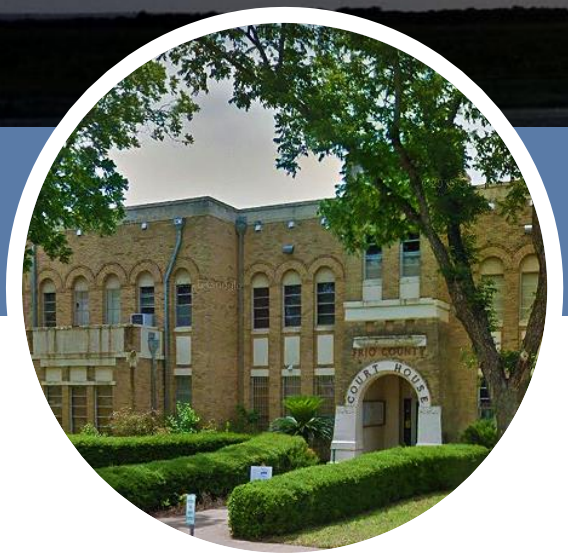
Frio County, TX
Office of Emergency Management

Frio County 2018 Hazard Mitigation Plan



Frio County Office of Emergency Management
101 N. Commerce St.
Dilley, Texas 78017

March 23, 2019

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U.S. Department of Homeland Security
FEMA Region 6
800 North Loop 288
Denton, TX. 76209-3698

FEMA

March 25, 2019

David Jackson, State Hazard Mitigation Officer
Texas Division of Emergency Management
P.O. Box 4087
Austin, TX 78773-0220

RE: Approval of the Frio County, Texas Multi-Jurisdiction Hazard Mitigation Plan

Dear Mr. Jackson:

This office has concluded its review of the referenced plan and we are pleased to provide our approval of this plan in meeting the criteria set forth by 44 CFR § 201.6. By receiving this approval, eligibility for the Hazard Mitigation Assistant Grants will be ensured for five years from the date of this letter, expiring on March 24, 2024.

This approval does not demonstrate approval of projects contained in the plan. This office has provided the enclosed Local Hazard Mitigation Planning Tool with reviewer's comments, to further assist the community in refining the plan going forward. Please advise the referenced community of this approval.

If you have any questions, please contact Bart Moore, HM Community Planner Lead, at (940) 898-5363.

Sincerely,

Ronald C. Wanhanen
Chief, Risk Analysis Branch

Enclosures

cc: Jeffrey Brewer, R6-MT-HM

Frio County
HAZARD MITIGATION PLAN

March 25, 2019

Prepared for:

Frio County
Office of Emergency Management
101 N. Commerce St.
Dilley, Texas 78017

Frio County
Hazard Mitigation Plan

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Disaster Mitigation Act of 2000 (DMA) is federal legislation that requires proactive, pre-disaster planning as a prerequisite for some funding available under the Robert T. Stafford Act. The DMA encourages state and local authorities to work together on pre-disaster planning. The planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

Hazard mitigation is the use of long- and short-term strategies to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards. It is impossible to predict exactly when and where disasters will occur or the extent to which they will impact an area. However, with careful planning and collaboration among public agencies, stakeholders, and citizens, it is possible to minimize losses that disasters can cause. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state, and federal government.

Frio County and the participating municipalities (the Cities of Dilley and Pearsall) have developed a hazard mitigation plan to reduce risks from natural disasters and to comply with the DMA.

PLAN DEVELOPMENT

The development of this hazard mitigation plan consisted of the following phases:

Phase 1: Organize and Review—A planning team was assembled to provide technical support for the plan, consisting of county emergency management representatives, key county and city staff, and a technical consultant. The first step in developing the plan was to establish a planning partnership (Steering Committee) with the unincorporated Frio County and the Cities of Dilley and Pearsall. Coordination with other county, state, and federal agencies involved in hazard mitigation occurred throughout the planning process. This phase included a review of the previous *Alamo Area Council of Governments (AACOG) Regional Mitigation Action Plan Update, 2012-2017* (that Frio County and the Cities of Dilley and Pearsall had participated in) that has expired and existing programs that may support or enhance hazard mitigation actions.

Phase 2: Develop the Risk Assessment—A risk assessment is the process of measuring the potential loss of life, personal injury, economic impact, and property damage resulting from natural hazards. This process assesses the vulnerability of people, buildings, and infrastructure to natural hazards. All facets of the risk assessment of the plan were reviewed by the Steering Committee and created with the best available data and technology. The work included the following:

- Hazard identification and profiling
- Assessment of the impact of hazards on physical, social, and economic assets
- Vulnerability identification
- Estimation of the cost of potential damage

Phase 3: Engage the Public—A public involvement strategy agreed upon by the Steering Committee was implemented by the planning team. The Steering Committee meetings were open to the public. Participation in the hazard mitigation survey occurred across the county.

Phase 4: Assemble the Updated Plan—The planning team and Steering Committee assembled key information into a document to meet the DMA requirements for all planning partners.

Phase 5: Adopt/Implement the Plan—Once pre-adoption approval has been granted by the Texas Division of Emergency Management (TDEM) and the Federal Emergency Management Agency (FEMA) Region VI, the final adoption phase begins. Each planning partner individually adopts the updated plan.

The plan maintenance process includes a schedule for monitoring and evaluating the plan's progress annually and producing a plan revision every 5 years. Throughout the life of this plan, a representative of the original Steering Committee will be available to provide consistent guidance and oversight.

MITIGATION GUIDING PRINCIPLE AND GOALS

The guiding principle for the Frio County Hazard Mitigation Plan is as follows:

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

The following plan goals were determined by the Steering Committee:

- **Goal 1:** Build capacity for hazard mitigation at the county and municipal levels through technical and financial assistance programs.
- **Goal 2:** Reduce the impact of natural disasters on populations and private property.
- **Goal 3:** Identify, introduce and implement programs designed to raise awareness and acceptance of the principles of hazard mitigation.
- **Goal 4:** Reduce the potential impact of natural disasters on critical facilities and infrastructure.
- **Goal 5:** Increase countywide capabilities to mitigate the effects of natural hazards.

IDENTIFIED HAZARDS OF CONCERN

For this plan, the Steering Committee considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern to the county. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude, and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to hazards was also included. Based on the review, this plan addresses the following natural hazards of concern:

- Dam Failure
- Drought / Extreme Heat
- Earthquake
- Flood
- Hurricane / Tropical Storms
- Severe Storms (Hail, Lightning, and Wind)
- Tornado
- Wildfire
- Winter Storms (including Ice Storms)

MITIGATION ACTIONS

Mitigation actions presented in this plan are activities designed to reduce or eliminate losses resulting from natural hazards. The update process resulted in the identification of 16 mitigation actions targeted for implementation by individual planning partners as listed in Table ES-1. The Steering Committee ranked the mitigation actions in order of priority, with 1 being the highest priority. The highest priority mitigation actions are shown in red on the table, medium priority actions are shown in yellow and low priority actions are shown in green.

Table ES-1. Recommended Mitigation Actions

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
FRIO COUNTY											
1	All Hazards Education for Homeowners	Post material on the effects of hazards to homeowners on the county website and Facebook sites. Publish articles concerning hazards in the local newspaper. Provide handouts at all county offices and satellite buildings.	1	Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather	●	G3	Office of Emergency Management	$5,000	County Budget	60	High
2	Retrofit Water Systems in County Buildings	Retrofit existing plumbing fixtures with water-saving devices. Install water-saving devices on all new county structures.	5	Drought	●	G4	Road & Bridge Maintenance	$10,000	County Budget and Grants	60	Medium
3	Retrofit Existing County Buildings	Replacement of roofing material and exterior siding with hail-resistant materials along with a cool roofing product that reflects sunlight and heat away from building. Anchoring of roof mounted equipment such as air conditioning units and portable buildings/offices to mitigate against earthquake, tornado, and wind damage. Installation of window film to reduce injury from shattered glass from thunderstorms and hurricanes. Adding insulation to walls and attic to protect building from winter wintry weather.	4	Earthquake, Extreme Heat, Hail, Hurricane/ Tropical Storm, Tornado, Wind, Winter Weather	●	G4	Road & Bridge Maintenance	$100,000	County Budgets and Grants	60	High

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
4	Electrical Protection on County Buildings	Install lightning rods and grounding devices on all county buildings. Install surge protection equipment on all critical electronic equipment.	6	Hurricane/ Tropical Storm, Lightning	●	G4	Road & Bridge Maintenance	$80,000	County Budget and Grants	60	High
5	Water Source Mapping & Property Owner MOU	Map rural water sources that are on privately owned property. Create MOUs with property owners to allow access to and use of water supplies for wildfire fighting.	3	Wildfire	●	G1, G2	Office of Emergency Management (mapping) Commissioners Court (MOUs/agreements)	$10,000	County Budgets	60	High
6	Adopt Higher Standard Flood Ordinance	Flood mapping is not available for the unincorporated areas of the county. Flooding from hurricanes/tropical storms, dam failure can result in the loss of life and property of local residents. FEMA has designed Frio County as a priority county for LiDAR and mapping to be completed in, but it has not be scheduled to date.	2	Dam Failure, Flood, Hurricane/ Tropical Storm	●	G1, G2	Commissioners Court	$10,000	County Budget and Grants	60	High
7	Purchase and Install Permanent Back-up Generator for Courthouse	County courthouse does not have a back-up generator, where an EOC is located. An extended power loss would cause disruption to county services as well as EOC operations. Frio County will purchase and install a permanent back-up generator in the event of extended power loss for the courthouse.	7	Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather	●	G2, G4	Office of Emergency Management	$100,000	County Budget, HMGP Grant	60	Medium
CITY OF DILLEY											
1	Purchase and Install Permanent Back-up Generator for City Hall	City Hall does not have a back-up generator and that is where an EOC is located. An extended power loss would cause disruption to city services as well as EOC operations. The city will purchase and install a permanent back-	4	Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado,	●	G2, G4	City Manager	$100,000	City Budget, HMGP Grant	60	Medium

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		up generator in the event of extended power loss for City Hall.		Wildfire, Wind, Winter Weather							
2	Conduct Public Outreach to Educate Homeowners on Mitigation Measures for Their Homes	The public needs reminders about mitigation measures to protect their home from natural hazards as storm events have become more intense, and droughts and extreme heat periods last longer.	3	Drought, Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather	●	G2, G3, G5	City Manager	$5,000	City Budget	60	Medium
3	Implement Drought and Extreme Heat Contingency Plan	The city is most impacted by drought and extreme heat conditions as these conditions are prevalent most years. Thus, a contingency plan for water usage is needed. The city will create and implement a drought and extreme heat contingency plan to create water conservation stages for users based on water availability.	1	Drought, Extreme Heat	●	G2, G3, G5	City Manager	$40,000	City Budget, Grants	60	Medium
4	Implement Box Fan Campaign for Residents	The city will create a donations campaign to give box fans to residents in need. The city cannot purchase these fans for residents, but they can lead the campaign and team with civic groups such as the Knights of Columbus, Chamber of Commerce and Society of St. Vincent de Paul to gather donations and distribute fans.	2	Extreme Heat	●	G2	City Manager	No cost	Donations	36	Medium
CITY OF PEARSALL											
1	Update IBC to 2015 Version	The city will adopt and enforce the measures and guidelines of IBC 2015. This will ensure the safety of natural hazards and incorporate these stricter building codes into other planning efforts	4	Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Hail,	●	G2, G4	Public Works, Police	No cost	City Budget	60	High

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		such as the Master Plan. The stricter codes can mitigate the identified hazards, such as tornado, high wind, and impact-resistant materials (windows, doors, roof bracings) by: dry-proofing public buildings for flooding; upgrading to higher standard insulation for extreme heat and winter storms; installing lighting rods and grounding systems on public buildings; retrofitting to low-flow plumbing and replacing landscaping with drought and fire resistant plants; creating stricter codes for hail and fire-resistant roofing and siding; and implementing higher standards for foundations.		Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather							
2	Purchase and Install Permanent Back-up Generator for Wastewater Treatment Facility	The city will purchase and install a permanent back-up generator in the event of extended power loss for the wastewater treatment facility.	5	Dam Failure, Earthquake, Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather	●	G2, G4	Public Works	$100,000	City Budget	6	High
3	Conduct Public Outreach to Educate Homeowners on Mitigation Measures for Their Homes	Information on methods and materials homeowners can use to minimize the hazards to property and human life; information posted and available in newspaper, on city website, and on marquees throughout the city.	2	Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning,	●	G2, G3, G5	Public Works	$5,000	City Budget	60	High

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
				Tornado, Wildfire, Wind, Winter Weather							
4	Maintain Storm Drainage System	The drainage system collects debris in culverts and becomes ineffective in containing flood waters during rain events. The Public Works Department will maintain the storm drainage system by clearing debris and cutting and mowing vegetation in drainage ditches at least twice a year.	1	Dam Failure, Flood, Hurricane/ Tropical Storm	●	G2, G4	Public Works	$20,000	City Budget	60	High
5	Drought and Extreme Heat Contingency Plan	The Public Works Department will update their Drought Contingency Plan, dated September 2011 to include extreme heat and update the 5 Stages Shortage conditions water usage limits and water impacts. Then city ordinance will be updated with latest information.	3	Drought, Extreme Heat	●	G1, G3, G4, G5	Public Works	$60,000	City Budget	48	Medium

LEGEND

Action Type: ● Education and Awareness Programs ● Structure and Infrastructure Projects ● Local Plans and Regulations ● Natural Systems Protection

Notes:

EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
HMGP	Hazard Mitigation Grant Program
IBC	International Building Code
LiDAR	A surveying technology that measures distance by illuminating a target with a laser light
MOU	Memorandum of Understanding

PART 1
PLAN ELEMENTS AND PARTICIPATING COMMUNITIES

Chapter 1.
INTRODUCTION

1.1 WHY PREPARE THIS PLAN?

1.1.1 The Big Picture

Hazard mitigation is defined as a way to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster. It involves long- and short-term actions implemented before, during and after disasters. Hazard mitigation activities involve planning efforts, policy changes, programs, improvement projects, and other activities to reduce the impacts of hazards.

For many years, federal disaster funding focused on relief and recovery after disasters occurred, with limited funding for hazard mitigation planning in advance. The Disaster Mitigation Act (DMA; Public Law 106-390), passed in 2000, shifted the federal emphasis toward planning for disasters before they occur. The DMA requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. Regulations developed to fulfill the DMA's requirements are included in Title 44 of the Code of Federal Regulations (44 CFR).

The responsibility for hazard mitigation lies with many, including private property owners, commercial interests, and local, state and federal governments. The DMA encourages cooperation among state and local authorities in pre-disaster planning. The enhanced planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk-reduction projects.

The DMA also promotes sustainability in hazard mitigation. To be sustainable, hazard mitigation needs to incorporate sound management of natural resources and address hazards and mitigation in the largest possible social and economic context. The planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

1.1.2 Purposes for Planning

Frio County prepared this hazard mitigation plan in compliance with the DMA that will be adopted and approved by the Texas Division of Emergency Management (TDEM) and the Federal Emergency Management Agency (FEMA) Region VI. This plan identifies resources, information, and strategies for reducing risk from natural hazards and for it to be revised on a 5-year cycle.

The County prepared this plan in partnership with local municipalities. Elements and strategies in the plan were selected because they meet a program requirement and because they best meet the needs of the planning partners and their citizens. One of the benefits of multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities. FEMA encourages multi-jurisdictional planning under its guidance for the DMA. This plan will help guide and coordinate mitigation activities throughout the planning area.

This plan meets the following objectives:

- Meet or exceed requirements of the DMA.
- Enable all planning partners to continue using federal grant funding to reduce risk through mitigation.
- Meet the needs of each planning partner as well as state and federal requirements.
- Create a risk assessment that focuses on Frio County hazards of concern.
- Create a single planning document that integrates all planning partners into a framework that supports partnerships within the county, and puts all partners on the same planning cycle for future updates.

- Coordinate existing plans and programs so that high-priority actions and projects to mitigate possible disaster impacts are funded and implemented.

1.1.3 Previous Participation

Frio County and the Cities of Dilley and Pearsall participated in the previous *Alamo Area Council of Governments (AACOG) Regional Mitigation Action Plan Update, 2012-2017* that has expired.

The *AACOG Regional Mitigation Action Plan Update, 2012-2017* ranked 14 hazards from high (H) to low (L) for Frio County and all the planning partners. Table 1-1 shows the hazards and their ranking from this plan. These hazards include three human-caused hazards: Hazardous Materials (fixed and transport), Pandemic (human and animal), and Terrorism. Although the *AACOG Regional Mitigation Action Plan Update, 2012-2017* profiled human-caused hazards, only natural hazards will be evaluated in this multi-jurisdictional Frio County Hazard Mitigation Plan.

Table 1-1. Hazards Evaluated in *AACOG Regional Mitigation Action Plan Update, 2012-2017*

	Flood (Flash and Riverine)	Flood (Dam and Levee Failure)	Tornado	Tropical Storms and Hurricanes	Severe Thunderstorms	Drought	Hail	Wildfire	Winter Storms and Freezes	Geologic Hazards: Earthquakes and Sinkholes	Energy Pipelines	Hazardous Materials (Fixed and Transport)	Pandemic (Human and Animal)	Terrorism
Frio County	H	M	M	M	H	H	M	M	L	L	L	M	M	L
City of Dilley	M	L	H	H	H	H	M	M	M	L	L	M	L	L
City of Pearsall	M	M	H	H	H	H	M	M	M	H	M	H	H	M

Notes:
AACOG Alamo Area Council of Governments
H High
M Moderate
L Low

1.2 WHO WILL BENEFIT FROM THIS PLAN?

All residents, businesses and visitors of and to Frio County are the ultimate beneficiaries of this multi-jurisdictional hazard mitigation plan. The plan reduces risk for those who live in, work in, and visit the county. It provides a viable planning framework for all foreseeable natural hazards that may impact the county. Participation in development of the plan by key stakeholders helped ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable countywide. The plan's goals and recommendations lay groundwork for the development and implementation of local mitigation activities and partnerships.

