</i>	Save lives and prevents property damage by elevating structures above the Base Flood Elevation within the flood plain
<i>Priority</i>	High
<i>Estimated cost</i>	\$50,000 per structure
<i>Responsible organization</i>	City of Clifton Office of Emergency Management
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>FEMA HMGP grants</i>

ACTION: Create and Implement Burn Bans

<i>Hazard</i>	Wildfire, Drought
<i>Background</i>	Create and implement an ordinance that prevents outdoor brush burning
<i>Benefits</i>	Create and implement Burn Ban Ordinance to prevent wildfire and during drought periods to help conserve water.
<i>Priority</i>	High
<i>Estimated cost</i>	No Costs

<i>Responsible organization</i>	City of Clifton Office of Emergency Management
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	No costs

ACTION: Public Outreach and Education

<i>Hazard</i>	Wildfire
<i>Background</i>	Educate the public about how to reduce vulnerability to wildfires around city structures through wildland/urban interface zones.
<i>Benefits</i>	Saves lives and prevents property damage
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Clifton Office of Emergency Management
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	Grants

ACTION: Implement a regular testing and maintenance program for all fire plugs/hydrants and sprinkler systems.

<i>Hazard</i>	Wildfire
<i>Background</i>	The current fire hydrant system, while adequate in numbers and area coverage, is large old and is not always tested on a regular basis. The city will implement and maintain the testing program, and to continue the maintenance and purchasing of parts as necessary to ensure its continued use.
<i>Benefits</i>	Public and property protection.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$10,000 to \$20,000 annually
<i>Responsible organization</i>	City of Clifton Office of Emergency Management

<i>Target completion timeline</i>	Four years
<i>Funding sources</i>	<i>Grants and general revenues</i>

ACTION: **Develop a drainage system improvement program that relieves in-town flooding and reduces widespread Bosque River flooding such as occurred twice in the early 1990s.**

<i>Hazard</i>	Flooding, Thunderstorms
<i>Background</i>	Historical floods struck the Bosque River and tributaries occurred in 1991/1994. Tributaries through town are contributors to flooding in the city limits, as well.
<i>Benefits</i>	Flood insurance and damage reduction.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$100,000 plus
<i>Responsible organization</i>	City of Clifton Office of Emergency Management
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>Local/Soil Conservation Service/other grants</i>

ACTION: **Build a community safe room**

<i>Hazard</i>	Tornado
<i>Background</i>	Build a dual-use community safe room
<i>Benefits</i>	Provides protection for local residents to safely wait until severe storms are over.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$500,000
<i>Responsible organization</i>	City of Clifton Office of Emergency Management
<i>Target completion timeline</i>	Five years

<i>Funding sources</i>	<i>Grants, LEPC</i>
------------------------	----------------------------

ACTION: Reinforce the roof of the Emergency Operations Center at City Hall.

<i>Hazard</i>	Tornado, Hail
<i>Background</i>	The roof of the City EOC is vulnerable to certain natural disasters. Reinforcing the roof can strengthen it from hazards.
<i>Benefits</i>	Keeping the EOC operational during a disaster is critical to saving lives.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$10,000
<i>Responsible organization</i>	City of Clifton Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>Local funds</i>

ACTION: Implement a tree-trimming program that routinely clears tree limbs hanging in right-of-way of existing structures.

<i>Hazard</i>	Tornado, Winter Storm, Thunderstorm, Hail
<i>Background</i>	Maintaining clear right-of-way hazards will minimize loss of life and property.
<i>Benefits</i>	Keep roads clear; minimize loss of life and property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Clifton Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	<i>Grants and general revenue</i>

ACTION: Individual Safe Room Program

<i>Hazard</i>	Tornado
---------------	---------

<i>Background</i>	Tornados can destroy structures and kill people without protection
<i>Benefits</i>	Allows for individuals to install a safe room within their own home and can save lives.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$3,000 each
<i>Responsible organization</i>	City of Clifton OEM
<i>Target completion timeline</i>	Four years
<i>Funding sources</i>	FEMA HMGP grants

ACTION: Create and Implement a Drought Contingency Plan

<i>Hazard</i>	Drought
<i>Background</i>	A local Drought Contingency Plan contains specific, quantified targets for water use restrictions. This includes drought response stages with triggers to begin and end at each stage.
<i>Benefits</i>	Each drought response stage will reduce the availability of water for certain events. Examples include not allowing the watering of lawns during the day or encouraging the use of xeriscape landscapes.
<i>Priority</i>	Medium
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Clifton OEM
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	No costs

Jurisdiction: City of Cranfills Gap

ACTION: Public Outreach and Education

<i>Hazard</i>	Floods, Wildfire, Tornados, Thunderstorm, Winter Storm, Hail, Drought
---------------	---

<i>Background</i>	Public Outreach and Education is important in notifying the public about the dangers of natural hazards.
<i>Benefits</i>	Can save lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Cransfills Gap Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	Grants

ACTION: Implement a Burn Ban

<i>Hazard</i>	Wildfire, Drought
<i>Background</i>	Outdoor brush burning can lead to accidental wildfires
<i>Benefits</i>	Create and implement Burn Ban Ordinance to prevent wildfire and during drought periods to help conserve water.
<i>Priority</i>	High
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Cransfills Gap Office of Emergency Management
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	No costs

ACTION: Implement a debris management program for cleaning drains and culverts.

<i>Hazard</i>	Flood
<i>Background</i>	For complete drainage to prevent localized flooding, the city will implement and maintain a debris management program, and to continue the maintenance and purchasing of parts as necessary to ensure its continued use.
<i>Benefits</i>	Prevention of loss of life and damage to property.
<i>Priority</i>	High

<i>Estimated cost</i>	\$400
<i>Responsible organization</i>	City of Cransfills Gap Office of Emergency Management
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	Local funds

ACTION: Create and Implement a Drought Contingency Plan

<i>Hazard</i>	Drought
<i>Background</i>	A local Drought Contingency Plan contains specific, quantified targets for water use restrictions. This includes drought response stages with triggers to begin and end at each stage.
<i>Benefits</i>	Each drought response stage will reduce the availability of water for certain events. Examples include not allowing the watering of lawns during the day or encouraging the use of xeriscape landscapes.
<i>Priority</i>	High
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Cransfills Gap Office of Emergency Management
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	No costs

ACTION: Implement a tree-trimming program that routinely clears tree limbs hanging in right-of-way of existing structures.

<i>Hazard</i>	Tornado, Winter Storm, Thunderstorm, Hail
<i>Background</i>	Maintaining clear right-of-way hazards will minimize loss of life and property.
<i>Benefits</i>	Keep roads clear; minimize loss of life and property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500

<i>Responsible organization</i>	City of Cransfills Gap Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	Grants and general revenue

Jurisdiction: City of Iredell

ACTION: Public Outreach and Education

<i>Hazard</i>	Floods, Wildfire, Tornadoes, Thunderstorm, Winter Storm, Hail, Drought
<i>Background</i>	Public Outreach and Education is important in notifying the public about the dangers of natural hazards.
<i>Benefits</i>	Can save lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Iredell Office of Emergency Management (OEM)
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	Grants

ACTION: Increase dimensions of drainage culverts in areas subject to flooding.

<i>Hazard</i>	Flood, Thunderstorms
<i>Background</i>	Whenever there is a large amount of rainfall, the flooding from the Bosque River can dangerous to people and structures.
<i>Benefits</i>	Increasing the dimensions of drainage culverts would help reduce the amount of flooding or even prevent flooding altogether.
<i>Priority</i>	High
<i>Estimated cost</i>	\$20,000

<i>Responsible organization</i>	City of Iredell Public Works
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	<i>NRCS – Watershed Protection and Flood Prevention Program</i>

ACTION: Create and Implement a Drought Contingency Plan

<i>Hazard</i>	Drought
<i>Background</i>	A local Drought Contingency Plan contains specific, quantified targets for water use restrictions. This includes drought response stages with triggers to begin and end at each stage.
<i>Benefits</i>	Each drought response stage will reduce the availability of water for certain events. Examples include not allowing the watering of lawns during the day or encouraging the use of xeriscape landscapes.
<i>Priority</i>	High
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Iredell Public Works
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	<i>No costs</i>

ACTION: Educate community on the dangers of low water crossings.

<i>Hazard</i>	Flood
<i>Background</i>	Riverine flooding is of particular concern to the City of Iredell due to its close proximity to the Bosque River. Many times, people do not realize the danger that even 2 feet of water can cause. Also, they may not know alternate routes to avoid certain trouble areas.
<i>Benefits</i>	Reduced risk to life.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Iredell Volunteer Fire Department

<i>Target completion timeline</i>	One year
<i>Funding sources</i>	<i>General revenues</i>

ACTION: Implement a debris management program for cleaning drains and culverts, and create a program to add or maintain thick vegetation on public lands along riverbanks.

<i>Hazard</i>	Flood, Thunderstorms
<i>Background</i>	For complete drainage to prevent localized flooding, the city will implement and maintain a debris management program, and to continue the maintenance and purchasing of parts as necessary to ensure its continued use.
<i>Benefits</i>	Prevention of loss of life and damage to property due to flooding, and the thick vegetation would help to absorb water, prevent flooding, and protect natural resources.
<i>Priority</i>	High
<i>Estimated cost</i>	\$300
<i>Responsible organization</i>	City of Iredell Public Works
<i>Target completion timeline</i>	Four years
<i>Funding sources</i>	<i>Local funds</i>

ACTION: Implement a tree-trimming program that routinely clears tree limbs hanging in right-of-way of existing structures.