1.3 LOCAL MITIGATION PLAN REVIEW TOOL

The Local Mitigation Plan Review Tool demonstrates how the local mitigation plan meets the regulation in 44 CFR §201.6 and offers states and FEMA Mitigation Planners an opportunity to provide feedback to the community. The FEMA Region VI Local Mitigation Plan Review Tool is included in Appendix C.

The Regulation Checklist provides a summary of FEMA's evaluation of whether the plan has addressed all requirements.

The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.

The Multi-Jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of each element of the plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference the *Local Mitigation Plan Review Guide* when completing the Local Mitigation Plan Review Tool.

Chapter 2.
PLAN METHODOLOGY

2.1 GRANT FUNDING

Frio County applied for a grant through FEMA's Pre-Disaster Mitigation grant program to supplement the plan development process. The Frio County EOM's Office was the applicant agent for the grant. Grant funding was appropriated in fiscal year 2015. Frio County hired Tetra Tech, Inc. to assist with development and implementation of the plan. The Tetra Tech Project Manager assumed the role of the lead planner, reporting directly to a county-designated project manager, Emergency Management Coordinator Mr. Ray Kallio.

2.2 ESTABLISHMENT OF THE PLANNING PARTNERSHIP

Frio County opened this planning effort to all eligible local governments in the county. The planning partners' responsible leaders (point of contacts) are shown in Table 2-1. These responsible leaders were asked to join the Steering Committee and participate in its process.

Table 2-1. County and City Planning Partners

Jurisdiction	Point of Contact	Agency	Title
Frio County	Ray Kallio	Frio County Emergency Management	Emergency Management Coordinator
City of Dilley	Jose "Rudy" Alvarez	City of Dilley	City Administrator
City of Pearsall	Xavier Antu	City of Pearsall	Public Works Director

2.2.1 Steering Committee

A Steering Committee was established comprised of representatives from Frio County as well as each of the planning partners' responsible leaders and stakeholders throughout the communities. Each planning partner and stakeholder wishing to join the Steering Committee was asked commit to the process and have a clear understanding of expectations. These include:

- Support and participate in the Steering Committee meetings overseeing the development of the plan. Support includes making decisions regarding plan development and scope on behalf of the partnership.
- Each partner will provide support as needed for the public involvement strategy developed by the Steering Committee in the form of mailing lists, possible meeting space, and media outreach such as newsletters, newspapers, or direct-mailed brochures.
- Each partner will participate in plan development activities such as:
  - Steering Committee meetings
  - Public meetings or open houses
  - Workshops and planning partner training sessions
  - Public review and comment periods prior to adoption

Attendance was tracked at these activities, and attendance records documenting participation for each planning partner are included in the plan. All participating communities were expected to attend and actively participate in all meetings and activities.

- Each partner within the Steering Committee is expected to review the risk assessment and identify hazards and vulnerabilities specific to its jurisdiction. Contract resources will provide jurisdiction-specific mapping and technical consultation to aid in this task, but the determination of risk and vulnerability ranking will be up to each partner.

- Each partner will be expected to review the mitigation recommendations chosen for the overall county and evaluate whether they will meet the needs of its jurisdiction. Projects within each jurisdiction consistent with the overall plan recommendations will need to be identified, prioritized, and reviewed to identify their benefits and costs.
- Each partner will be required to sponsor at least one public meeting to present the draft plan at least two weeks prior to adoption.
- Each partner will be required to formally adopt the plan.
- Each partner will agree to the plan implementation and maintenance protocol.

Failure to meet these criteria may result in a partner being dropped from the partnership by the Steering Committee, and thus losing eligibility under the scope of this plan.

2.3 DEFINING THE PLANNING AREA

The planning area was defined to consist of all of Frio County (Figure 2-1). Relevant planning area characteristics are described in Chapter 4. All partners to this plan have jurisdictional authority within this planning area.

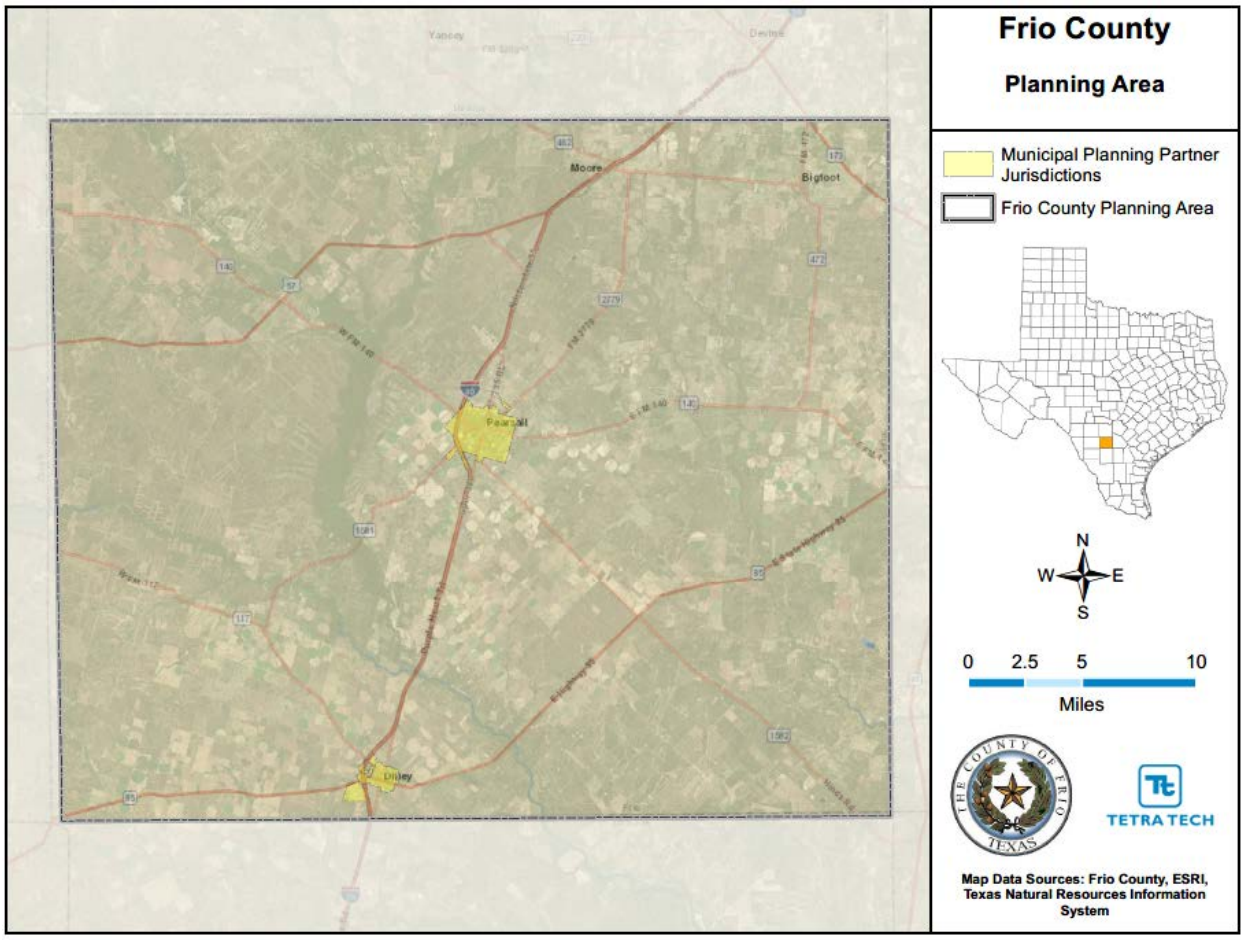


Figure 2-1. Frio County Planning Area

2.4 THE STEERING COMMITTEE

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. A Steering Committee was formed to oversee all phases of the plan development. The members of this committee included key planning partner staff, citizens, and other stakeholders from the planning area. Table 2-2 shows the representation of each participating jurisdiction at the planning meetings and development of mitigation actions. Sign-in sheets are included in Appendix B: Planning Process Documentation. All the jurisdictions listed as official participants in this plan met all of these participation requirements.

Table 2-2. Steering Committee Members Participation in Planning Process

Jurisdiction	Kick-off Meeting	Planning Meeting #2	Planning Meeting #3	Mitigation Actions Received
Frio County	X	X	X	X
City of Dilley	X	X	X	X
City of Pearsall	X		X	X
Bigfoot Volunteer Fire Department		X		
Frio Regional Hospital	X		X	
TDEM			X	

Notes:
TDEM Texas Division of Emergency Management

The Steering Committee agreed to meet a minimum of three times or as needed throughout the course of the plan's development. The consultant and the Frio County Emergency Manager facilitated each Steering Committee meeting, which addressed a set of objectives based on the work plan established for the plan. The Steering Committee met three times from October 2017 through May 2018. Meeting agendas, notes, and attendance logs can be found in Appendix B of this document.

The Steering Committee Kickoff Meeting occurred on October 19, 2017, to introduce the mitigation planning process. The Steering Committee, planning partners, and the public were encouraged to participate in the plan process. Key meeting objectives at the October meeting were as follows:

- Steering Committee purposes and responsibilities
- Plan partners and signators responsibilities
- Purpose and goals of the plan process
- Review mitigation goals
- Critical facilities discussion

The Steering Committee met on December 11, 2017, to review the hazard risk assessment for Frio County and the results of the community survey. Based on the risk assessment and survey results, the Steering Committee then ranked the natural hazards. The hazards were ranked based on their probability of occurrence and their potential impact on people, property, and the economy. The results of the hazard ranking are discussed in Chapter 15.

The third Steering Committee meeting was held on May 8, 2018. The main objective of the meeting was to present and rank mitigation actions, which were developed to address all hazards of concern. The mitigation actions are discussed in Chapter 16. The meeting provided for an exchange of information on how the plan would be maintained and the consultant presented a fact sheet on Hazard Mitigation Assistance (HMA) grants.

2.5 COORDINATION WITH OTHER AGENCIES

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development,

businesses, academia, and other private and non-profit interests (44 CFR, Section 201.6(b)(2)). This task was accomplished by the planning team as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee.
- **Agency Notification**—TDEM was invited to participate in the plan development process from the beginning and was kept apprised of plan development milestones.
- **Pre-Adoption Review**—Agency representatives listed above were provided an opportunity to review and comment on this plan, primarily through the county's website and during the Steering Committee meetings. Each agency was sent an email message informing them that draft portions of the plan were available for review. In addition, the complete draft plan was sent to TDEM for a pre-adoption review to ensure program compliance.

2.6 REVIEW OF EXISTING PROGRAMS

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports and technical information (44 CFR, Section 201.6(b)(3)). Chapter 3 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation actions. In addition, the following programs can affect mitigation within the planning area:

- Frio County
  - Subdivision Regulations
  - Flood Damage Prevention Order
  - Floodplain Map
  - Basic Emergency Operations Plan

An assessment of all planning partners' regulatory, technical, and financial capabilities to implement hazard mitigation actions is presented in Chapter 4. Many relevant plans, studies, and regulations are cited in the capability assessment.

2.7 PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1)). The strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the Steering Committee
- Use a community survey/questionnaire to evaluate whether the public's perception of risk and support of hazard mitigation has changed since the initial planning process
- Attempt to reach as many planning area citizens as possible using multiple media
- Identify and involve planning area stakeholders
- Solicit public feedback at each stage of plan implementation, monitoring, and evaluation.

2.7.1 Stakeholders and the Steering Committee

Stakeholders are the individuals, agencies, and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan and may be affected by a mitigation action or policy. Examples of stakeholders encouraged to participate in the planning process include business owners, chamber of commerce, neighborhood associations, the American Red Cross, hospital districts, and private

organizations. The effort to include stakeholders in this process included stakeholder participation on the Steering Committee and encouragement to attend and participate in all jurisdictional committee meetings. Stakeholders were notified by various methods including email, community news webpages, social media, and face-to-face invites.

Additionally, representatives from the Steering Committee were encouraged to give plan progress updates at their various organizations public and private committee meetings. Plan and Steering Committee updates were also included on community and/or department websites encouraging interested stakeholders to either reach out to Steering Committee leaders one-on-one to provide comments, or to ask questions.

2.7.2 Survey/Questionnaire

A hazard mitigation plan questionnaire (see Figure 2-2) was developed to gauge household preparedness for natural hazards; the level of knowledge of tools and techniques that assist in reducing risk and loss from natural hazards; and the perceived impact of natural hazards on Frio County residents and businesses. This online questionnaire was designed to help identify areas vulnerable to one or more natural hazards. The answers to these 35 questions helped guide the Steering Committee in prioritizing hazards of impact and in selecting goals, objectives, and mitigation strategies. A total of 15 questionnaires were completed during this planning process.

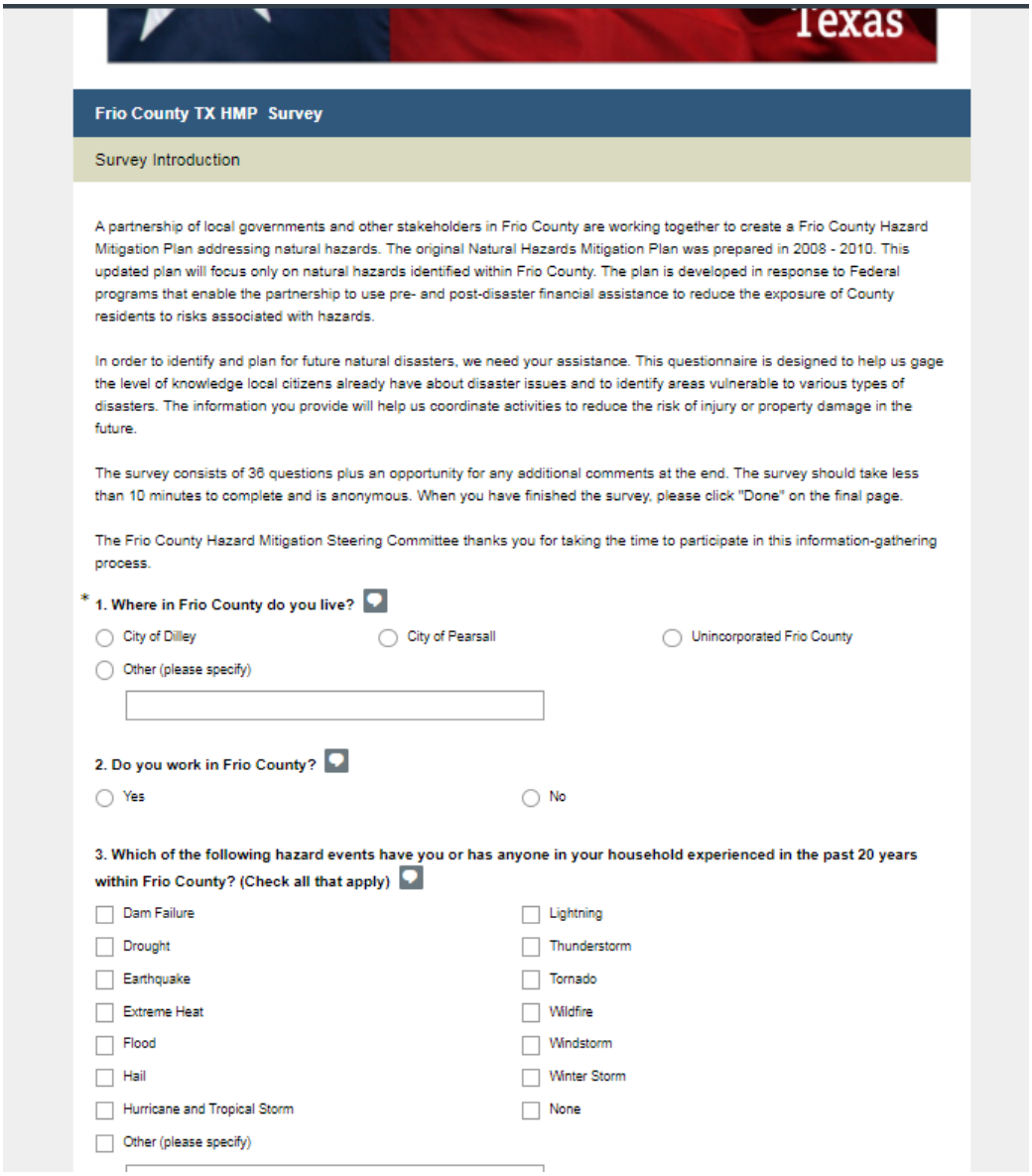


Figure 2-2. Sample Page from Questionnaire Distributed to the Public

2.7.3 Meetings

Three Steering Committee meetings were held in the City of Pearsall on October 19, 2017; December 11, 2017; and May 8, 2018. The meeting format allowed attendees to access handouts, maps, and other resources and ask questions during the meetings. Additionally, project staff and county personnel remained after the meeting to have direct conversations with interested attendees. Details regarding the planning and information generated for the risk assessment were shared with attendees via a PowerPoint presentation.

Frio County and the planning partners held public meetings to present the draft plan, discuss the benefits of the plan, and solicit public comments. Unless otherwise noted below, the public meetings were held as part of a regularly scheduled public meeting and the plan was discussed as an item on the meeting agenda. Notice of the public meeting was provided in compliance with the communities' individual requirements. A member of the planning team was available during all meetings to answer questions from the public on the development of the hazard mitigation plan.

The 1st public outreach period was from July X, 2018. Frio County issued a press release (see Figure 2-4) to solicit public comments on the draft plan. The draft plan was available for review in hard copy at the Frio County Office of Emergency Management starting July X 2018 for review by interested parties and posted on the Frio County website (see X). The participating jurisdictions also solicited public comments on the draft. The City of Dilley had hard copies available at the X. The City of Pearsall had hard copies at X.

Once the draft plan became approved pending adoption by FEMA, a second public outreach occurred. The plan was available to the public and was presented and reviewed in a public meeting before the Frio County Commissioners Court on XXX XX, 2018.