<i>Hazard</i>	Tornado, Winter Storm, Thunderstorm, Hail
<i>Background</i>	Maintaining clear right-of-way hazards will minimize loss of life and property.
<i>Benefits</i>	Keep roads clear; minimize loss of life and property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Iredell Public Works

<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	<i>Grants and general revenue</i>

ACTION: Build a dual use community safe room

<i>Hazard</i>	Tornadoes
<i>Background</i>	There are no protected shelters in Iredell.
<i>Benefits</i>	Provides shelter to residents and can save lives during severe storms.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$500,000
<i>Responsible organization</i>	City of Iredell Public Works
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>HMGP Mitigation Grant</i>

ACTION: Implement a burn ban

<i>Hazard</i>	Wildfire, Drought
<i>Background</i>	Create and implement an ordinance that prevents outdoor brush burning
<i>Benefits</i>	Create and implement Burn Ban Ordinance to prevent wildfire and during drought periods to help conserve water.
<i>Priority</i>	High
<i>Estimated cost</i>	No Costs
<i>Responsible organization</i>	City of Iredell Public Works
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	<i>No costs</i>

Jurisdiction: City of Meridian

ACTION: Public Outreach and Education

<i>Hazard</i>	Floods, Wildfire, Tornadoes, Thunderstorm, Winter Storm, Hail, Drought
<i>Background</i>	Public Outreach and Education is important in notifying the public about the dangers of natural hazards.
<i>Benefits</i>	Can save lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Meridian Office of Emergency Management (OEM)
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	Grants

ACTION: Burn Bans

<i>Hazard</i>	Wildfires, Drought
<i>Background</i>	Pass an ordinance to restrict outdoor brush burning
<i>Benefits</i>	Create and implement Burn Ban Ordinance to prevent wildfire and during drought periods to help conserve water.
<i>Priority</i>	Medium
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Meridian Office of Emergency Management (OEM)
<i>Target completion timeline</i>	One year
<i>Funding sources</i>	No costs

ACTION: Implement a regular testing and maintenance program for all fire plugs/hydrants and sprinkler systems.

<i>Hazard</i>	Wildfire
<i>Background</i>	The current fire hydrant system, while adequate in numbers and area coverage, is large old and is not always tested on a regular basis. The city will implement and maintain the testing program, and to continue the maintenance and purchasing of parts as necessary to ensure its continued use.
<i>Benefits</i>	Ensure water availability to protect lives and property during fires.
<i>Priority</i>	High
<i>Estimated cost</i>	\$1,500 annually
<i>Responsible organization</i>	City of Meridian OEM
<i>Target completion timeline</i>	Four years
<i>Funding sources</i>	General revenues

ACTION: Create and Implement a Drought Contingency Plan

<i>Hazard</i>	Drought
<i>Background</i>	A local Drought Contingency Plan contains specific, quantified targets for water use restrictions. This includes drought response stages with triggers to begin and end at each stage.
<i>Benefits</i>	Each drought response stage will reduce the availability of water for certain events. Examples include not allowing the watering of lawns during the day or encouraging the use of xeriscape landscapes.
<i>Priority</i>	High
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Meridian OEM
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	No costs

ACTION: Establish and manage riparian buffers along area waterways.

<i>Hazard</i>	Flood
<i>Background</i>	This waterway flows into the North Bosque River. This waterway has experienced a 59% reduction of forest cover since 1980. There has been an expansion of invasive species, increased erosion and sedimentation, and a reduction in fish species.
<i>Benefits</i>	Renewal of riparian corridor habitat and fish habitat
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$565,000 plus annual O&M of \$12,000
<i>Responsible organization</i>	City of Meridian OEM
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>U.S. Army Corps of Engineers, general revenues and work in kind</i>

ACTION: Evaluate water quality and quantity from new sources.

<i>Hazard</i>	Drought
<i>Background</i>	The City has been working in conjunction with the Brazos River Authority to develop an alternative source of water for Meridian and its surrounding communities. Various studies including those associated with Senate Bill 1 have recommended surface water. The City anticipates contracting with the City of Clifton to treat Meridian water rights out of the Bosque River.
<i>Benefits</i>	Establishes new and additional water sources.
<i>Priority</i>	High
<i>Estimated cost</i>	\$3 – 4 million
<i>Responsible organization</i>	City of Meridian OEM
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>General revenues, Federal grants, State grants and funding</i>

ACTION: Require any future structures built in the 100-year floodplain to be elevated 6 inches above Base Flood Elevation (BFE).

<i>Hazard</i>	Floods, Thunderstorms
<i>Background</i>	Amend the floodplain ordinance to require any future structures built in the special flood hazard area to have the first flood raised 6 inches above the established BFE.
<i>Benefits</i>	Reduced loss of life and property damage by elevating structures in the 100 year floodplain
<i>Priority</i>	Medium
<i>Estimated cost</i>	No Cost
<i>Responsible organization</i>	City of Meridian OEM
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	<i>No Costs</i>

ACTION: Implement a tree-trimming program that routinely clears tree limbs hanging in right-of-way of existing structures.

<i>Hazard</i>	Tornado, Winter Storm, Thunderstorm, Hail
<i>Background</i>	Maintaining clear right-of-way hazards will minimize loss of life and property.
<i>Benefits</i>	Keep roads clear; minimize loss of life and property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$400
<i>Responsible organization</i>	City of Meridian OEM
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	<i>Grants and general revenue</i>

ACTION: Build a dual use community safe room

<i>Hazard</i>	Tornadoes
---------------	-----------

<i>Background</i>	There are no protected shelters in Meridian.
<i>Benefits</i>	Provides shelter to residents and can save lives during severe storms.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Meridian OEM
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	HMGP Grant

Jurisdiction: City of Morgan

ACTION: Public Outreach and Education

<i>Hazard</i>	Floods, Wildfire, Tornadoes, Thunderstorm, Winter Storm, Hail, Drought
<i>Background</i>	Public Outreach and Education is important in notifying the public about the dangers of natural hazards.
<i>Benefits</i>	Can save lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Morgan Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	Grants

ACTION: Create and Implement a Drought Contingency Plan

<i>Hazard</i>	Drought
<i>Background</i>	A local Drought Contingency Plan contains specific, quantified targets for water use restrictions. This includes drought response stages with triggers to begin and end at each stage.

<i>Benefits</i>	Each drought response stage will reduce the availability of water for certain events. Examples include not allowing the watering of lawns during the day or encouraging the use of xeriscape landscapes.
<i>Priority</i>	High
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Morgan Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	No costs

ACTION: Implement a regular testing and maintenance program for all fire plugs/hydrants and sprinkler systems.

<i>Hazard</i>	Wildfire
<i>Background</i>	The current fire hydrant system, while adequate in numbers and area coverage, is large old and is not always tested on a regular basis. The city will implement and maintain the testing program, and to continue the maintenance and purchasing of parts as necessary to ensure its continued use.
<i>Benefits</i>	Fire department members would know a hydrant was functional and reduce possible loss of life/property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$100
<i>Responsible organization</i>	City of Morgan Volunteer Fire Department
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	Local funds

ACTION: Refurbish/replace early warning system for hazardous events.

<i>Hazard</i>	Floods, Thunderstorms, Winter Storm, Hail, Tornado
<i>Background</i>	City of Morgan's early warning system is currently non-functional.
<i>Benefits</i>	Early warning to citizens might prevent loss of life and property.

<i>Priority</i>	Medium
<i>Estimated cost</i>	\$10,000
<i>Responsible organization</i>	City of Morgan OEM, Morgan VFD
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>Local general revenues and grants</i>

ACTION: Purchase burn ban signs for use during periods of county burn bans.

<i>Hazard</i>	Wildfire
<i>Background</i>	Periodically, drought facilitates the need for a countywide burn ban. This ban is issued and revoked by the county commissioners. Burn bans are published in the county paper. However, violations continue.
<i>Benefits</i>	Local advertisement of ban would inform residents who might miss the publication. It could reduce loss of life/property.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Morgan OEM, Morgan VFD
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	<i>Local general revenues and grants</i>

ACTION: Adopt building codes for future construction/renovation in the City of Morgan.

<i>Hazard</i>	Tornado, Thunderstorm, Winter Storm, Hail, Flood
<i>Background</i>	City of Morgan does not currently have building codes in place.
<i>Benefits</i>	Future building would be required to meet certain safety codes. This could reduce loss of life/property to hazards.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$0

<i>Responsible organization</i>	City of Morgan OEM
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	<i>Not applicable</i>

ACTION: Create and Implement a Drought Contingency Plan

<i>Hazard</i>	Drought
<i>Background</i>	A local Drought Contingency Plan contains specific, quantified targets for water use restrictions. This includes drought response stages with triggers to begin and end at each stage.
<i>Benefits</i>	Each drought response stage will reduce the availability of water for certain events. Examples include not allowing the watering of lawns during the day or encouraging the use of xeriscape landscapes.
<i>Priority</i>	High
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Morgan OEM
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	<i>No costs</i>

ACTION: Build a dual use community safe room

<i>Hazard</i>	Tornadoes
<i>Background</i>	There are no protected shelters in Morgan.
<i>Benefits</i>	Provides shelter to residents and can save lives during severe storms.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$50,000
<i>Responsible organization</i>	City of Morgan OEM

<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	HMGP Grant

ACTION: Acquire existing homes located in the special flood hazard area.

<i>Hazard</i>	Floods
<i>Background</i>	City of Morgan periodically experiences mild flooding.
<i>Benefits</i>	Future building would be required to meet certain safety codes. This could reduce loss of life/property to hazards.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$0
<i>Responsible organization</i>	City of Morgan OEM
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	Not applicable

Jurisdiction: City of Valley Mills

ACTION: Public Outreach and Education

<i>Hazard</i>	Floods, Wildfire, Tornadoes, Thunderstorm, Winter Storm, Hail, Drought
<i>Background</i>	Public Outreach and Education is important in notifying the public about the dangers of natural hazards.
<i>Benefits</i>	Can save lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Valley Mills Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Three years

<i>Funding sources</i>	Grants
------------------------	---------------

ACTION: Create and implement Burn Bans Ordinance

<i>Hazard</i>	Wildfire
<i>Background</i>	Create and implement a Burn Ban Ordinance to prevent wildfire and during drought periods to help conserve water.
<i>Benefits</i>	Prevents outdoor burning, which could lead to accidental wildfires, and helps conserve water during droughts.
<i>Priority</i>	High
<i>Estimated cost</i>	No Costs
<i>Responsible organization</i>	City of Valley Mills Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	No costs