Each city held a public meeting on X to present the draft plan and solicit public comments. The draft plan was made available for review in hard copy at the City Hall on XX for review by interested parties. In addition, the draft was posted on the City of X website on XX. No comments that resulted in changes to the plan were received from the public electronically or in person at the city hall or during the public meeting. The draft plan was presented and reviewed in a public meeting before the City Council on XXX XX, 2018.

2.7.4 Press Releases/News Articles

Press releases were distributed over the course of the plan's development as key milestones were achieved and prior to each public meeting. Figure 2-3 shows how the HMP survey link was shared with the public. Figure 2-4 is a sample press release issued by the Frio County to participate in the hazard mitigation plan.

Source: Frio-Nueces Current, 2017

Emergency coordinator seeks community input

By Breyana Segura

Frio County 9-1-1 Emergency Coordinator Ray Kallio is calling for community involvement this week, after a mere seven county residents have participated in the Frio County Hazard Mitigation Plan Update survey.

The survey calls for community input and involvement that is instrumental to the development of a mitigation plan that truly reflects the perceptions and needs of Frio County residents.

The survey can be found at https://www.surveymonkey.com/r/FrioHMPCommunitySurveyrev

A meeting to discuss the survey results will be held on Monday, December 11 at 2 p.m. in the Frio County Extension Office Community Room.

Source: Frio-Nueces Current. November 23, 2017

Figure 2-3. Hazard Mitigation Plan Survey Article, November 23, 2017

Figure 2-4. Frio County Draft Plan Availability, July X, 2018

2.8 PLAN DEVELOPMENT, CHRONOLOGY, MILESTONES

Table 2-3 summarizes important milestones in the development of this plan.

Table 2-3. Plan Development Chronology/Milestones

Date	Event	Description	Attendance
		2017	
	Organize Resources	County OEM holds kickoff meeting for potential planning partners to inform them of the next steps in the plan process, solicit commitment to participate, explain expectations, and organize resources for the update.	N/A
9/28	Contract signed	Notice to proceed given to Tetra Tech, Inc.	N/A
10/19	Steering Committee Meeting #1	• Introduction to hazard mitigation planning process • Steering Committee purpose and responsibilities • Plan goals • Critical facilities • Capabilities assessment • Discuss options for public outreach strategy and survey	13
11/23	Ongoing Public Outreach	• Newspaper article	N/A
12/11	Steering Committee Meeting #2	• Reminder hazard mitigation planning process • Review completed items – goals, capabilities assessment • Hazards of concern presentation • Survey results to date • Hazard ranking exercise • Mitigation action worksheet	6
		2018	
5/8	Steering Committee Meeting #3	• Mitigation actions prioritization • HMA project development	7
7/	1st Public Outreach Period	Public comment period of draft plan opens for Frio County and the planning partners. Press release of draft plan availability to public issued. Draft plan available on Frio County's website, planning partners websites, and in hard copy at X	
X	Plan Review	Final draft plan submitted to Texas Division of Emergency Management for review	N/A
	Plan Approval Pending Adoption	Plan approval pending adoption by FEMA	N/A
	2nd Public Outreach Period	Final public meeting on draft plan	N/A
	Adoption	Adoption window of final plan opens	N/A
	Plan Approval	Final plan approved by FEMA	N/A

Notes:
FEMA Federal Emergency Management Agency
HMA Hazard Mitigation Assistance
N/A Not Applicable
OEM Office of Emergency Management

Chapter 3.
FRIO COUNTY PROFILE

3.1 GEOGRAPHIC OVERVIEW

Frio County forms a rectangle and comprises of 1,133 square miles of land area and 1.3 square miles of water. It is located in southwest Texas and is bordered to the east by Atascosa County, to the south by La Salle County, to the west by Zavala County and to the north by Medina County. Frio County is named after the Frio River, which flows northwest to southwest through the county. The County is in the Nueces River Basin and is drained by the Frio and Leona Rivers in the west and by San Miguel Creek in the east.

The City of Pearsall, the county seat, is 50 miles southwest of San Antonio and 75 miles east of the U.S.-Mexican border at Eagle Pass. Interstate 35 traverses the middle of Frio County through the Cities of Dilley and Pearsall. U.S. Highway 81 parallels Interstate 35.

Figure 3-1. Location of the Frio County Planning Area within the State of Texas

The county terrain is mainly flat and the majority of the county is prime farmland. Hickory, oak, brush, mesquite, prickly pear, and grasses are predominate in the landscape.

3.2 HISTORICAL OVERVIEW

Frio County was formed from parts of Atascosa, Bexar, and Uvalde Counties in February 1858 but later organized in May 1871 when the county seat was named and located. Most of this section was summarized from the *Handbook of Texas Online* (Ochoa 2017). The county was named for the Frio River.

Before the era of European explorers and settlers, the county was periodically inhabited by the Payaya and Pachal Indians, Coahuiltecan groups. Many of the nomadic Coahuiltecan Indians in Frio County were eventually embraced by the missions of San Antonio. Frenchman René Robert Cavelier, who recorded his travels across the northwest corner of the county in 1685, was probably the first European to set foot in Frio County. A north/south route through the future county became the principal road from Mexico to San Antonio.

In the 1840s, the Republic of Texas issued land grants for lands along the Frio River, Leona River, and various creeks in the region to settlers. However, few people settled in the county before the Civil War because Comanche mustangers frequented the region.

The decade between 1870 and 1880 was a period of rapid development. The county population rose dramatically from a reported 309 in 1870 to 2,130 in 1880. The fourteen farmers reported as operating in the northeastern Frio County area in 1870 were actually stock raisers of cattle or sheep; farmers raised small vegetable gardens. Frio City developed as a "cowboy capital" and an outpost cultural center of southwest Texas during the 1870s; ranchers in the area controlled vast numbers of cattle on expansive landholdings. Although the county was expanding rapidly, the frequency of Comanche raids led to the establishment in 1876 of Ranger Camp on Elm Creek three miles southwest of Frio City. The last Indian disturbance in the county occurred in 1877.

In 1883, the first term of the county commissioners' court was held in Pearsall, the new county seat. Thus, a substantial portion of the population in Frio City (former county seat) moved to Pearsall. Additional roads were built during this era and iron bridges were constructed across rivers and creeks beginning in 1887. By 1892, as many as ten iron bridges had been built in the county's road system.

Between 1880 and 1900 the population of the county grew from 2,130 to 4,200, acreage devoted to cotton production increased from 543 acres to 13,764 acres, and honey production jumped from an annual production of 1,930 pounds in 1880 to 35,400 pounds in 1900. Irrigation became an integral part of farming especially after 1875 when the Texas legislature passed a general law that offered a bonus of land to companies that would build irrigation systems. This legislation prompted the San Antonio-based Leona Irrigation, Manufacturing and Canal Company to construct a dam across the Leona River and several miles of ditches in southwestern Frio County. The dam was destroyed by a flood and never replaced, however, any attempts at irrigated farming were delayed until 1905, when the first artesian well in the county was dug on the Schreiner and Halff Farm, four miles southwest of Pearsall. Wells were soon dug along the Frio and Leona River valleys. In 1913 it was reported that about 2,000 acres were irrigated by artesian water in Frio County.

In 1900 Frio County had 394 farms; by 1910 it had 918 farms and 100,122 acres of improved land. Livestock in 1910 totaled 34,213 cattle, 6,414 horses and mules, 5,666 sheep, and 2,911 goats. The major crops were cotton, hay and forage crops, and corn. Several thousand acres was planted with citrus and nut trees.

As early as 1930, a Texas A&M county agent for Frio County promoted the cultivation of peanuts as a substitute for cotton. By 1970 peanuts were Frio County's largest money crop; income from peanut culture was $5,776,900 and that from cattle was $3,276,000. Peanut production in 1982 amounted to 50,230,224 pounds, making Frio County the largest producer of peanuts in Texas at that time.

In 1949 peanut production covered 19,780 acres, and watermelons 7,042. In 1950, 20% of the county's total acreage supported 600 farms; corn was cultivated on 10,426 acres. By 1951 farmers were practicing diversification and double cropping on mechanized farms. Tractors increased in number from 206 in 1940 to 656 in 1950. Other agricultural machinery, such as the squeeze chute and the labor-saving peanut combine, which was developed by a Frio County farmer, helped reduce the cost of farming and ranching in the county. Frio County was one of the leading honey-producing counties in Texas in 1950, when 640,237 pounds was marketed. The native huajillo, whitebrush, and catclaw, as well as the cultivated citrus, were sources of nectar.

By 1970 small farms were no longer prevalent in Frio County. The use of expensive farm machinery had forced average farm acreage to expand to meet the payments necessary to operate profitable farms. The 73,884 acres of harvested cropland included 30,076 planted in sorghum, 17,596 in peanuts, and 10,208 in melons and vegetables. In 1982 the county produced more than 23,262 tons of watermelons; Frio County was the top producer in Texas at that time.

Interstate 81, also known as the Pan-American Highway, became the first paved road in Frio County in 1926. Two years later a highway from Dilley to Eagle Pass was completed. In 1941 the state legislature supplied the funds to construct farm roads 1582, 1465, 1581, and 1583. The road from Pearsall to Charlotte was completed in 1946. By 1953 seventy-six miles of farm roads had been paved in the county. In 1968 the portion of Interstate 35 that paralleled Interstate 81 and the Missouri Pacific was completed.

Oil reserves in Frio County were first exploited around 1930 by the Amerada Petroleum Corporation; by 1936 Amerada had more than 85,000 acres leased for oil exploration. Oil production was 2,334 barrels in 1942, 448,499 barrels in 1948, and by 1952, when over 100 wells operated in both the Pearsall and Bigfoot fields, it had reached 1,505,740 barrels. In 1966 Frio County had more than 600 producing oil and gas wells. Annual oil and natural gas production in the early 1980s averaged around three million barrels and 1.75 million cubic feet respectively.

By 1989 the Bigfoot field in northeast Frio County had produced twenty-nine million barrels of oil, and Pearsall field in west central Frio County had produced sixty million barrels; these two fields were among the most productive oilfields in the San Antonio Oil and Gas District. In 1989 agribusiness and the oil business remained the dominant economic enterprises in the county. Farmers and ranchers of Frio County made $41,705,000 in 1989. The leading products were peanuts, $17,465,000; beef cattle, $9,848,000; vegetables (mainly Irish potatoes and spinach), $5,076,000; cotton, $2,100,000; and hogs, $1,133,000. Hunting grossed $1,740,000. The cash receipts for beef dropped dramatically in 1989 from the three previous years because of drought. Since 1990 the oil industry in Frio County has been successful because of new oil-extraction technology that permits horizontal drilling to considerable depths.

Despite a small decline in the late twentieth century, Frio County has seen an overall growth in population since 1940. Between 1940 and 1980 the number of residents increased from 9,207 to 13,785. During the 1980s, however, the area’s population showed a modest drop, and in 1990 the number of inhabitants was 13,472.

In the early twenty-first century agriculture, oilfield services, and hunting leases were essential elements of the local economy. In 2002 the county had 537 farms and ranches covering 603,119 acres, 67% of which were devoted to pasture, 25% to crops, and 6% to woodlands. Peanuts, potatoes, spinach, cucumbers, watermelons, beef cattle and goats were the chief agricultural products. More than 620,189 barrels of oil, and 805,503 thousand cubic feet of gas well gas, were produced in the county in 2004; by the end of that year 145,829,486 barrels of oil had been taken from county lands since 1934.

3.3 MAJOR PAST HAZARD EVENTS

Federal disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government. However, no specific dollar

loss threshold has been established for these declarations. A federal disaster declaration puts federal recovery programs into motion to help disaster victims, businesses, and public entities. Some of the programs are matched by state programs. The planning area has experienced 13 hazard-related events since the first federal disaster declaration was issued in 1990 for Frio County. These events are listed in Table 3-1.

Review of these events helps identify targets for risk reduction and ways to increase a community's capability to avoid large-scale events in the future. Still, many natural hazard events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern. More detailed event tables can be found in the individual hazard profile sections.

Table 3-1. Presidential Disaster Declarations in Frio County

Type of Event	FEMA Disaster Number	Declaration Date
Severe Storms, Tornadoes, Straight-Line Winds and Flooding	DR-4223	5/29/2015
Wildfires	DR-1999	7/1/2011
Wildfires	EM-3284	3/14/2008
Extreme Wildfire Threat	DR-1624	1/11/2006
Hurricane Rita	DR-1606	9/24/2005
Hurricane Rita	EM-3261	9/21/2005
Hurricane Katrina Evacuation	EM-3216	9/2/2005
Hurricane Claudette	DR-1479	7/17/2003
Tropical Storm Fay	DR-1434	9/26/2002
Severe Storms and Flooding	DR-1425	7/4/2002
Tropical Storm Charley	DR-1239	8/26/1998
Extreme Fire Hazard	EM-3113	9/10/1993
Severe Freeze	DR-850	1/9/1990

Source: FEMA 2018
Notes:
DR Disaster Declaration
EM Emergency Declaration
FEMA Federal Emergency Management Agency

3.4 CLIMATE

In Frio County, the summers are hot and oppressive, the winters are fairly warm. Average temperatures range from 96.6 degrees Fahrenheit (°F) in the summer to 40.6°F in the winter. Cold temperatures and snowfall are rare. The Western Regional Climate Center (WRCC) reports data from the City of Pearsall weather station in Frio County. Table 3-2 contains temperature summaries for the station.

Table 3-2. Temperature Summaries for Planning Area

	Pearsall Weather Station
Period of record	1902 - 2012
Winter[a] Average Minimum Temperature	40.6°F
Winter[a] Average Maximum Temperature	67.0°F
Winter[a] Mean Temperature	53.8°F
Spring[a] Average Minimum Temperature	57.0°F
Spring[a] Average Maximum Temperature	83.5°F
Spring[a] Mean Temperature	70.3°F

	Pearsall Weather Station
Summer[a] Average Minimum Temperature	70.1°F
Summer[a] Average Maximum Temperature	96.6°F
Summer[a] Mean Temperature	83.3°F
Fall[a] Average Minimum Temperature	57.8°F
Fall[a] Average Maximum Temperature	84.0°F
Fall[a] Mean Temperature	70.9°F
Maximum Temperature	113°F, June 2000
Minimum Temperature	7°F, December 1983
Average Annual Number of Days >90°F	143.2°F
Average Annual Number of Days <32°F	6.3°F

Source: WRCC 2018
Notes:
°F Degrees Fahrenheit
< Less Than
> Greater Than
a. Winter: December, January, and February; Spring: March, April, and May; Summer: June, July, and August; Fall: September, October, and November.

Rainfall is usually heaviest in late spring and early fall. Precipitation is highest in May. Rain in the fall is often associated with a dissipating tropical storm. The average annual precipitation is 23.82 inches which is usually adequate for range vegetation. Though because of a high rate of evapotranspiration, it is commonly not adequate for cotton, small grain, and sorghum. Irrigation is needed if these crops are grown (Natural Resources Conservation Service [NRCS] 1992). Based on information measured by the National Lightning Detection Network, Frio County received 6 to 12 cloud-to-ground lightning flashes per square mile from 2008 to 2017 (National Lightning Detection Network 2018).

Table 3-3. Precipitation Summaries for Planning Area

	Pearsall Weather Station
Period of record	1902 - 2012
Winter[a] Mean Precipitation	3.81 inches
Spring[a] Mean Precipitation	6.71 inches
Summer[a] Mean Precipitation	6.73 inches
Fall[a] Mean Precipitation	6.56 inches
One Date Maximum Precipitation	7.84 inches, August 29, 1946
Annual Precipitation	23.82 inches

Source: WRCC 2018
Notes:
a. Winter: December, January, and February; Spring: March, April, and May; Summer: June, July, and August; Fall: September, October, and November.

3.5 GEOLOGY AND SOILS

Texas is broadly divided into four regions by physical geography features such as landforms, and vegetation. Frio County is in southwestern Texas and it lies in within the Northern Rio Grande Plain Land Resource area and part of the Winter Garden District. The land surface is nearly level to rolling and generally slopes to the southwest. Elevations range from 400 to 850 feet above sea level. The Carrizo Sand Aquifer supplies the county with water.

In Frio County, the Duval-Webb soil type is mainly very deep to moderately deep, well drained, and moderately slowly permeable. The County is comprised of about 46% Duval soils, 17% Webb soils, and 37% minor soils according to the Frio County Soil Survey (NRCS 1992). It produces a large amount of forage and a variety of crops. The shallow and very shallow soils are used primarily as rangeland.

Duval soils are typically a surface layer of yellowish, red very fine sandy loam about 16 inches thick. The subsoil is also a yellowish red and red sandy clay loam.

Webb soils are typically a surface layer of dark brown very fine sandy loam about 10 inches thick. The upper part of the subsoil is reddish brown sandy clay. The lower part is reddish brown, yellowish red, and strong brown sandy clay loam.

3.6 CRITICAL FACILITIES AND INFRASTRUCTURE

Critical facilities and infrastructure are assets, systems and networks, whether physical or virtual, whose incapacity or destruction would have a debilitating impact on security, economic security, public health or safety, or any combination. Risk assessment of hazards considers the potential impact of a hazard on the function of critical facilities and infrastructure. All critical facilities and infrastructure were analyzed in FEMA's Hazards, United States-Multi Hazard (Hazus) model to help rank risk and identify mitigation actions. The risk assessment for each hazard discusses critical facilities with regard to that hazard.

Typical critical facilities include hospitals, fire stations, police stations, and similar facilities. These facilities should be given special consideration when formulating regulatory alternatives and emergency management plans. A critical facility should not be located in high hazard areas if at all possible. If a critical facility must be located in a high hazard area, it should be provided a higher level of protection so that it can continue to function and provide services after the hazard event. Communities should develop emergency plans to continue to provide these services during the hazard event.

The Hazus model used for risk assessment in this plan defines specific types of critical facilities and infrastructure as well as broader categories that include multiple types. Table 3-4 summarizes the critical facilities and infrastructure within each broad category for each municipality and unincorporated county area. This information was obtained from Hazus and county emergency management personnel.

Table 3-4. Planning Area Critical Facilities and Infrastructure

Jurisdiction	Medical and Health Services	Emergency Services	Educational Facilities	Other Critical Facilities	Utilities and Communication	Transportation Infrastructure	Total
City of Dilley	0	2	5	0	0	1	8
City of Pearsall	1	3	4	0	2	6	16
Unincorporated County	0	0	4	0	4	80	88
Total	1	5	13	0	6	87	112

Figure 3-2, Figure 3-3, and Figure 3-4 show the location of critical facilities and infrastructure in the county and the Cities of Dilley and Pearsall with symbols showing each specific type of facility. The figure legend identifies the broader category that encompasses each type. Because of the sensitivity of this information, a detailed list of facilities is not provided. The list is on file with each planning partner. Critical facilities and infrastructure were analyzed in Hazus to help rank risk and identify mitigation actions. The risk assessment for each hazard discusses critical facilities and infrastructure with regard to that hazard.

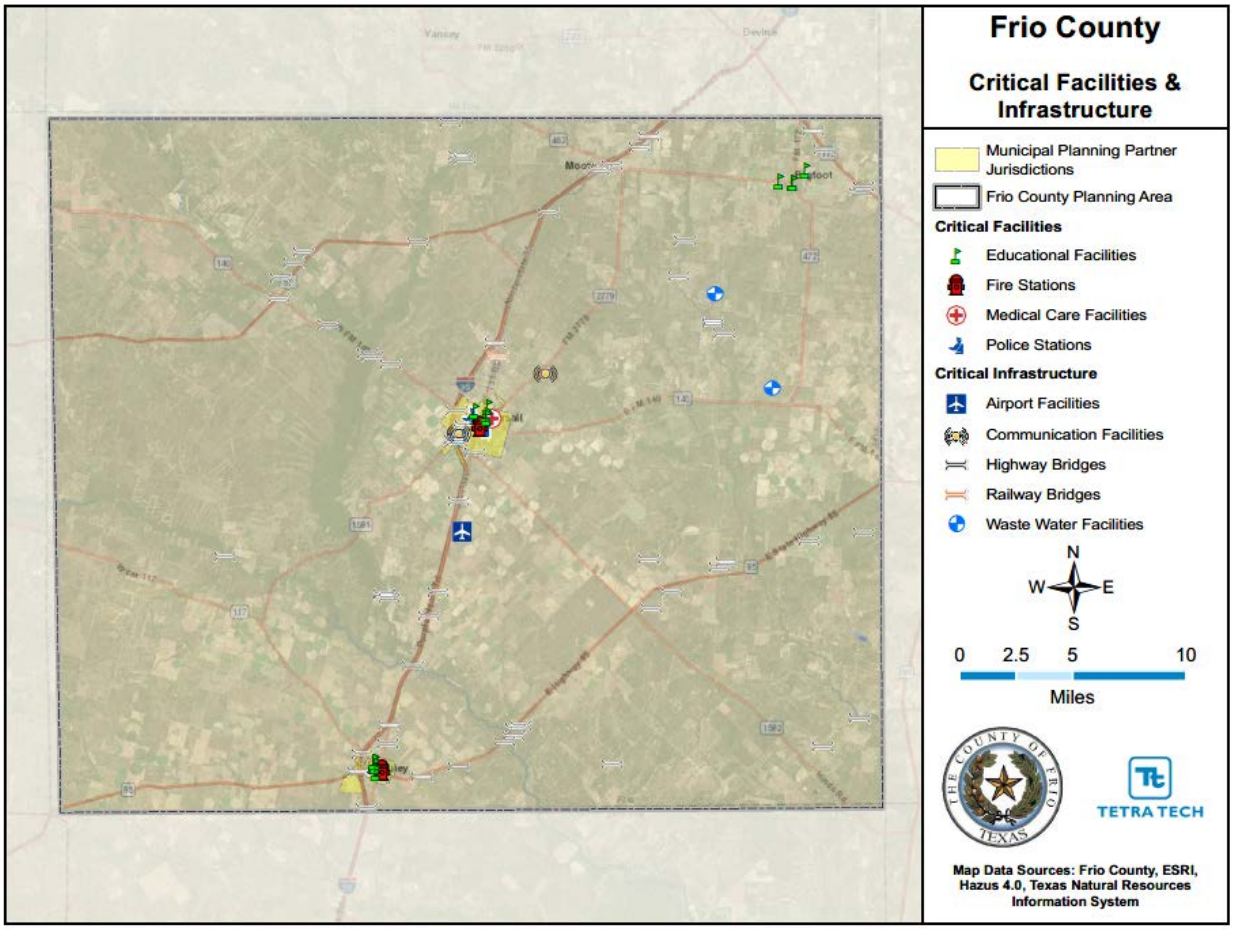


Figure 3-2. Critical Facilities and Infrastructure in Frio County

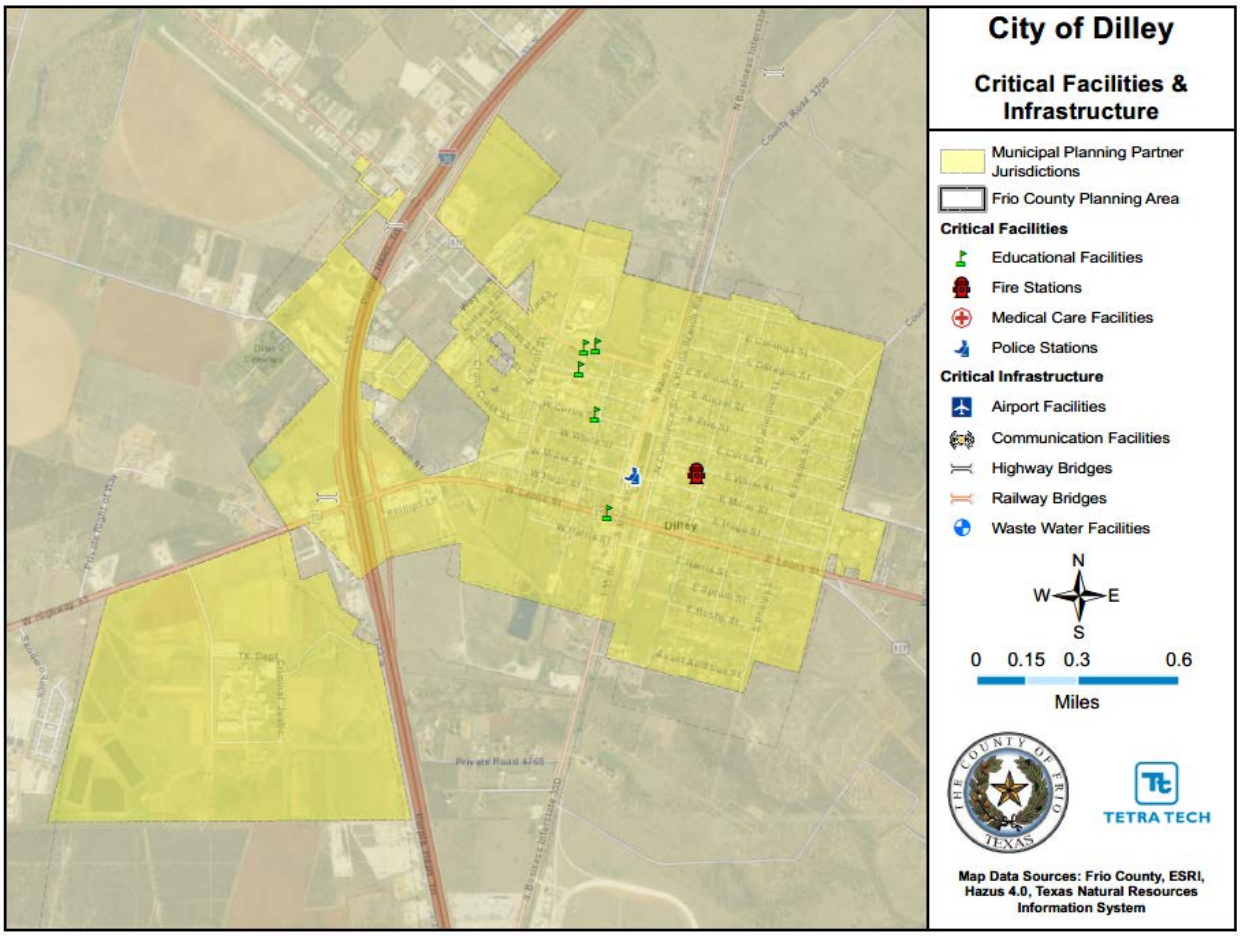


Figure 3-3. Critical Facilities and Infrastructure in the City of Dilley

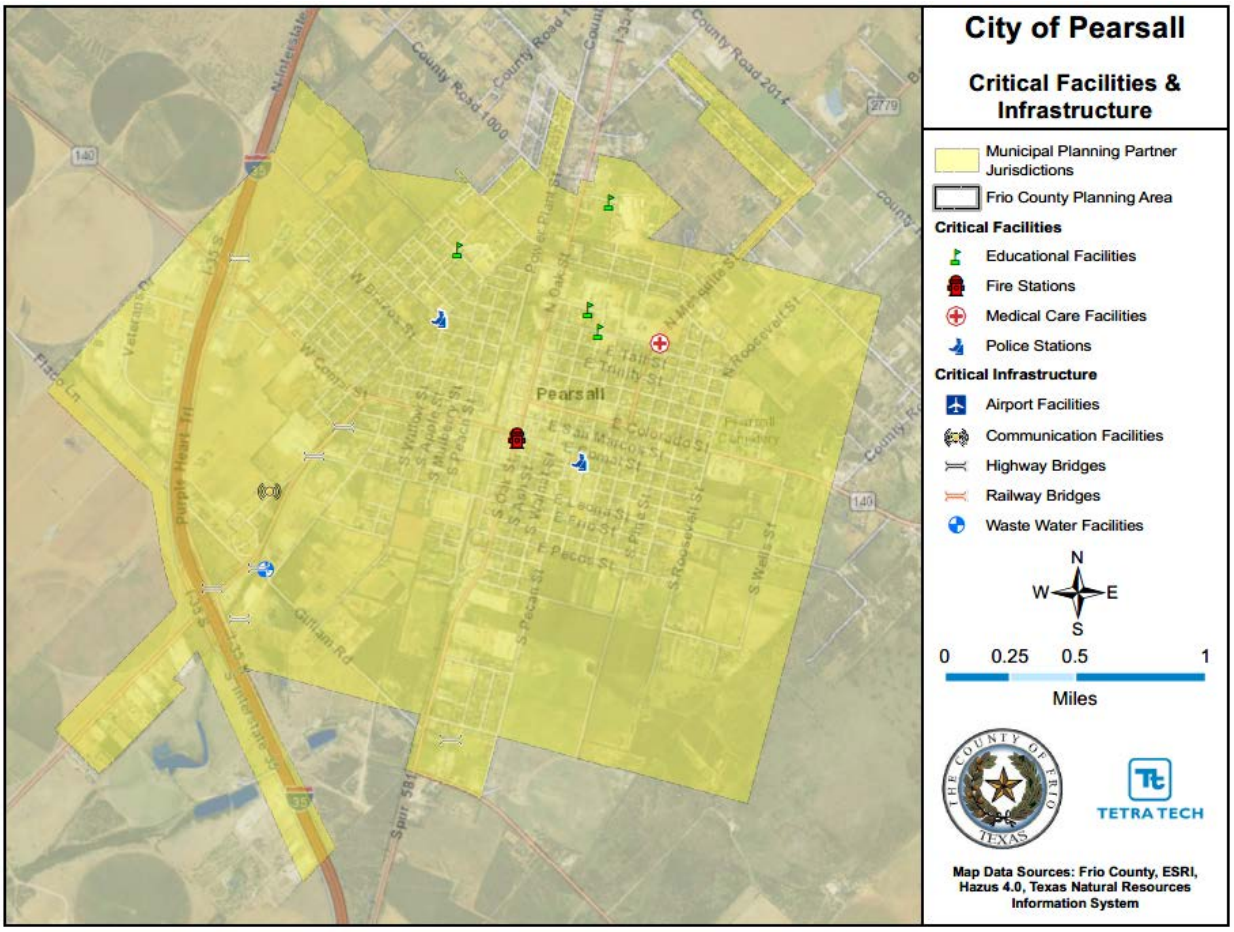


Figure 3-4. Critical Facilities and Infrastructure in the City of Pearsall

3.7 DEMOGRAPHICS

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly, women, children, ethnic minorities, renters, individuals with disabilities, and others with access and functional needs, all experience more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas where there are higher concentrations of vulnerable community members would help to extend focused public outreach and education to these most vulnerable citizens. Select U.S. Census demographic and social characteristics for Frio County and the planning partners are shown in Table 3-5.

Table 3-5. Frio County and Planning Partners Demographic and Social Characteristics

	Frio County	City of Dilley	City of Pearsall
Gender/Age (% of Total Population)			
Male	59.1%	67.5%	57.8%
Female	40.9%	32.5%	42.2%
Under 5 Years	6.6%	8.3%	6.4%
65 years and over	12.2%	8.5%	11.0%
Race/Ethnicity (% of Total Population)			
White	72.0%	72.7%	72.2%
American Indian/Alaska Native	0.1%	0.0%	0.1%
Asian	0.5%	0.0%	0.0%
Black or African American	3.7%	10.1%	2.7%
Other Race	23.0%	16.0%	23.8%
Two or more races	0.9%	1.2%	0.4%
Hispanic or Latino[a]	78.4%	73.5%	83.2%
Education			
High School Graduate or Higher	62.8%	63.%	65.1%

Source: U.S. Census, 2012-2016 American Community Survey
Notes:
a. U.S. Census Bureau considers the Hispanic/Latino designation an ethnicity, not a race.

3.7.1 Population

The Texas Association of Counties estimates a population of 19,600 for Frio County as of July 1, 2017. Table 3-6 shows planning area population data from 1990 through 2017. The Frio County population has increased 27% from 1990 to 2000, only 2% increase from 2000 to 2010, and a significant increase of 11.46% from 2010 to 2017. The City of Pearsall is the county's principal population center. The populations in both Cities of Dilley and Pearsall has increased since 1990.

Table 3-6. Population Data

	Population			
	1990	2000	2010	2017
City of Dilley	2,632	3,894	3,905	4,358
City of Pearsall	6,924	9,146	9,172	10,345
Remainder of Frio County[a]	4,001	4,177	4,181	4,897
Total	13,557	17,217	17,584	19,600

Source: Texas Association of Counties 2018
Notes:
a. Includes unincorporated county and non-participating communities

Figure 3-5 shows 10-year population changes in Frio County and the State of Texas from 1990 to 2010, and the 7-year change from 2010 to 2017. Between 1990 and 2017, the State of Texas' population grew by 66% (about 2.4% per year) while Frio County's population increased by 44.57% (1.6% per year).

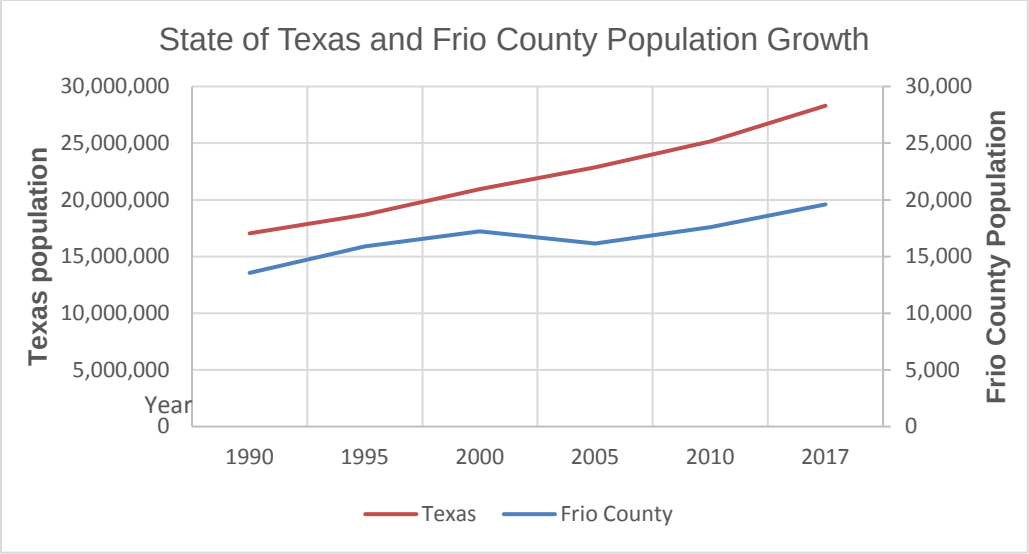


Figure 3-5. State of Texas and Frio County Population Growth, 1990-2017

3.7.2 Age Distribution

As a group, the elderly is more apt to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly is more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as "critical facilities" by emergency managers because they require extra notice to implement evacuation. Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters because of isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the national population.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

The overall age distribution for the planning area is illustrated in Figure 3-6. Based on U.S. Census, 2012-2016 American Community Survey 5-year estimates, 12.2% of the planning area's population is 65 or older. American Community Survey data do not provide information regarding disabilities in the planning area's over-65 population. The 2012-2016 American Community Survey 5-year estimates indicate that 26.1% of Frio County families have children under 18 and are below the poverty line.