ACTION: Create and Implement a Drought Contingency Plan

<i>Hazard</i>	Drought
<i>Background</i>	A local Drought Contingency Plan contains specific, quantified targets for water use restrictions. This includes drought response stages with triggers to begin and end at each stage.
<i>Benefits</i>	Each drought response stage will reduce the availability of water for certain events. Examples include not allowing the watering of lawns during the day or encouraging the use of xeriscape landscapes.
<i>Priority</i>	High
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Valley Mills Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years

<i>Funding sources</i>	No costs
------------------------	-----------------

ACTION: Build a dual use community safe room

<i>Hazard</i>	Tornadoes
<i>Background</i>	There are no protected shelters in Valley Mills
<i>Benefits</i>	Provides shelter to residents and can save lives during severe storms.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$50,000
<i>Responsible organization</i>	City of Valley Mills Office of Emergency Management
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	HMGP Grant

ACTION: Conduct public education programs on fire risks.

<i>Hazard</i>	Wildfire, Drought
<i>Background</i>	Not enough water supplies during droughts to fight large wildfires.
<i>Benefits</i>	Reduce loss of property and lives by educating the public on how to conserve water during droughts.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$70,000 to \$100,000
<i>Responsible organization</i>	City of Valley Mills Office of Emergency Management
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	Grants

ACTION: Implement a debris management program for cleaning drains and culverts.

<i>Hazard</i>	Flooding
<i>Background</i>	For complete drainage to prevent localized flooding, the city will implement and maintain a debris management program, and to continue the maintenance and purchasing of parts as necessary to ensure its continued use.
<i>Benefits</i>	Reduce loss of property and lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$15,000 to \$20,000
<i>Responsible organization</i>	City of Valley Mills Office of Emergency Management
<i>Target completion timeline</i>	Four years
<i>Funding sources</i>	<i>Grant/local labor</i>

ACTION: Implement a new program for the fire department to begin a regular testing and maintenance program for all fire plugs/hydrants and sprinkler systems.

<i>Hazard</i>	Wildfires
<i>Background</i>	The current fire hydrant system, while adequate in numbers and area coverage, is large old and is not always tested on a regular basis. The city will implement and maintain the testing program, and to continue the maintenance and purchasing of parts as necessary to ensure its continued use.
<i>Benefits</i>	Reduce loss of lives and property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$8000 to \$15,000
<i>Responsible organization</i>	City of Valley Mills Fire Department
<i>Target completion timeline</i>	Four years
<i>Funding sources</i>	<i>Grants/local general revenues</i>

ACTION: Implement a tree-trimming program that routinely clears tree limbs hanging in right-of-way of existing structures.

<i>Hazard</i>	Tornado, Winter Storm, Thunderstorm, Hail
---------------	---

<i>Background</i>	Maintaining clear right-of-way hazards will minimize loss of life and property.
<i>Benefits</i>	Keep roads clear; minimize loss of life and property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$300
<i>Responsible organization</i>	City of Valley Mills Office of Emergency Management
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	Grants and general revenue

Jurisdiction: City of Walnut Springs

ACTION: Public Outreach and Education

<i>Hazard</i>	Floods, Wildfire, Tornadoes, Thunderstorm, Winter Storm, Hail, Drought
<i>Background</i>	Public Outreach and Education is important in notifying the public about the dangers of natural hazards.
<i>Benefits</i>	Can save lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Walnut Springs Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	Grants

ACTION: Acquire existing structures located in the special flood hazard area.

<i>Hazard</i>	Flood, Thunderstorms
---------------	----------------------

<i>Background</i>	Walnut Springs experiences periodic minor flooding.
<i>Benefits</i>	Saves lives and prevents property damage by removing structures permanently from the identified special flood hazard.
<i>Priority</i>	High
<i>Estimated cost</i>	\$100,000
<i>Responsible organization</i>	City of Walnut Springs OEM
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	FEMA HMGP Mitigation Grants

ACTION: Create and Implement a Drought Contingency Plan

<i>Hazard</i>	Drought
<i>Background</i>	A local Drought Contingency Plan contains specific, quantified targets for water use restrictions. This includes drought response stages with triggers to begin and end at each stage.
<i>Benefits</i>	Each drought response stage will reduce the availability of water for certain events. Examples include not allowing the watering of lawns during the day or encouraging the use of xeriscape landscapes.
<i>Priority</i>	High
<i>Estimated cost</i>	No costs
<i>Responsible organization</i>	City of Walnut Springs Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	No costs

ACTION: Implement a tree-trimming program that routinely clears tree limbs hanging in right-of-way of existing structures.

<i>Hazard</i>	Tornado, Winter Storm, Thunderstorm, Hail
---------------	---

<i>Background</i>	Maintaining clear right-of-way hazards will minimize loss of life and property.
<i>Benefits</i>	Keep roads clear; minimize loss of life and property.
<i>Priority</i>	High
<i>Estimated cost</i>	\$500
<i>Responsible organization</i>	City of Walnut Springs Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Three years
<i>Funding sources</i>	<i>Grants and general revenue</i>

ACTION: Build a dual use community safe room

<i>Hazard</i>	Tornadoes
<i>Background</i>	There are no protected shelters in Walnut Springs.
<i>Benefits</i>	Provides shelter to residents and can save lives during severe storms.
<i>Priority</i>	Medium
<i>Estimated cost</i>	\$50,000
<i>Responsible organization</i>	City of Walnut Springs Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Five years
<i>Funding sources</i>	<i>HMGP Grant</i>

ACTION: Implement a debris management program for cleaning drains and culverts.

<i>Hazard</i>	Flooding
<i>Background</i>	For complete drainage to prevent localized flooding, the city will implement and maintain a debris management program, and to continue the maintenance and purchasing of parts as necessary to ensure its continued use.

<i>Benefits</i>	Reduce loss of property and lives.
<i>Priority</i>	High
<i>Estimated cost</i>	\$10,000 to \$13,000
<i>Responsible organization</i>	City of Walnut Springs Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Four years
<i>Funding sources</i>	Grant/local labor

ACTION: Create and implement a Burn Ban Ordinance

<i>Hazard</i>	Wildfire, Drought
<i>Background</i>	Create and implement Burn Ban Ordinance to prevent wildfire and during drought periods to help conserve water.
<i>Benefits</i>	Prevents outdoor burning, which could lead to accidental wildfires, and helps conserve water during droughts.
<i>Priority</i>	High
<i>Estimated cost</i>	No Costs
<i>Responsible organization</i>	City of Walnut Springs Office of Emergency Management (OEM)
<i>Target completion timeline</i>	Two years
<i>Funding sources</i>	No costs

SECTION 14: PLAN IMPLEMENTATION & MAINTENANCE

This section discusses how this Hazard Mitigation Plan will be implemented by the participating jurisdictions. This section also addresses how the Plan will be evaluated and improved over time and how the public will continue to be involved in the hazard mitigation planning process.

Each participating jurisdiction will be responsible for implementing its own Mitigation Action Plan contained in Section 14. Each action has been assigned to a specific person or local government office that is responsible for implementing each specific action. When the governing body of each participating jurisdiction has adopted the Mitigation Action Plan for its jurisdiction, copies of the governing body resolutions will be contained in Appendix E (pending approval).

Jurisdictional Capabilities

Each participating jurisdiction has various capabilities (existing authorities, policies, staff and funding) to implement their action items.

Bosque County has one full-time staff member dedicated to emergency management coordination. The cities of Clifton, Meridian and Valley Mills each have two people on city staff that can assist with mitigation, along with their other duties. The cities of Cransfill Gap, Iredell, Morgan and Walnut Springs have only volunteer staff.

Local funding for implementation of action items is low and federal assistance will be necessary to achieve many of the proposed projects.

A funding source has been listed for each identified action. Many of the funding sources are federal mitigation grants. The grant source may be used when the jurisdiction begins to seek funds to implement the action. An implementation timeline has also been assigned to each action as an incentive for seeing the action through to completion and to gauge whether actions are timely implemented.

Capabilities can be expanded by each local jurisdiction hosting an annual mitigation meeting for the public and mitigation team members to attend to discuss the status of the mitigation action plan and apply for federal mitigation grants to achieve the actions listed in the plan.

Plan Integration

Participating jurisdictions will integrate implementation of their Mitigation Action Plans into other, already existing planning mechanisms, when appropriate.

Bosque County will review the local Emergency Operations Plan (EOP) “Anenx P Mitigation”, local building codes, fire codes and floodplain ordinances.

The cities of Clifton, Meridian and Valley Mills will review their local EOP’s, building codes, fire codes and floodplain ordinances.

Table 14:1 Jurisdictional Plan Integration

Jurisdiction	Planning Mechanisms	Method of Incorporation
Bosque County	Emergency Operations Plan (EOP) & county floodplain ordinance.	The Plan will be consulted during the update of the planning mechanisms. Related mitigation projects will be included in the updated planning mechanisms.
Clifton	Emergency Operations Plan (EOP), fire codes, building codes and floodplain ordinance.	The Plan will be consulted during the update of the planning mechanisms. Related mitigation projects will be included in the updated planning mechanisms.
Meridian	Emergency Operations Plan (EOP), fire codes, building codes and floodplain ordinance.	The Plan will be consulted during the update of the planning mechanisms. Related mitigation projects will be included in the updated planning mechanisms.
Valley Mills	Emergency Operations Plan (EOP), fire codes, building codes and floodplain ordinance.	The Plan will be consulted during the update of the planning mechanisms. Related mitigation projects will be included in the updated planning mechanisms.

The cities of Cransfill Gap, Iredell, Morgan and Walnut Springs are small communities and have only volunteer staff and therefore do not have EOP's, fire codes, building codes or floodplain ordinances to integrate this plan into.

Plan Implementation

In situations where mitigation actions can be achieved through these other local planning mechanisms, then the jurisdictions of Clifton, Meridian, Valley Mills and Bosque County will do so by incorporating the actions into those plans.