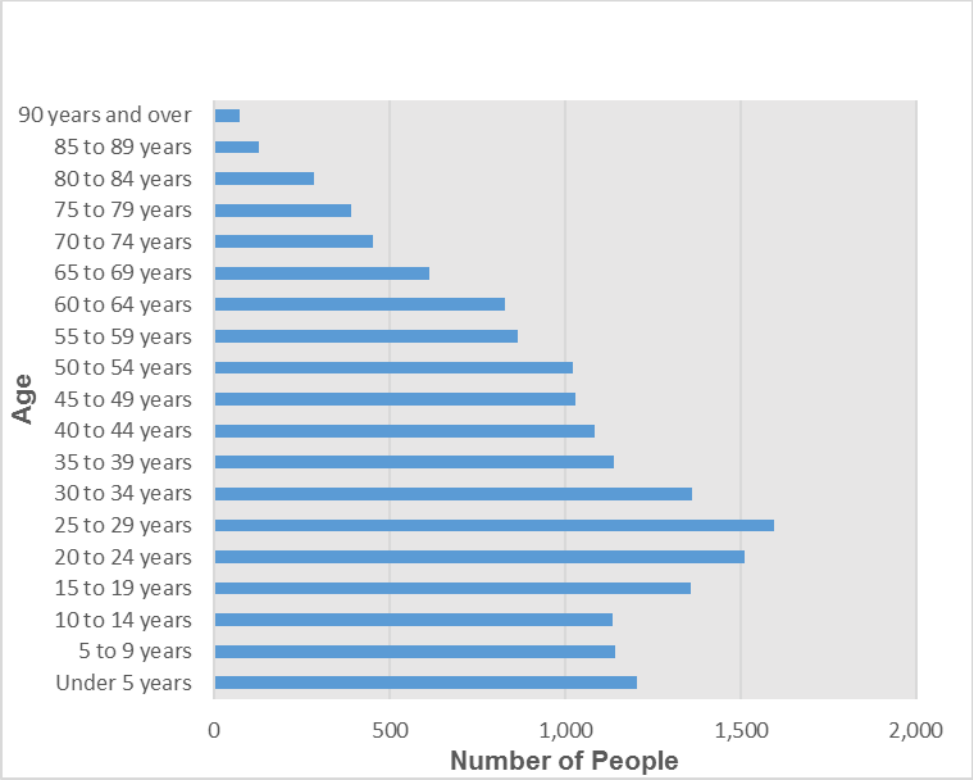


Figure 3-6. Frio County Age Distribution

3.7.3 Disabled Populations

The 2010 U.S. Census estimated that 57 million non-institutionalized Americans with disabilities live in the U.S. This equates to about one-in-five persons. People with disabilities are more likely to have difficulty responding to a hazard event than the general population. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with a disability will allow emergency management personnel and first responders to have personnel available who can provide services needed by those with access and functional needs. According to the U.S. Census, 2012-2016 American Community Survey 5-year estimates, 17.8% of the population in the planning area lives with some form of disability.

3.7.4 Ethnic Populations

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be less effective for ethnic populations and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to 2012-2016 American Community Survey 5-year estimates, the ethnic composition of Frio County is predominantly white, at about 72.0%. The largest minority population is Hispanic or Latino at 78.4%. Figure 3-7 shows the population distribution by race and ethnicity in Frio County. The values shown on Figure 3-7 exceed 100% because according to the U.S. Census, Hispanic or Latino is listed as an ethnicity, not a race. Therefore, the Hispanic or Latino designation encompasses several races.

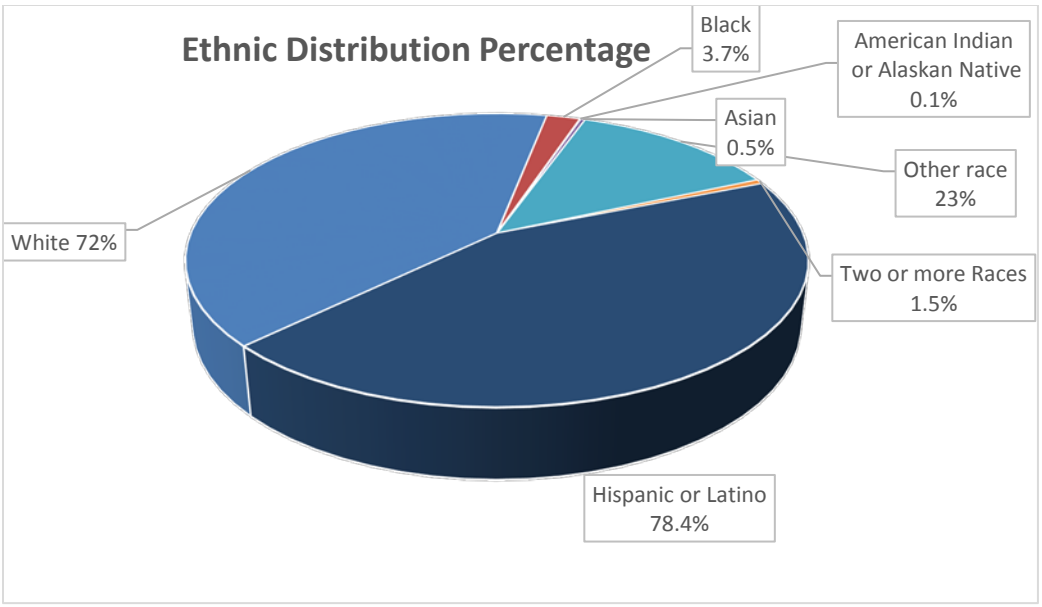


Figure 3-7. Frio County Ethnic Distribution

Frio County has a 12.5% foreign-born population. Other than English, the most commonly spoken language in Frio County is Spanish. The American Community Survey estimates 18.1% of the residents speak English "less than very well."

3.8 ECONOMY

The U.S. Census, 2012-2016 American Community Survey 5-year economic characteristics estimates for the planning area are shown in Table 3-7.

Table 3-7. Economic Characteristics

	Families Below Poverty Level	Individuals Below Poverty Level	Median Home Value	Median Household Income	Per Capita Income	Population >16 Years Old in Labor Force	Population Employed
City of Dilley	24.0%	30.9%	$45,000	$31,518	$8,827	37.4%	34.4%
City of Pearsall	20.7%	22.6%	$73,000	$37,063	$16,732	49.8%	46.4%
Frio County	17.8%	21.3%	$71,900	$37,163	$17,547	50.3%	46.7%

Source: U.S. Census, 2012-2016 American Community Survey

3.8.1 Income

In the United States, individual households are expected to use private resources to some extent to prepare for, respond to, and recover from disasters. This means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. The events following Hurricane Katrina in 2005 illustrated that personal household economics significantly impact people's decisions on evacuation. Individuals who cannot afford gas for their cars will likely decide not to evacuate.

Based on the U.S. Census, 2012-2016 American Community Survey 5-year estimates, per capita income in the planning area was $17,547 and the median household income was $37,163. It is estimated that 9.2% of households receive an income between $100,000 and $149,999 per year and 4.9% are above $150,000 annually. Families with incomes below the poverty level made up 17.8% of all families and 21.3% of the total population in Frio County.

3.8.2 Employment Trends

According to the Federal Reserve Economic Data, Frio County's unemployment rate as of April 2018, was 2.6%, compared to a statewide rate of 4.1%. Figure 3-8 shows Frio County's unemployment trends from January 1,1990, through April 1, 2018. Frio County's unemployment rate was lowest in April 2018 at 2.6% and peaked in 1992 at 16%.

Source: FRED 2018
Note: Shaded areas indicate U.S. recessions

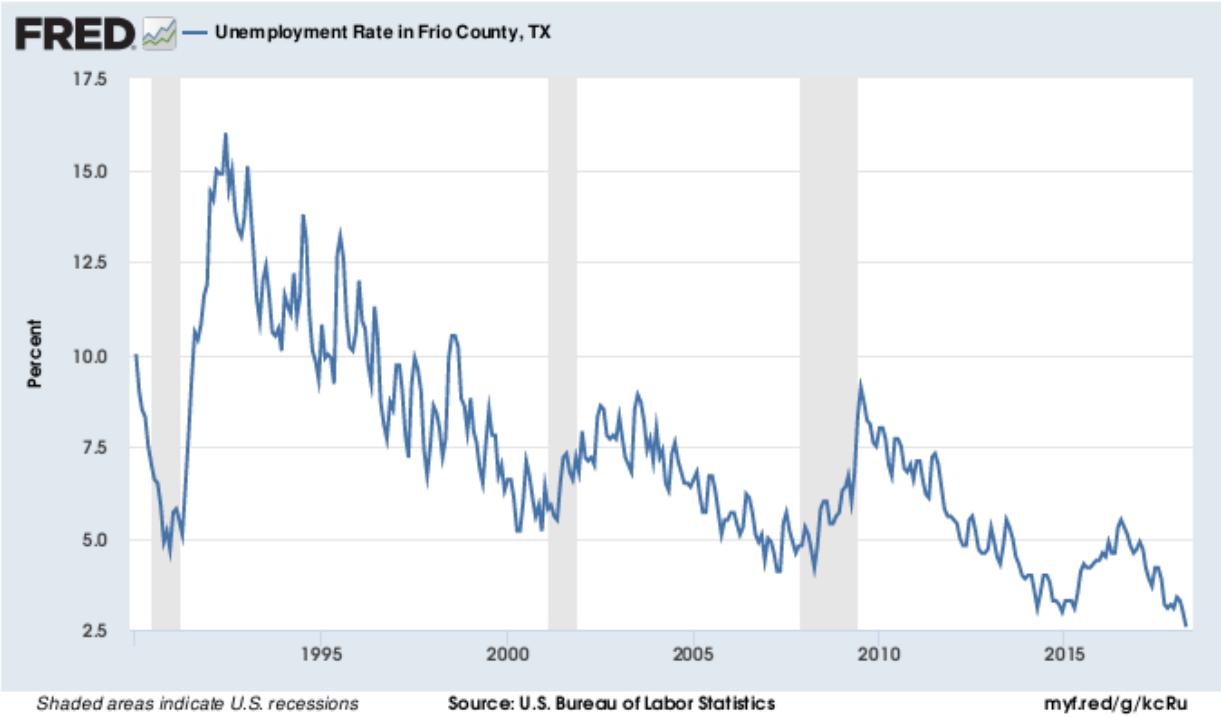


Figure 3-8. Frio County Unemployment Rate, 1992-2018

According to 2012-2016 American Community Survey 5-year estimates, 50.3% of Frio County's population 16 years and older is in the labor force, including 48.6% of women and 51.4% of men.

3.8.3 Occupations and Industries

According to 2012-2016 American Community Survey 5-year estimates, the planning area's economy is strongly based in the education, health care and social assistance industries (19.8% of total employment), followed by agriculture, forestry, fishing and hunting, and mining (15.70%), and retail trade (11.20%). Figure 3-9 shows the distribution of industry types in Frio County, based on share of total employment.

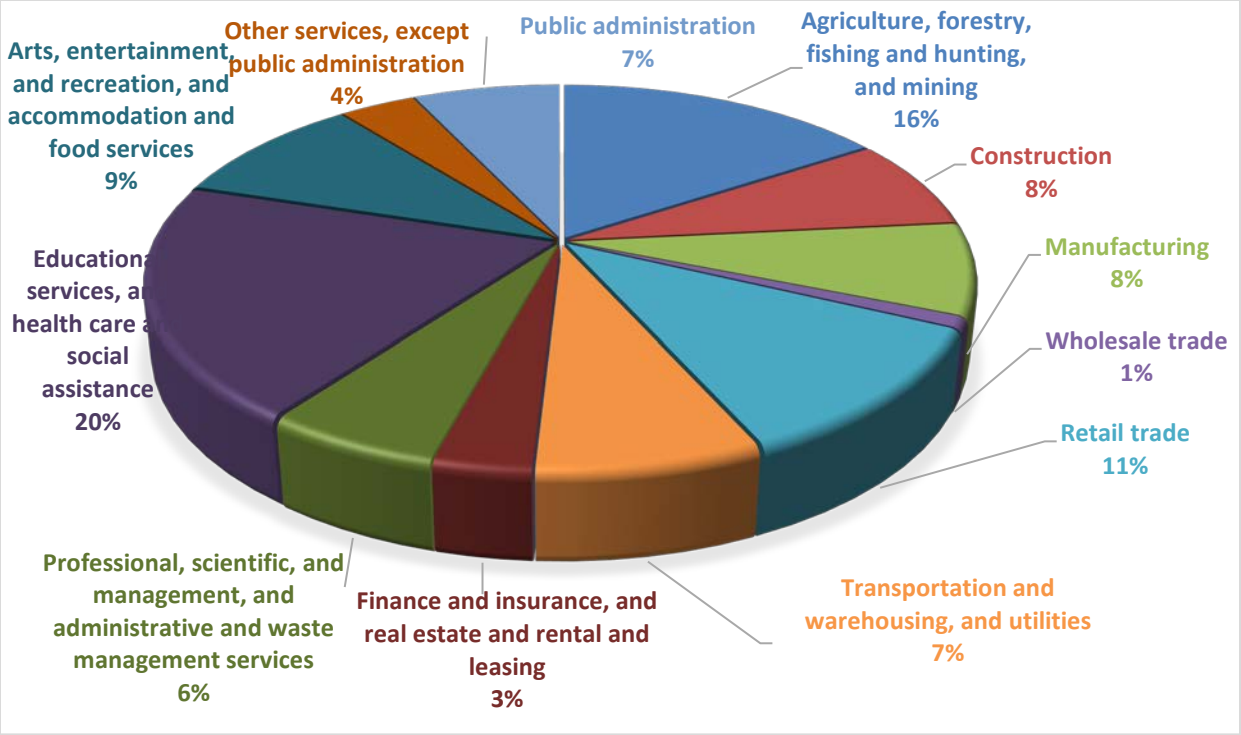


Figure 3-9. Percent of Total Employment by Industry in Frio County

3.9 LAND USE AND DEVELOPMENT TRENDS

The municipal planning partners have adopted plans that govern land use decision and policy making in their jurisdictions. Decisions on land use will be governed by these programs. This plan will work together with these programs to support wise land use in the future by providing vital information on the risk associated with natural hazards in the planning area.

It is the goal that all municipal planning partners will incorporate this hazard mitigation plan in their comprehensive plans (if applicable) by reference. This will help ensure that future development trends can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan. The county and the city partners have not formally tracked the impacts of changes in development over the last 5 years and how these changes in development were influenced by the risk associated with natural hazards in the county or the city partners. As part of this hazard mitigation plan, Frio County and the cities are now equipped with the knowledge and the tools to track and implement changes to the plan during their annual reviews and 5-year updates to reflect development changes. However, it should be noted that the mitigation actions developed and prioritized through the mitigation action ranking process reflect the current development conditions and applicable policies.

3.9.1 Frio County

As described in Chapter 3.7.1, the Frio County population has increased 27% from 1990 to 2000, only 2% increase from 2000 to 2010, and a significant increase of 11.46% from 2010 to 2017. The population in 2017 was 19,600. Table 3-9 shows three population projection scenarios, created by the Texas Demographic Center, based on migration to and from the county. Zero Scenario assumes that in-migration and out-migration are equal resulting in growth only through natural increases; the 0.5 Scenario assumes rates of net migration one-half of those of the 2000-2010 decade; and the 1.0 Scenario assumes that the trends in 2000-2010 decade will continue and occur in the future. 1.0 Scenario is a high-growth alternative and it is unlikely to be sustained over time.

As shown in Table 3-9, mitigation of people is occurring because the Zero Scenario for 2020 population projection has already been surpassed in 2017 population.

Table 3-8. Frio County Population Projections, 2020-2050

Migration Scenario	2020 Population Projection	2030 Population Projection	2040 Population Projection	2050 Population Projection
Zero Scenario	18,646	20,068	21,316	22,604
0.5 Scenario	19,188	21,229	22,998	24,813
1.0 Scenario	20,080	23,016	25,150	26,701

Source: Texas Demographic Center 2018

Housing units in Frio County are mainly single-family detached homes. Figure 3-10 shows the number of building permits recorded in Frio County between 2007 and 2014. The highest number of permits was in 2012 with 31 building permits issued with the average home buildings cost at $33,100 (city-data.com 2018). The small number of new home permits coincides with the statistic that the Frio County population mainly lives in the cities and not in the unincorporated county.

Source: City-Data.com 2018

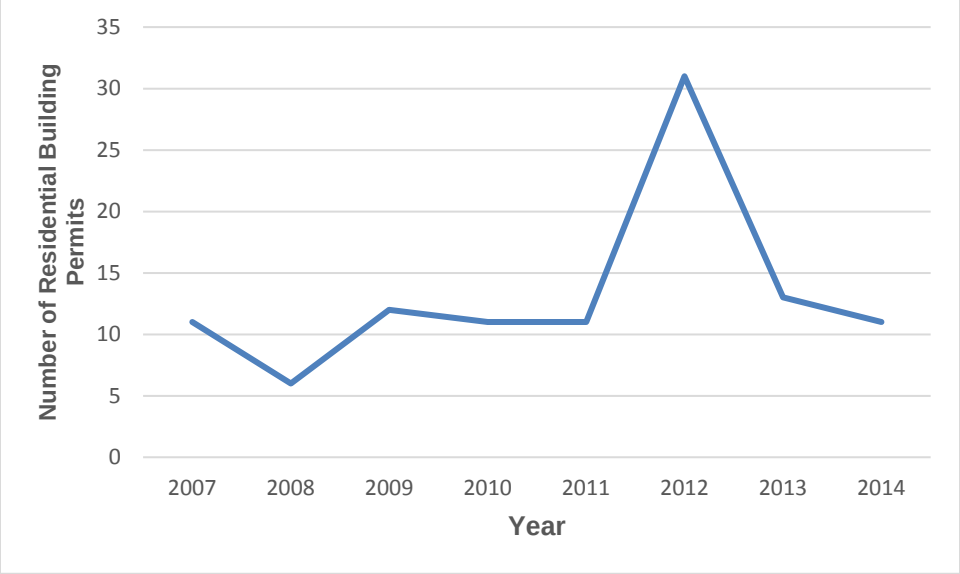


Figure 3-10. Residential Building Permits in Frio County

3.9.2 City of Dilley

The City of Dilley experienced a 12% population increase between 2000 and 2017 (less than 1% per year) and moderate population increases are expected in the future. The city has been averaging two residential

building permits per year for new construction between 2010 and 2014 with an average building cost of $11,500 (see Table 3-9). The vulnerability of hazard prone areas in the City of Dilley has stayed the same since the *AACOG Regional Mitigation Action Plan Update, 2012-2017* was approved in 2011 based on minimal new housing development and only a small population increase.

Table 3-9. City of Dilley Residential Building Permits

Year	Building Permits Issued	Average Cost
2014	2	$11,500
2013	2	$11,500
2012	2	$11,500
2011	2	$11,500
2010	2	$11,500

Source: City-data.com 2017

3.9.3 City of Pearsall

The City of Pearsall experienced a 13% population increase between 2000 and 2016 (less than 1% per year) and moderate population increases are expected in the future.

Building permits indicate what types of buildings are being constructed and their relative uses. Table 3-10 lists the number of residential building permits for the city that have been granted between 2010 and 2014. The data include all sizes of family homes for reported permits, as well as the average construction costs, to show the potential increase in vulnerability of structures to the various hazards reviewed in the risk assessment. The increase in vulnerability can be attributed to the construction costs that would be factored into repairing or replacing a structure using current market values.

The vulnerability of hazard prone areas has increased since the *AACOG Regional Mitigation Action Plan Update, 2012-2017* was approved in 2011 based on their population increases and new building permits issued.

Table 3-10. City of Pearsall Residential Building Permits

Year	Building Permits Issued	Average Cost
2014	9	$86,200
2013	11	$34,300
2012	29	$34,300
2011	9	$28,000
2010	9	$28,000

Source: City-data.com 2017

3.10 LAWS AND ORDINANCES

Existing laws, ordinances, and plans at the federal, state, and local level can support or impact hazard mitigation actions identified in this plan. Hazard mitigation plans are required to include review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). Pertinent federal, state, and local laws are described below. These laws, programs, documents, and departments were reviewed to identify the plans, regulations, personnel, and funding mechanisms available to the county and planning partners to impact and mitigate the effects of natural hazards. The county and municipals partners have the capacity to expand their hazard mitigation capabilities through the training of existing staff, cross-training staff across program areas, and hiring of additional staff, as well as acquiring additional funding through the attainment of grant funds, raising of taxes, and levying of new taxes.

3.10.1 Federal

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Assistance grant funds are available to communities. This plan is designed to meet the requirements of DMA, improving the planning partners' eligibility for future hazard mitigation funds.

Community Development Block Grant Disaster Resilience Program

In response to disasters, the U.S. Congress may appropriate additional funding for the U.S. Department of Housing and Urban Development Community Development Block Grant programs to be distributed as Disaster Recovery grants (CDBG-DR). These grants can be used to rebuild affected areas and provide seed money to start the recovery process. CDBG-DR assistance may fund a broad range of recovery activities, helping communities and neighborhoods that otherwise might not recover due to limited resources. CDBG-DR grants often supplement disaster programs of FEMA, the Small Business Administration, and the U.S. Army Corps of Engineers (USACE). The U.S. Department of Housing and Urban Development generally awards noncompetitive, nonrecurring CDBG-DR grants by a formula that considers disaster recovery needs unmet by other federal disaster assistance programs. To be eligible for CDBG-DR funds, projects must meet the following criteria:

- Address a disaster-related impact (direct or indirect) in a presidentially declared county for the covered disaster
- Be a CDBG-eligible activity (according to regulations and waivers)
- Meet a national objective

Incorporating preparedness and mitigation into these actions is encouraged, as the goal is to rebuild in ways that are safer and stronger.

Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, and pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

National Dam Safety Act

The potential for catastrophic flooding due to dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of every major dam in the country. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure to protect the lives and property of the public.

To help the State Dam Safety Program achieve its goal, the State of Texas' dam safety regulations now include the requirement for emergency action plans on all non-exempt Significant-Hazard and High-Hazard Potential dams (Title 30, Texas Administrative Code, Ch. 299, 299.61b).

National Flood Insurance Program

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. Frio County and the Cities of Dilley and Pearsall participate in the NFIP and have adopted regulations that meet the NFIP requirements. At the time of the preparation of this plan, Frio County and the Cities of Dilley and Pearsall are in good standing with NFIP requirements.

3.10.2 State and Regional

Texas Division of Emergency Management

The TDEM is a division within the Texas Department of Public Safety and has its roots in the civil defense programs established during World War II. It became a separate organization through the Texas Civil Protection Act of 1951, which established the Division of Defense and Disaster Relief in the Governor's Office to handle civil defense and disaster response programs. The division was collocated with the Department of Public Safety (DPS) in 1963. The division was renamed the Division of Disaster Emergency Services in 1973. After several more name changes, it was designated an operating division of the Texas Department of Public Safety in 2005. Legislation passed during the 81st session of the Texas Legislature in 2009 formally changed the name to TDEM. TDEM operates according to the Texas Disaster Act of 1975 (Chapter 418 of the Texas Government Code).

TDEM is "charged with carrying out a comprehensive all-hazard emergency management program for the state and for assisting cities, counties, and state agencies in planning and implementing their emergency management programs. A comprehensive emergency management program includes pre- and post-disaster mitigation of known hazards to reduce their impact; preparedness activities, such as emergency planning, training, and exercises; provisions for effective response to emergency situations; and recovery programs for major disasters."

Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality (TCEQ) has jurisdiction over rule changes to dams as 99% of dams are under state regulatory authority. Those regulations are implemented by the TCEQ Dam Safety Program, which monitors and regulates both private and public dams in Texas. The program periodically inspects dams that pose a high or significant hazard and makes recommendations and reports to dam owners to help them maintain safe facilities. The primary goal of the state's Dam Safety Program is to reduce the risk to lives and property from the consequences of dam failure.

In 2008, TCEQ proposed several rule changes including the definition of dams and dam classifications. According to the new definition, a dam in Texas is a barrier with a "height greater than or equal to 25 feet and a maximum storage (top of dam) capacity of 15 acre-feet; a height greater than 6 feet and a maximum storage capacity greater than or equal to 50 acre-feet; or one that poses a threat to human life or property in the event of failure, regardless of height or maximum storage capacity."

Texas Water Development Board

The Texas Water Development Board (TWDB) was created in 1957 but its history dates back to a 1904 constitutional amendment authorizing the first public development of water resources. The TWDB mission is "to provide leadership, information, education, and support for planning, financial assistance, and

outreach for the conservation and responsible development of water for Texas." TWDB provides water planning, data collection and dissemination, financial assistance, and technical assistance services.

TWDB financial assistance programs are funded through state-backed bonds, a combination of state bond proceeds and federal grant funds, or limited appropriated funds. Since 1957, the Texas State Legislature and voters approved constitutional amendments authorizing TWDB to issue up to $10.93 billion in Texas Water Development Bonds. In 1987, TWDB added the Clean Water State Revolving Fund (CWSRF) to its portfolio of financial assistance programs. Low-interest loans from the CWSRF finance costs associated with the planning, design, construction, expansion, or improvement of wastewater treatment facilities, wastewater recycling and reuse facilities, collection systems, stormwater pollution control projects, and nonpoint source pollution control projects. Funded in part by federal grant money, CWSRF provides loans at interest rates lower than the market can offer to any eligible applicant. CWSRF offers 20-year loans using either a traditional long-term, fixed-rate or a short-term, variable-rate construction period loan that converts to a long-term, fixed-rate loan on project completion.

Texas State Soil and Water Conservation Board

The Texas State Soil and Water Conservation Board (TSSWCB) is the state agency that administers Texas' soil and water conservation law and coordinates conservation and nonpoint source water pollution abatement programs. The TSSWCB was created in 1939 by the Texas Legislature to organize the state into 216 soil and water conservation districts (SWCD) and to serve as a centralized agency for communicating with the Texas Legislature as well as other state and federal entities. The TSSWCB is the lead state agency for the planning, management, and abatement of agricultural and silvicultural (forestry) nonpoint source water pollution, and administers the Water Supply Enhancement Program. Each SWCD is an independent political subdivision of state government. Local SWCDs are actively involved throughout the state in soil and water conservation activities such as operation and maintenance of flood control structures.

Texas Bureau of Economic Geology

The University of Texas at Austin, Bureau of Economic Geology serves as the State Geological Survey of Texas. The bureau conducts research focusing on the intersection of energy, environment, and economy. The bureau partners with federal, state, and local agencies, academic institutions, industry, nonprofit organizations, and foundations to conduct high-quality research and to disseminate the results to the scientific and engineering communities as well as to the broad public. The Geophysical Log Facility (GLF) is the official well log repository for the Railroad Commission of Texas, which by law receives a copy of geophysical logs from every new, deepened, or plugged well drilled in Texas since September 1985.

Texas Forest Service

Texas Forest Service (TFS) was created in 1915 by the 34th Legislature as an integral part of the Texas A&M University System. It is mandated by law to assume direction of all forest interests and all matters pertaining to forestry within the jurisdiction of the state. TFS administers the Community Wildfire Protection Plan (CWPP) to reduce related risks to life, property, and the environment. Its Fire Control Department provides leadership in wildland fire protection for state and private lands in Texas and reduces wildfire-related loss of life, property, and critical resources.

The intention of the TFS CWPP is to reduce the risk of wildfire and promote ecosystem health. The plan also is intended to reduce home losses and provide for the safety of residents and firefighters during wildfires. It has the following goals:

- Provide for the safety of residents and emergency personnel
- Limit the number of homes destroyed by wildfire
- Promote and maintain healthy ecosystems

- Educate citizens about wildfire prevention

CWPPs are developed to mitigate losses from wildfires. By developing a CWPP, a community is outlining a strategic plan to mitigate, prepare, respond, and recover from wildfires.

Texas Department of State Health Services

The mission of the Department of State Health Services is to protect and preserve the health of the citizens of Texas. Public health nurses provide a variety of services including immunizations, preventive assessments of children and the elderly, and a full range of services designed to assist individuals and groups to attain and maintain good health and to cope with illnesses.

Alamo Area Council of Governments

AACOG helps local communities work cooperatively to improve the conditions and well-being of the Alamo area planning region. The AACOG includes the following counties: Atascosa, Bandera, Bexar, Comal, Frio, Gillespie, Guadalupe, Karnes, Kendall, Kerr, Medina, McMullen, and Wilson. AACOG provides services and programs including air quality, agency on aging, caregiver empowerment, regional transit, government services, joint land use study, public safety, veterans' services, and the Weatherization Assistance Program.

3.10.3 Frio County

The Frio County government is made up of the following offices and departments (Frio County of Texas 2017):

- Commissioners' Court
- County Attorney
- County Clerk
- County Engineer
- County Treasurer
- County Tax Assessor
- Constable
- Emergency Management
- Human Resources
- Information Center
- WIC (Woman, Infants, Children)
- Juvenile Probation Office
- Veterans' Office
- 911 Addressing

Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more details on existing mitigation capabilities to expand on and improve upon integration with this plan.

Frio County Subdivision Regulations, 2014 (revised)

The Frio County Subdivision Regulations established rules, regulations, and standards governing the subdivision of land within the unincorporated areas of Frio County. In November 2014, acting pursuant to Section 232, Texas Local Government Code, the Frio County Subdivision Regulations revised the legal provisions, bond requirements, platting procedures, design standards, and water regulations for dividing property within the county.

Frio County's Flood Damage Prevention Order, 2016 revised

The Flood Damage Prevention Order established the Frio County Commissioners' Court as the governing body to administer the National Flood Insurance Act and Texas Flood Control and Insurance Act. The purpose of the order and attached regulations is to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas by regulations designed to: (1) protect human life and health; (2) minimize the expenditure of public money for costly flood control

projects; (3) minimize the need for rescue and relief efforts associated with flooding and usually undertaken at public expense; (4) minimize prolonged business interruptions; (5) minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, and streets and bridges located in or near floodplains; (6) help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas and (7) insure that potential buyers are notified that property is in a flood area.

The order is implemented through methods authorized by federal and state law to: (1) restrict or prohibit uses that are dangerous to health, safety, or property in times of flood, or uses that cause excessive increases in flood heights or velocities; (2) require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction; (3) control the alteration of natural floodplains, stream channels, watercourses, and natural protective barriers which are involved in the accommodation of flood waters; (4) control filling, grading, dredging, and other development which may increase flood damage; and (5) prevent or regulate the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards to other lands.

Frio County Basic Emergency Operations Plan, 2013

The purpose of the Frio County Basic Emergency Operations Plan (EOP) (including a base plan and 22 functional annexes) is to:

- Identify the roles, responsibilities and actions required of county departments and other agencies in preparing for and responding to major emergencies and disasters
- Provide a framework for coordinating, integrating, and administering the EOPs and related programs of local, state, and federal governments
- Provide for the integration and coordination of volunteer agencies and private organizations involved in emergency response and relief efforts

The EOP covers Frio County and the Cities of Dilley and Pearsall.

Frio County Emergency Management

The Frio County Office of Emergency Management (OEM) assists Frio County in preparing for, responding to, and recovering from disasters. The OEM works year-round with city departments, regional emergency management and public safety officials, and elected officials to develop a plan to lessen the impact of disasters on county residents. In addition, communication is maintained with state and federal agencies for coordination in the event of large disasters, natural or manmade.

3.10.4 City of Dilley

The City of Dilley's government is made up of the following offices and departments (Dilley 2018):

- City Administrator
- City Secretary
- General Clerk
- Finance Director
- Fire Department
- Police
- Municipal Court
- Parks and Recreation
- Public Works
- Utility Clerk

The City of Dilley only has floodplain and zoning ordinances in place. There are no specific departments or additional ordinances to discuss.

3.10.5 City of Pearsall

The City of Pearsall's government is made up of the following offices and departments (Pearsall 2018):

- City Clerk
- City Manager
- Finance
- Human Resources
- Municipal Court
- Parks and Recreation
- Planning and Communities Development
- Police Department
- Public Works
- Utility Billing
- Volunteer Fire Department

Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more details on existing mitigation capabilities to expand on and improve upon integration with this plan.

Comprehensive Subdivision Ordinance

The City of Pearsall's Subdivision Ordinance was adopted and signed August 25, 1976. It outlines the authority and method or approving plats and subdivision providing standards and specifications for streets, utilities, and other public improvement in subdivision.

Flood Hazard Prevention Ordinance

The Flood Damage Prevention Order was established by the City of Pearsall to maintain eligibility in the NFIP and meet the floodplain management requirements outlined in 24 CFR, 1910.39 (d). The purpose of the order is to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions.

Zoning Ordinance

The City of Pearsall, Texas Zoning Ordinance was enacted for lessening confusion in the streets; to secure safety from fire, panic and other dangers; to promote health and general welfare; to provide adequate light and air; to prevent the overcrowding of a land and abutting traffic ways; to avoid undue concentration of populations; and to facilitate the economic and adequate provision of transportation, water, sewerage, schools, parks and other public facilities.

Chapter 4.
HAZARD MITIGATION CAPABILITIES ASSESSMENT

The planning team performed an inventory and analysis of existing authorities and capabilities called a "capability assessment." A capability assessment creates an inventory of an agency's mission, programs and policies, and evaluates its capacity to carry them out. The county and cities used this capabilities assessment to identify mitigation actions to strengthen their ability to mitigate the effects of a natural hazard.

4.1 FRIO COUNTY

4.1.1 Legal and Regulatory Capabilities

Table 4-1 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Frio County.

Table 4-1. Frio County Regulatory Capabilities

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	No	
Zoning ordinance	No	State of Texas does not enable counties to utilize zoning.
Subdivision ordinance	Yes	Frio County Subdivision Ordinance, November 2014 Revised, established rules, regulations and standards governing the subdivision of land within the unincorporated areas of Frio County.
Growth management	No	
Floodplain ordinance	Yes	Flood Damage Prevention Order, Updated 05/23/2016 Joined National Flood Insurance Program on 09/30/1997
Other special purpose ordinance (stormwater, steep slope, wildfire)	Yes	Manufactured Home Rental Communities Infrastructure Requirements, July 2014 Revised.
Building code	No	
Erosion or sediment control program	No	
Stormwater management	No	
Site plan review requirements	No	
Capital improvement plan	No	
Economic development plan	No	
Local emergency operations plan	Yes	Frio County Emergency Operations Plan, signed April 2013
Other special plans	No	
Flood insurance study or other engineering study for streams	No	
Elevation certificates	Yes	

4.1.2 Administrative and Technical Capabilities

Table 4-2 identifies the county personnel responsible for activities related to mitigation and loss prevention in Frio County.

Table 4-2. Frio County Administrative and Technical Capabilities

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	No	
Engineer/professional trained in construction practices related to buildings or infrastructure	No	
Planner/engineer/scientist with an understanding of natural hazards	No	
Personnel skilled in GIS	No	
Full-time building official	No	
Floodplain manager	Yes	EMC is CFM
Emergency manager	Yes	EMC
Grant writer	No	
Other personnel	No	
GIS data: Hazard areas	No	
GIS data: Critical facilities	No	
GIS data: Building footprints	No	
GIS data: Land use	No	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	Reverse 911
Other		

Notes:
CFM Certified Floodplain Manager
EMC Emergency Management Coordinator
GIS Geographic Information System

4.1.3 Financial Capabilities

Table 4-3 identifies financial tools or resources that Frio County could use to help fund mitigation activities.

Table 4-3. Frio County Financial Capabilities

Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes
Fees for water, sewer, gas, or electric services	No
Impact fees for new development	Yes
Incur debt through general obligation bonds	Yes
Incur debt through special tax bonds	Yes
Incur debt through private activities	Yes
Withhold spending in hazard prone areas	No
Other	No

4.2 CITY OF DILLEY

4.2.1 Legal and Regulatory Capabilities

Table 4-4 lists regulatory and planning tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the City of Dilley.