The cities of Clifton, Meridian, Valley Mills, and Bosque County, will ensure that the actions contained in this mitigation plan are reflected in these other planning efforts. These other planning efforts will be used to advance the mitigation strategies of the jurisdictions. Upon formal adoption of the plan, hazard mitigation team members from each jurisdiction will review their local EOP's, building codes, fire codes and floodplain ordinances.

The hazard mitigation team members from the cities of Clifton, Meridian, Valley Mills, and Bosque County, will work to integrate the hazard mitigation strategies into these other plans and codes. Each jurisdiction will conduct periodic reviews of their local plans and policies and analyze the need for any amendments in light of the approved hazard mitigation plan. Participating jurisdictions will ensure that planning in the future will also contribute to the goals of this hazard mitigation plan to reduce the long-term risk to life and property from all hazards. Within one year of formal adoption of the hazard mitigation plan, existing planning mechanisms will be reviewed by each jurisdiction.

Table 14:2 Jurisdictional Plan Implementation

Jurisdiction	Planning Mechanisms	Method of Incorporation
Bosque County	Emergency Operations Plan (EOP) & county floodplain ordinance.	The local planning mechanisms will be consulted during annual reviews of the mitigation plan. Related mitigation projects from the local planning mechanisms will be included in the updated mitigation plan.
Clifton	Emergency Operations Plan (EOP), fire codes,	The local planning mechanisms will be

	building codes and floodplain ordinance.	consulted during annual reviews of the mitigation plan. Related mitigation projects from the local planning mechanisms will be included in the updated mitigation plan.
Meridian	Emergency Operations Plan (EOP), fire codes, building codes and floodplain ordinance.	The local planning mechanisms will be consulted during annual reviews of the mitigation plan. Related mitigation projects from the local planning mechanisms will be included in the updated mitigation plan.
Valley Mills	Emergency Operations Plan (EOP), fire codes, building codes and floodplain ordinance.	The local planning mechanisms will be consulted during annual reviews of the mitigation plan. Related mitigation projects from the local planning mechanisms will be included in the updated mitigation plan.

The cities of Cransfill Gap, Iredell, Morgan and Walnut Springs are small communities and have only volunteer staff and therefore have no other existing planning mechanisms for this plan to be implemented into.

Monitoring of the Mitigation Plan

Periodic revisions and updates of the Plan are required to ensure that the goals, objectives, and action items are kept current. More importantly, revisions may be necessary to ensure that the Plan is in full compliance with federal regulations and state statutes. This portion of the Plan outlines the procedures for completing such revisions and updates.

Hazard mitigation team members from each jurisdiction are responsible for continual monitoring those components of the hazard mitigation plan that pertains to their jurisdiction. As part of the monitoring process, team members will assess any changes in risk; determine whether implementation of mitigation

actions is on schedule or if there are any implementation problems, such as technical, political, legal or coordination issues; and reflect changes in land development or programs that affect mitigation priorities or actions. On an annual basis, participating jurisdictions will review the mitigation plan for any needed changes in the plan based upon their monitoring activities.

This Mitigation Action Plan will be formally reviewed every five years to determine whether there have been significant changes in the County that might affect the Plan. The five-year review will be conducted under the auspices of the Bosque County Office of Emergency Management (OEM).

Below is table of who is responsible for monitoring, evaluating and updating the mitigation plan.

Table 14:3 Jurisdictional Representatives

Jurisdiction	Name	Title
Bosque County	Tim Jeske	Emergency Management Coordinator (EMC)
City of Clifton	Steve Adcack	EMC
City of Cransfills Gap	Russell Algren	EMC
City of Iredell	Royce Heath	Mayor
City of Meridian	Johnnie Hauerland	Mayor
City of Morgan	Tim Jeske	EMC
City of Valley Mills	Kenny Hallmark	EMC
City of Walnut Springs	Tim Jeske	EMC

The plan will be monitored by each jurisdictional representative to ensure that the identified mitigation actions per jurisdiction are being completed and reporting this information on a quarterly basis to the Bosque County OEM. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques, and revisions to federal or state legislation are examples of changes that may affect the currency of the Plan.

Community officials will also be given an opportunity to evaluate successful actions and to explore the possibility of documenting losses avoided because of actions taken. The Plan will be evaluated once per year by the representatives listed in Table 14:1. The Plan also will need to be revised to reflect lessons learned following a disaster declaration or to address specific circumstances arising from changing conditions surrounding disaster events. Criteria on how the evaluation will happen includes, at a minimum:

- The goals and objectives address current and expected conditions;
- The nature, magnitude, and/or type of risks has changed;
- The current resources are appropriate for implementing the plan;
- There are implementation problems, such as technical, political, legal, or coordination issues with other agencies;
- The outcomes have occurred as expected; and,
- The agencies and other partners participated as originally proposed.