Table 4-4. City of Dilley Regulatory Capabilities

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	No	
Zoning ordinance	Yes	
Subdivision ordinance	No	
Growth management	No	
Floodplain ordinance	Yes	Joined National Flood Insurance Program on 02/01/1988
Other special purpose ordinance (stormwater, steep slope, wildfire)	No	
Building code	No	
Erosion or sediment control program	No	
Stormwater management	No	
Site plan review requirements	No	
Capital improvement plan	No	
Economic development plan	No	
Local emergency operations plan	Yes	Frio County Emergency Operations Plan, signed April 2013
Other special plans	No	
Flood insurance study or other engineering study for streams	No	
Elevation certificates	Yes	

4.2.2 Administrative and Technical Capabilities

Table 4-5 identifies the city personnel responsible for activities related to mitigation and loss prevention in the City of Dilley.

Table 4-5. City of Dilley Administrative and Technical Capabilities

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	No	
Engineer/professional trained in construction practices related to buildings or infrastructure	No	
Planner/engineer/scientist with an understanding of natural hazards	No	
Personnel skilled in GIS	No	
Full-time building official	No	
Floodplain manager	No	
Emergency manager	No	
Grant writer	No	
Other personnel	No	
GIS data: Hazard areas	No	
GIS data: Critical facilities	No	
GIS data: Building footprints	No	
GIS data: Land use	No	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	There is one outdoor warning siren (South Commerce Street, on the elevated water tower).
Other		

Note:
GIS Geographic Information System

4.2.3 Financial Capabilities

Table 4-6 identifies financial tools or resources that the City of Dilley could use to help fund mitigation activities.

Table 4-6. City of Dilley Financial Capabilities

Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes
Fees for water, sewer, gas, or electric services	Yes – water and gas only
Impact fees for new development	No
Incur debt through general obligation bonds	Yes
Incur debt through special tax bonds	Yes
Incur debt through private activities	Yes
Withhold spending in hazard prone areas	No
Other	No

4.3 CITY OF PEARSALL

4.3.1 Legal and Regulatory Capabilities

Table 4-7 lists regulatory and planning tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the City of Pearsall.

Table 4-7. City of Pearsall Regulatory Capabilities

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	No	
Zoning ordinance	Yes	City of Pearsall, Code of Ordinance, Chapter 56
Subdivision ordinance	Yes	City of Pearsall, Subdivision Ordinance, revised 10/10/1984
Growth management	No	
Floodplain ordinance	Yes	City of Pearsall, Code of Ordinance, Chapter 42, March 11, 1981 Joined National Flood Insurance Program 05/19/1981
Other special purpose ordinance (stormwater, steep slope, wildfire)	No	
Building code	Yes	International Building Code 2003
Erosion or sediment control program	No	
Stormwater management	No	
Site plan review requirements	No	
Capital improvement plan	No	
Economic development plan	No	
Local emergency operations plan	Yes	Frio County Emergency Operations Plan, signed April 2013
Other special plans	No	
Flood insurance study or other engineering study for streams	Yes	Flood Insurance Study Report for City of Pearsall, 1980
Elevation certificates	Yes	

4.3.2 Administrative and Technical Capabilities

Table 4-8 identifies the personnel responsible for activities related to mitigation and loss prevention in the City of Pearsall.

Table 4-8. City of Pearsall Administrative and Technical Capabilities

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	No	
Engineer/professional trained in construction practices related to buildings or infrastructure	No	
Planner/engineer/scientist with an understanding of natural hazards	No	
Personnel skilled in GIS	No	
Full-time building official	No	
Floodplain manager	No	
Emergency manager	No	
Grant writer	No	
Other personnel	No	
GIS data: Hazard areas	No	
GIS data: Critical facilities	No	
GIS data: Building footprints	No	
GIS data: Land use	No	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	One outdoor warning siren located at the intersection of S. Elm Street and E. San Marcos.
Other		

Note:
GIS Geographic Information System

4.3.3 Financial Capabilities

Table 4-9 identifies financial tools or resources that the City of Pearsall could use to help fund mitigation activities.

Table 4-9. City of Pearsall Financial Capabilities

Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	No
Incur debt through general obligation bonds	Yes
Incur debt through special tax bonds	Yes
Incur debt through private activities	Yes
Withhold spending in hazard prone areas	No
Other	No

PART 2
RISK ASSESSMENT

Chapter 5.
IDENTIFIED HAZARDS OF CONCERN AND RISK ASSESSMENT METHODOLOGY

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. It allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The process focuses on the following elements:

- **Hazard identification**—Use all available information to determine what types of disasters may affect a jurisdiction, how often they can occur, and their potential severity.
- **Vulnerability identification**—Determine the impact of natural hazard events on the people, property, environment, economy, and lands of the region.
- **Cost evaluation**—Estimate the cost of potential damage or cost that can be avoided by mitigation.

The risk assessment for this hazard mitigation plan evaluates the risk of natural hazards prevalent in the planning area and meets requirements of the DMA (44 CFR, Section 201.6(c)(2)).

5.1 IDENTIFIED HAZARDS OF CONCERN

For this plan, the Steering Committee considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude, and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also used. Based on this review, this plan addresses the following hazards of concern:

- Dam Failure
- Drought / Extreme Heat
- Earthquake
- Flood
- Hurricane / Tropical Storm
- Severe Storms (Hail, Lightning and Wind)
- Tornado
- Wildfire
- Winter Storms (including Ice Storms)

Several of these hazards were profiled together because of their common occurrence or damage assessments, such as drought and extreme heat, and severe storms with lightning, hail and high winds.

The following hazards are profiled in the 2013 *State of Texas Hazard Mitigation Plan*; however, the Steering Committee decided not to profile hazards listed in Table 5-1 for the stated reasons. Hazards not identified for inclusion at this time may be addressed during future evaluations and updates.

Table 5-1. Hazards Not Profiled in Plan

Hazard	Reason for Omission
Coastal Erosion	Geographic location. Frio County is an inland location and negligible potential for occurrence.
Expansive Soil	Lack of risk to the Frio County planning area and participating jurisdictions.
Land Subsidence	Probability and potential impacts are negligible risk.
Levees	There are no levees in Frio County nor neighboring counties that are acknowledged by the USACE National Levee Database System.

Note:
USACE U.S. Army Corps of Engineers

5.2 CLIMATE CHANGE

Climate includes patterns of temperature, precipitation, humidity, wind, and seasons. Climate plays a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. The term "climate change" refers to changes over an extended period of time. It is generally perceived that climate change will have a measurable impact on the occurrence and severity of natural hazards around the world. Impacts include the following:

- Stronger and more frequent severe / intense thunderstorms and tornados
- The risk of drought and the frequency, intensity, and duration of heat waves are expected to increase
- More extreme precipitation is likely, increasing the risk of flooding
- The world's average temperature is expected to increase

Climate change will affect communities in a variety of ways. Impacts could include an increased risk for extreme events such as drought, storms, flooding, and wildfires; more heat-related stress; and the spread of existing or new vector-born disease into a community. In many cases, communities are already facing these problems to some degree. Climate change influences the frequency, intensity, extent, or magnitude of the problems.

Each chapter addressing one of the hazards of concern includes a section with a qualitative discussion on the probable impacts of climate change for that hazard. While many models are being developed to assess the potential impacts of climate change, none are currently available to support hazard mitigation planning. As these models are developed in the future, this risk assessment may be enhanced to better measure these impacts.

5.3 METHODOLOGY

The risk assessments in Chapter 6 through Chapter 14 describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and probable event scenarios. The following steps were used to define the risk of each hazard:

- **Identify and profile each hazard**—The following information is given for each hazard:
  - Geographic areas most affected by the hazard
  - Extent used to measure the hazards
  - Past events in planning area
  - Warning time likely to be available for response
- **Determine exposure to each hazard**—Exposure was evaluated by overlaying hazard maps, when available, with an inventory of structures, facilities, and systems to identify which of them would be exposed to each hazard. When hazard mapping was not available, a more qualitative discussion of exposure is presented.
- **Assess the vulnerability of exposed facilities**—Vulnerability of exposed structures and infrastructure was evaluated by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as geographic information system (GIS) and FEMA's hazard-modeling program Hazus, were used to perform this assessment for the flood and hurricane hazards. Outputs similar to those from Hazus were generated for other hazards, using maps generated through GIS.

5.4 RISK ASSESSMENT TOOLS

5.4.1 Hazus—Flood and Hurricane

Overview

In 1997, FEMA developed the standardized Hazus model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. Hazus was later expanded into a multi-hazard methodology with new models for estimating potential losses from hurricanes and floods.

Hazus is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that they can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.
- Facilitates review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.
- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Levels of Detail for Evaluation

Hazus provides default data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All the information needed to produce an estimate of losses is included in the software's default data. These data are derived from national databases and describe in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics, and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

Application for this Plan

This risk assessment was conducted using Hazus analysis and GIS-based methodology. The default Hazus inventory database for Frio County contains 2010 U.S. Census data and the replacement cost is based on industry-standard cost-estimation models published in *RS Means Square Foot Costs* (RS Means, 2014). It is calculated using the RS Means square foot cost for a structure, which is based on the Hazus occupancy class (i.e., multi-family residential or commercial retail trade), multiplied by the square footage of the structure from the tax assessor data. The construction class and number of stories for single-family residential structures also factor into determining the square foot costs.

The following methods were used to assess specific hazards for this plan:

Flood—A Level 1 flood analysis was performed using Hazus. The flood risk in unincorporated Frio County has never been identified on a Flood Insurance Rate Map (FIRM) and the FIRM for the Cities of Dilley and Pearsall is outdated (completed in 1980s).

Hurricane—A Hazus Level 1 analysis was performed to assess hurricane and tropical storm risk and exposure for coastal and near coastal communities. The 100-year probabilistic option in the Hazus hurricane module was used for analysis of this hazard.

5.4.2 Other Hazards of Concern

For hazards of concern that are not directly modeled in Hazus, future losses could not be estimated. However, Hazus can map hazard areas and calculate exposures if geographic information is available on the locations of the hazards and inventory data. Areas and inventory susceptible to some of the hazards of concern were mapped and exposure was evaluated. For other hazards, a qualitative analysis was conducted using the best available data. Locally relevant information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists, and others. The primary data sources were the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI), augmented with state and federal data sets. Additional data sources for specific hazards were as follows:

- **Dams**—USACE Dam Inventory Database
- **Drought**—National Drought Mitigation Center (NDMC)
- **Extreme Heat**—Western Regional Climate Center, Census of Agriculture, U.S. Department of Agriculture (USDA**)** Risk Management Agency
- **Hail, Lightning, Tornado, Wind, and Winter Weather**—Data provided by NOAA National Climatic Data Center storm events database.
- **Wildfire**—Information on wildfire hazards areas was provided by the Texas A&M Forest Service Wildfire Risk Assessment Portal (TxWRAP), U.S. Geological Survey (USGS) Federal Wildfire History, Fire Program Analysis-Fire Occurrence Database (FPA-FOD), and USDA Wildfire Hazard Potential (WHP) data.

Chapter 6.
DAM FAILURE

DAM FAILURE HAZARD	
Jurisdiction	Dam Failure
Frio County	7
City of Dilley	0
City of Pearsall	6
See Chapter 15 for more information on hazard ranking.	

6.1 HAZARD PROFILE

Water is an essential natural resource and one of the most efficient ways to manage and control water resources is through dam construction. A dam in Texas is a water storage, control or diversion structure that impounds water upstream with a "height greater than or equal to 25 feet and a maximum storage (top of dam) capacity of 15 acre-feet; a height greater than 6 feet and a maximum storage capacity greater than or equal to 50 acre-feet; or one that poses a threat to human life or property in the event of failure, regardless of height or maximum storage capacity" as defined by TCEQ (TCEQ 2017).

Most dams and lakes in Texas benefit users for water supplies for drinking, irrigation, and industrial uses; flood control; hydroelectric power; recreation; and navigation. However, despite the benefits and importance of dams to our public works infrastructure, many safety issues exist for dams as with any complex infrastructure; the most serious threat is dam failure. All the dams in Frio County are privately owned.

Causes of Dam Failure

Dam failure is a collapse or breach in a dam. While most dams have storage volumes small enough that failures have little or no repercussions, dams with large storage amounts can cause significant downstream flooding. Dam failures typically occur from any one or combination of the following:

- Prolonged periods of rainfall and flooding, which cause most failures.
- Overtopping of the primary dam structure, which can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure.
- Improper maintenance, including failure to remove trees, repair internal seepage problems, or maintain gates, valves, and other operational components.

DEFINITIONS

Dam Failure — A collapse, breach, or other failure of a dam structure resulting in downstream flooding. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and severe property damage if development exists downstream of the dam.

Emergency Action Plan — Owners of high and significant hazard dams are required by law to submit an Emergency Action Plan to TCEQ. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency (TCEQ 2016)

High-Hazard Dam — Dams where failure or operational error cause loss of human life in the breach inundation area downstream of the dam. Excessive economic losses to public facilities, agricultural, industrial, or commercial facilities, main highways, and railroad lines. (TCEQ 2016)

Significant-Hazard Dam — Dams where failure or operational error will result in possible loss of human life in the breach inundation area downstream of the dam. Economic losses may include damage to isolated homes, secondary highways, railroad lines, and interruption of service or use of public utilities (TCEQ 2016).

Low-Hazard Dam — Dams where failure or operational error where no loss of human life is expected and no permanent habitable structures are located downstream of the dam. The economic loss is minimal and the dam is in a rural area with occasional farm or agricultural damages.

- Failure of upstream dams in the same drainage basin.
- Secondary results from earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage.

6.1.1 Location

According to USACE's National Inventory of Dams, there are 17 dams in Frio County; one is classified as significant-hazard and 16 are classified as low-hazard. Table 6-1 lists all 17 dams in Frio County that have the potential to affect downstream areas. No high-hazard dams are located in the planning area. Figure 6-1 shows locations of all dams in Frio County.

Table 6-1. Dams in Frio County

Name	National ID Number	Hazard Class	Owner	Dam Type	Purpose	Water Course	Height (Feet)	NID Storage
Thompson Lake Dam	Tx01718	Low	Private	Earth	Recreation	Martin Branch	8	912
Vincent Lake Dam	Tx01714	Low	Private	Earth	Fire Protection	Becerro Creek	23	322
Morrow Lake No 1 Dam	Tx01715	Low	Private	Earth	Water Supply	Buckhorn Creek	19	213
Derby Dam	Tx01717	Low	Private	Gravity	Irrigation	Frio River	13	520
Sirrianni Lake Dam	Tx01712	Low	Private	Earth	Recreation	TR-Frio River	19	334
Eschenburg Lake Dam	Tx01713	Low	Private	Earth	Water Supply	TR-Seco Creek	14	135
Cox River Dam	Tx01720	Significant	Private	Earth	Irrigation	TR-Chacon Creek	18	419
Triple S Lake No 1 Dam	Tx01711	Low	Private	Earth	Recreation	TR-Horse Creek	20	112
Burns Reservoir Dam	Tx01719	Low	Private	Earth	-	-	13	1525
Triple S Lake No 2 Dam	Tx01710	Low	Private	Earth	Recreation	Horse Creek	16	288
Morrow Lake No 2 Dam	Tx01716	Low	Private	Earth	Water Supply	TR-Buckhorn	11	216
Holcomb Reservoir Dam	Tx04577	Low	Private	Earth	Irrigation	Elm Creek	15	146
Kyote Lake Dam	Tx04580	Low	Private	Earth	Water Supply	Padilla Creek	14	62
Morrow Dam No 4	Tx04579	Low	Private	Earth	Irrigation	Buckhorn Creek	10	104
County Line Tank Dam	Tx04581	Low	Private	Earth	Water Supply	TR-West Clear Creek	32	1367
Morrow Dam No 3	Tx04578	Low	Private	Earth	Irrigation	Buckhorn Creek	14	252
Miracle Lake Dam	Tx04582	Low	Private	Earth	Recreation	TR-Liveoak Creek	37	1529

Source: U.S. Army Corps of Engineers 2017; Stanford National Performance of Dams Program 2017
Notes:
NID National Inventory of Dams
TR Tributary

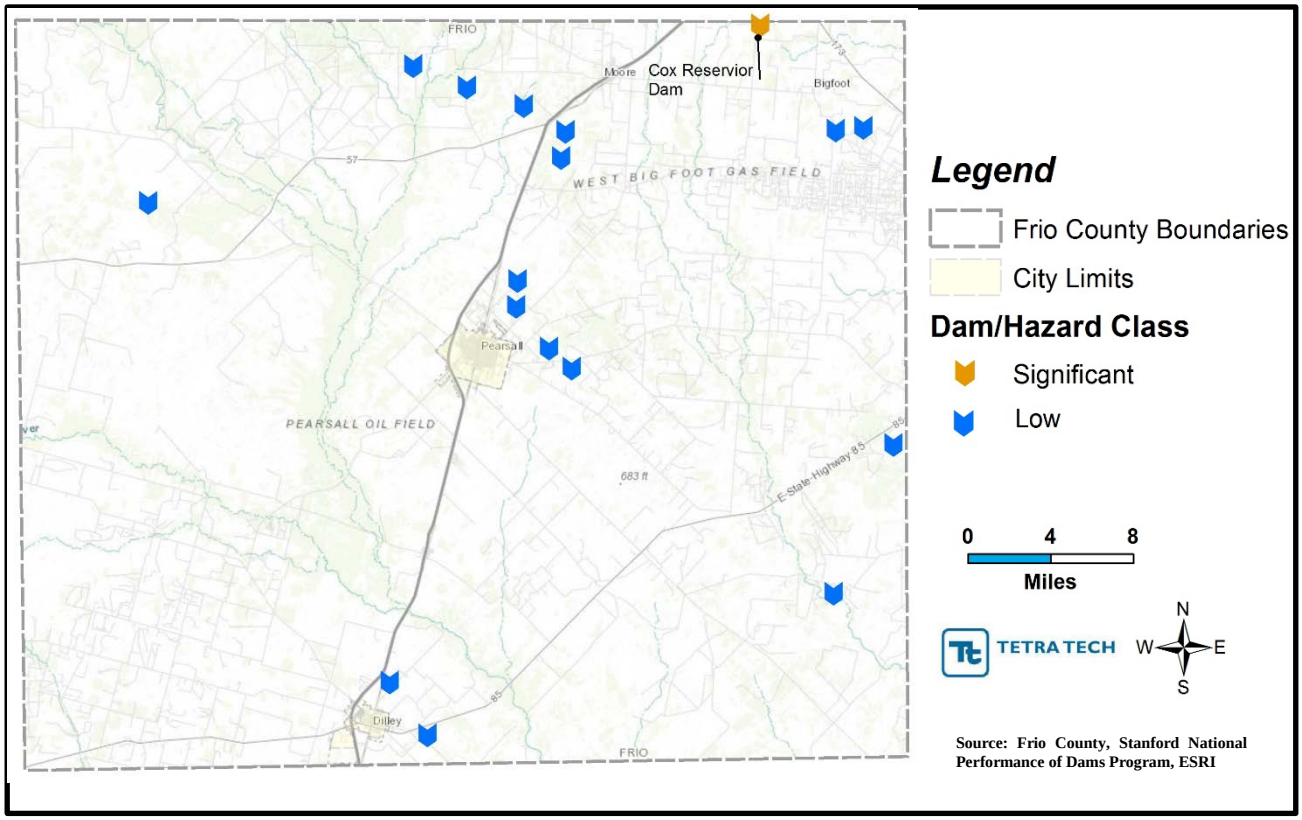


Figure 6-1. Dam Locations in Frio County

6.1.2 Extent

TCEQ has developed the extent or magnitude of a dam failure event described in terms of the classification of damages that could result from a dam's failure as shown in Table 6-2. The hazard classification system is based only on the potential consequences of a dam failure; not the probability of such failures or the condition of the dam.