Based on the review, the plan will be updated or revised within every five years by the representatives listed in Table 14:1. The five-year review will begin in May 2018 and be completed by November 2018. The plan will then be submitted to TDEM and FEAM for review and approval. As part of the plan review and update under the auspices of the OEM, participating jurisdictions will be asked to:

- review each goal and objective to determine their continued relevance;
- review the risk assessment portion of the plan to determine if the information should be updated or modified;
- report on the status of each of their mitigation actions;
- report on which implementation processes worked well,
- any difficulties encountered, how coordination efforts are proceeding, and which mitigation actions should be revised;
- and evaluate the effectiveness of their mitigation action plans and recommend changes or amendments.

Data is not currently available to describe vulnerability in terms of types and numbers of future buildings, infrastructure and critical facilities. Depending upon resource availability, during the five-year plan update process, an analysis will be conducted for all jurisdictions of vulnerability in terms of the types and numbers of future buildings, infrastructure and critical facilities located in identified hazard areas.

Plan Amendments

At any time, minor technical changes may be made to the plan to keep it up to date. However, any changes to the mitigation actions or major changes in the overall direction of the plan or the policies contained within it must be subject to formal adoption by the participating jurisdictions. As long as the plans of existing jurisdictions are not affected, additional jurisdictions may be added to the plan without requiring the existing jurisdictions to re-adopt the plan.

After initial adoption, amendments to the Plan must be approved by the governing body of the participating city or county. Upon ratification, the amendment will be submitted to the Texas Division of Emergency Management.

Continued Public Involvement

Public input was an integral part of the preparation of this Plan and will continue to be essential as the Plan grows and changes. As with any officially adopted plan or ordinance, a significant change to this Plan shall require an opportunity for the public to make its views known.

This Hazard Mitigation Action Plan will be kept in each jurisdiction and at the Bosque County OEM office, located at 102 North Main, Meridian, Texas 76665 for public inspection and review.

Appendix A: Bosque County Hazard Mitigation Team Members

Jurisdiction	Name	Title
Bosque County	Dewey Ratliff	Emergency Management Coordinator (EMC)
City of Clifton	Steve Adcack	EMC
City of Cransfills Gap	Russell Algren	EMC
City of Iredell	Royce Heath	Mayor
City of Meridian	Johnnie Hauerland	Mayor
City of Morgan	Dewey Ratliff	EMC
City of Valley Mills	Kenny Hallmark	EMC
City of Walnut Springs	Dewey Ratliff	EMC
(NA)	David Larner	Mitigation Consultant

**Bosque County
Hazard Mitigation Action Plan Update
Kickoff Meeting June 27, 2011**

[illegible]

PUBLIC NOTICE
COMMISSIONERS COURT
OPEN MEETING
JUNE 27, 2011

FILED FOR RECORD
2011 JUN 24 AM 8:56
Betty D. Carter
BETTY D. CARTER, COUNTY CLERK
BOSQUE COUNTY, TEXAS

Commissioner's Court of Bosque County, Texas, will meet in Open Meeting on Monday, June 27, 2011 at 6:00 p.m. in the Commissioners Courtroom of the Bosque County Courthouse, Meridian, Texas, for the following:

1. CALL TO ORDER
2. DETERMINATION OF QUORUM
3. PROOF OF NOTICE
4. PLANNING MEETING FOR THE UPDATE TO OUR COUNTY AND CITY HAZARD MITIGATION ACTION PLANS
5. ANNOUNCEMENTS
6. ADJOURN

Appendix B: Critical Facilities in Bosque County

County	Name	Type	Replacement Cost (\$1,000)
Bosque	Kwow Ch 281	Communication	89
Bosque	Kopperl Area Vol Fire Dept	Fire Station	534
Bosque	Steele Creek Acres Fire Dept	Fire Station	534
Bosque	Iredell Fire Dept	Fire Station	534
Bosque	Meridian Fire Dept	Fire Station	534
Bosque	Cranfills Gap Vol Fire Dept	Fire Station	534
Bosque	Bosque County Sheriff's Office	Police Station	1,246
Bosque	Meridian City Police Dept	Police Station	1,246
Bosque	Bosque County Sheriff's Office	Police Station	1,246
Bosque	Police Dept	Police Station	1,246
Bosque	Valley Mills Police Dept	Police Station	1,246
Bosque	AT & SF Railroad	Railway Bridge	192
Bosque	AT&SF Railroad	Railway Bridge	168
Bosque	Iredell City Of	Waste Water Treatment	59,274
Bosque	Morgan City Of	Waste Water Treatment	59,274
Bosque	Meridian City Of	Waste Water Treatment	59,274
Bosque	Clifton City Of	Waste Water Treatment	59,274
Bosque	Valley Mills City Of	Waste Water Treatment	59,274
Bosque	Clifton Police Department*	Police Station	unavailable
Bosque	Clifton Fire Department*	Fire Station	unavailable
Bosque	West Shore Fire Department*	Fire Station	unavailable
Bosque	Valley Mills Fire Department*	Fire Station	unavailable
Bosque	Lakeside Village Fire Department*	Fire Station	unavailable
Bosque	Morgan Fire Department*	Fire Station	unavailable
Bosque	Walnut Springs Fire Department*	Fire Station	unavailable

Appendix C: Local Resolution Adoption Documents