The worst-case scenario for the Frio County planning area would be to see up to a significant hazard dam failure; this could cause loss of life with some economic losses in the inundation area. The extent of the flood waters can vary based on dam size capacity, topography, weather and soil conditions, and the cause of the dam failure. The jurisdictions of the City of Pearsall and the unincorporated county can expect to have up to 2 to 4 feet of flood waters inundate their floodplain areas from a dam failure. The City of Dilley would experience negligible affects.

Table 6-2. TCEQ Dam Hazard Extent Classification

Hazard Category	Human Impact	Economic Impact
Low	No loss of life expected (no lives or permanent habitable structures in the inundation area)	Minimal economic loss (failure may cause damage to occasional farms, agricultural improvements, and minor highways)
Significant	Loss of life is possible (1 to 6 lives or 1 to 2 permanent habitable structures in the inundation area)	Appreciable economic loss (failure may cause damage to isolated homes, secondary highways, minor railroads, or cause interruption of public services)
High	Loss of life is expected (7 or more lives or 3 or more permanent habitable structures in the inundation area)	Excessive economic losses (failure may cause damage to public, agricultural, industrial, or commercial facilities or utilities, and main highways or railroads)

Source: TCEQ 2017
Note:
TCEQ Texas Commission on Environmental Quality

6.1.3 Past Events

There have been no previous dam failure occurrences in Frio County.

6.1.4 Warning Time

Warning time for dam failure varies depending on the cause of the failure and if the dam owner has an up-to-date Dam Emergency Actions Plan with specific actions and call notification procedures in place. In events of extreme precipitation, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours (USACE, 1997).

6.2 VULNERABILITY AND IMPACTS

Overall, dam failure impacts would likely be rare and limited in the Frio County planning area. Jurisdictions of Frio County and the City of Pearsall have identified Dam Failure as a low hazard event and the City of Dilley feels it would have "no exposure" to impacts.

There are 17 dams in the Frio County planning area; one is classified as significant-hazard and 16 are low-hazard dams. While low-hazard dams are those at which failure or mis-operation are not anticipated to result in loss of human life, they are projected to cause limited or no economic or environmental losses. However, damage to agriculture is possible due to the number of low-hazard dams in the planning area. Because of this situation, low-hazard dams are not evaluated in the vulnerability section.

Flooding from intense rain events is the most prominent cause of dam failure. If the dam failure is extensive, a large amount of water would enter the downstream waterway forcing the water out of its banks. There may be significant environmental effects from flood waters carrying and dispersing debris and hazardous materials downstream that can contaminate the ecosystem. If the event is severe, debris carried downstream can block traffic flow, cause power outages, and disrupt local utilities, such as water and wastewater.

Dam failure inundation mapping for the planning area was not available digitally to allow Hazus loss estimations to be modeled, thus annualized losses were not estimated. Neither is a breakdown of potential dollar losses for critical facilities or critical infrastructure provided.

Table 6-3 provides the water course, jurisdiction and assets that would be impacted in the event of failure of the significant-hazard dam. This information was obtained from Dam Emergency Action Plan, USACE National Inventory of Dams, local knowledge, and Google Earth software

Table 6-3. Dams Impacts in Frio County

Name	National ID Number	Hazard Class	Water Course	Nearest Downstream City	Distance to Nearest City (miles)	Assets Downstream
Cox Reservoir Dam	Tx01720	Significant	TR-Chacon Creek	None	-	Unknown number of properties in unincorporated county

Source: U.S. Army Corps of Engineers 2017; Google Earth 2017

Community Perception of Vulnerability

See the first page of the current chapter for a summary of hazard rankings for Frio County and the planning partners in this plan. Chapter 15 gives a detailed description of these rankings and Chapter 16.2 addresses mitigations actions for this hazard vulnerability.

6.3 PROBABILITY OF FUTURE EVENTS

The Steering Committee members assessed the future probability of a major occurrence of a dam failure based on their jurisdiction's proximity to high-hazard dams, their knowledge of the structural integrity of the nearby dams and that no recorded historical events have occurred in the Frio County planning area.

Frio County and the City of Pearsall ranked the probability of a future event low for a dam failure to occur within 100 years. The City of Dilley said they had "no exposure" to dam failure, mainly based on no high-hazard dams upstream for these jurisdictions.

6.4 CLIMATE CHANGE IMPACTS

Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream.

Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

6.5 ISSUES

The most significant issue associated with dam failure involves the properties and populations in the inundation zones. Flooding because of a dam failure would significantly impact these areas. There is often limited warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, or severe weather, which limits their predictability and compounds the hazard. Critical issues associated with dam failure hazards include the following:

- Mapping for federally regulated dams is already required and available; however, mapping for non-federally regulated dams that estimates inundation depths is needed to better assess the risk associated with dam failure from these facilities.
- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.
- Security concerns should be addressed and the need to inform the public of the risk associated with dam failure is a challenge for public officials.

Chapter 7.
DROUGHT AND EXTREME HEAT

DROUGHT AND EXTREME HEAT RANKING		
Jurisdiction	Drought	Extreme Heat
Frio County	39	54
City of Dilley	30	42
City of Pearsall	54	54
See Chapter 15 for more information on hazard ranking.		

DEFINITIONS

Drought — The cumulative impacts of several dry years on water users. It can include deficiencies in surface and subsurface water supplies and generally impacts health, well-being, and quality of life.

Meteorological Drought — Precipitation's departure from normal over some period of time. Meteorological measurements are the first indicators of drought and are usually region-specific.

Agricultural Drought — Inadequate soil moisture for a particular crop at a particular time.

Hydrological Drought — Deficiencies in surface and subsurface water supplies. It is measured as stream flow and as lake, reservoir, and groundwater levels.

Socioeconomic Drought — Drought impacts on health, well-being, and quality of life.

Extreme Heat — Summertime weather that is substantially hotter or more humid than average for a location at that time of year.

7.1 HAZARD PROFILE

Drought

Drought is a normal phase in the climatic cycle of most geographical areas. According to the NDMC, drought originates from a deficiency of precipitation over an extended period, usually a season or more. This results in a water shortage for some activity, group, or environmental sector. Drought is the result of a significant decrease in water supply relative to what is "normal" in a given location. Unlike most disasters, droughts normally occur slowly but last a long time.

Defining when drought begins is a function of the impacts of drought on water users, and includes consideration of the supplies available to local water users as well as the stored water they may have available in surface reservoirs or groundwater basins. Different local water agencies have different criteria for defining drought conditions in their jurisdictions. Some agencies issue drought watch or drought warning announcements to their customers. Determinations of regional or statewide drought conditions are usually based on a combination of hydrologic and water supply factors.

Precipitation and runoff into the area lakes and dams is the main source of Texas' water supply. Precipitation is the only naturally reoccurring/renewable water supply for Frio County. Annual precipitation in the populated areas of the planning area is approximately 25 inches per year. There are various streams and tributaries contributing to water supply in the area. This supply is stored in four forms throughout the state: streamflow, reservoir water, soil moisture, and groundwater.

Extreme Heat

Severe, excessive summer heat is characterized by a combination of exceptionally high temperatures and humidity. When these conditions persist over a period of time, it is called a heat wave. Many areas in Texas are susceptible to heat waves, including Frio County.

Major human risks associated with severe summer heat include heatstroke, heat exhaustion, and heat cramps. Most at risk are outdoor workers, the elderly, children, and people in poor physical health. The effects of severe summer heat are always more pronounced in urbanized areas than in rural areas. Within urbanized areas, pervasive heat is exacerbated by what is known as the heat island effect, in which concrete and metal infrastructure absorbs radiant heat energy from the sun during the day and emit that heat energy during the night. This cyclical process essentially traps the heat in urbanized areas and makes them as much as 10 degrees warmer than surrounding areas.

During summer months, Frio County is frequently affected by severe heat hazards. Daily high temperatures range into the upper 90s and low 100s. Moderate to high relative humidity levels are prevalent in the county. The heat index (a measure of discomfort that combines temperature and humidity) can move into dangerous levels. Many people begin to experience extreme discomfort or physical distress when the heat index reaches 105 degrees.

Severe summer heat is an invisible killer. Although a heat wave does not happen with the spectacle of other hazards such as tornadoes and floods, the Centers for Disease Control and Prevention reports that from 2006 to 2010, excessive heat exposure caused 3,332 deaths in the United States. Heat-related deaths were reported most frequently among males (69%) and adults aged 65 years and older (25%).

7.1.1 Location

Drought

Due to Texas' humid sub-tropical to semi-arid conditions, drought is a natural but unpredictable occurrence in the state. However, because of natural variations in climate and precipitation sources, it is rare for all of Texas to be deficient in moisture at the same time. Single season droughts over some portion of the state are quite common.

Droughts occur regularly in Central Texas and are a normal condition, but can vary greatly in their intensity and duration. According to the 2012 Census of Agriculture, of the 1,100 square miles (704,000 acres) of land in Frio County, almost 100% is used for agricultural purposes. In 2012, there were 651 farms with an average size of 1,096 acres per farm. The entire planning area in Frio County is at risk for drought, with agricultural areas are more vulnerable to the immediate effects.

Extreme Heat

The entire planning area is at risk for extreme heat events and summers can be described as hot and muggy. There is no distinct geographic boundary to excessive summer heat. Excessive heat can occur in every participating jurisdiction within Frio County.

In Frio County, the hot season lasts for almost 4 months from end of May to mid-September. The average high is 97°F and low is 74°F.

7.1.2 Extent

Drought

NOAA has developed Palmer Drought Indices that are used to measure the extent of drought. The ***Palmer Z Index*** measures short-term drought on a monthly basis. The ***Palmer Drought Severity Index*** attempts to measure the duration and intensity of the long-term drought-inducing circulation patterns. Long-term drought is cumulative, with the intensity of drought during the current month dependent upon the current weather patterns plus the cumulative patterns of previous months. The hydrological impacts of drought (for example, reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The ***Palmer Hydrological Drought Index***, was developed to quantify the long term hydrological effects. These Palmer Drought Indices classifications are listed in Table 7-1 and Table 7-2 and depict the magnitude of drought indices.

Table 7-1. Palmer Drought Classification Indices

Drought Index	Drought Condition Classifications						
	Extreme	Severe	Moderate	Normal	Moderately Moist	Very Moist	Extremely Moist
Palmer Z Index	-2.75 and below	-2.00 to -2.74	-125 to -1.99	-1.24 to +.99	+1.00 to +2.49	+2.50 to +3.49	N/A
Palmer Drought Severity Index	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.9	+3.00 to +3.9	+4.00 and above
Palmer Hydrological Drought Index	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.9	+3.00 to +3.9	+4.00 and above

Source: NOAA, 2017
Note:
N/A Not Applicable

Table 7-2. Palmer Drought Category Descriptions

Category	Description	Possible Impacts	Palmer Drought Severity Index
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully	-1.0 to -1.9
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested	-2.0 to -2.9
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies	-5.0 or less

Source: NOAA 2017

Drought is a slow-onset hazard, but over time can have damaging effects on crops, municipal water supplies, recreation, and wildlife. The worst-case scenario for the Frio County planning area is to see up to D4, Exceptional Drought conditions that extend over a number of years, the direct and indirect economic impact can be significant.

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 USGS, the TWDB, the TCEQ, and the Texas Agricultural Statistics Service. Warnings encompass five “levels of concern” and take into account assessments of climatology, agriculture, and water availability for each of 10 climatic regions of the state.

Drought is monitored nationwide by the U.S. Drought Monitor which is produced through a partnership between the NDMC, the USDA, and NOAA (NDMC, 2017). Indicators are used to describe broad scale drought conditions across the U.S. Indicators correspond to the intensity of drought. Figure 7-1 shows the drought conditions in Texas and Frio County, as of March 2018. The majority of Frio County was abnormally dry with a small portion in northwest corner as moderate drought conditions designation.

Source: USDM 2018

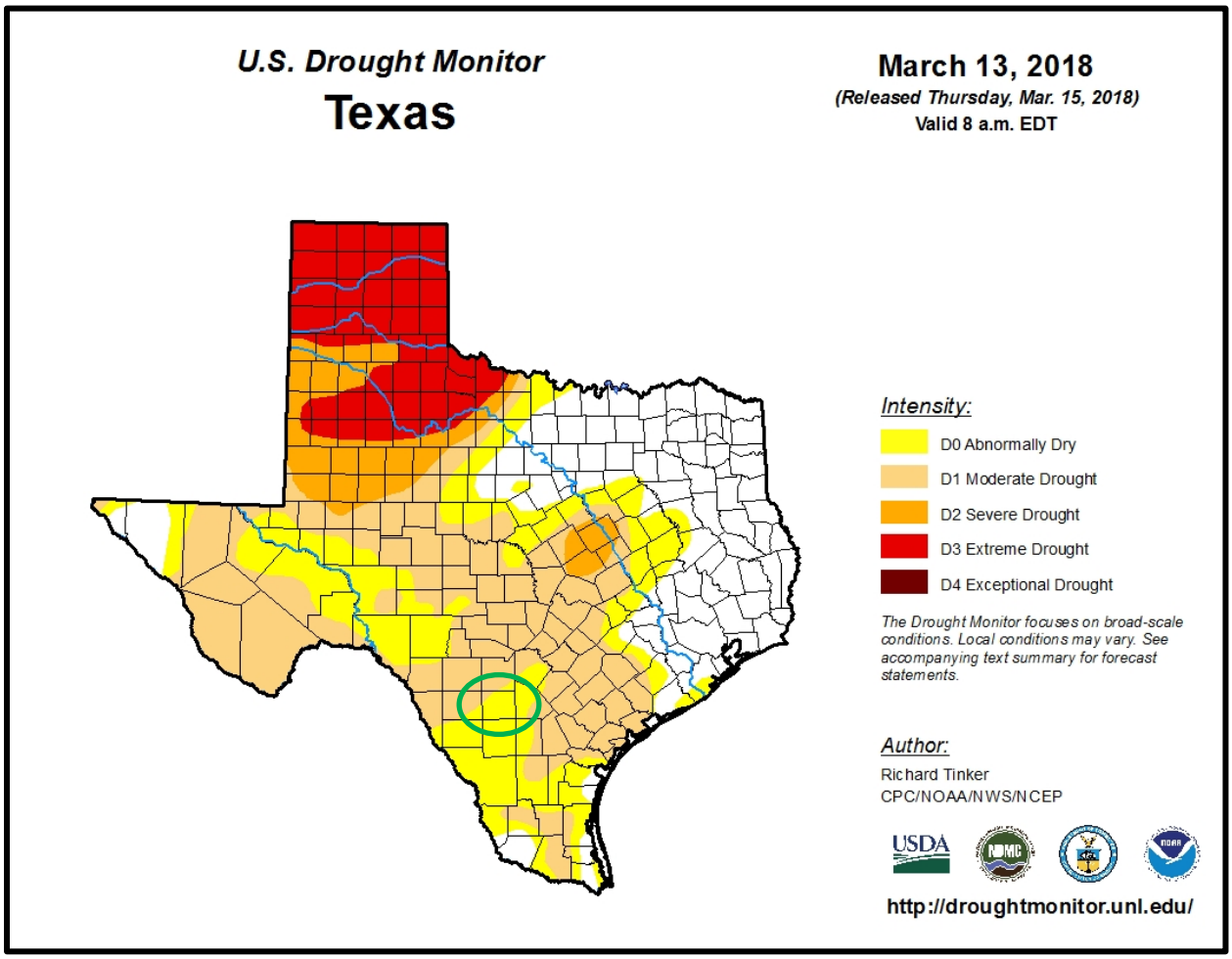


Figure 7-1. U.S. Drought Monitor Texas, March 2018

Note: Green circle shows location of Frio County.

The U.S. Forest Service (USFS) and the Texas A&M Forest Service use the Keetch-Byram Drought Index to determine the fire potential based on daily water balance, precipitation and soil moisture. Figure 7-2 shows the Texas Drought Index according to Keetch-Byram Drought Index, which uses a color-coded rating classification with a scale of 0 to 800 (low risk to high risk). Frio County was at a low to moderate risk in March 2018.

Source: Texas Weather Connection 2018

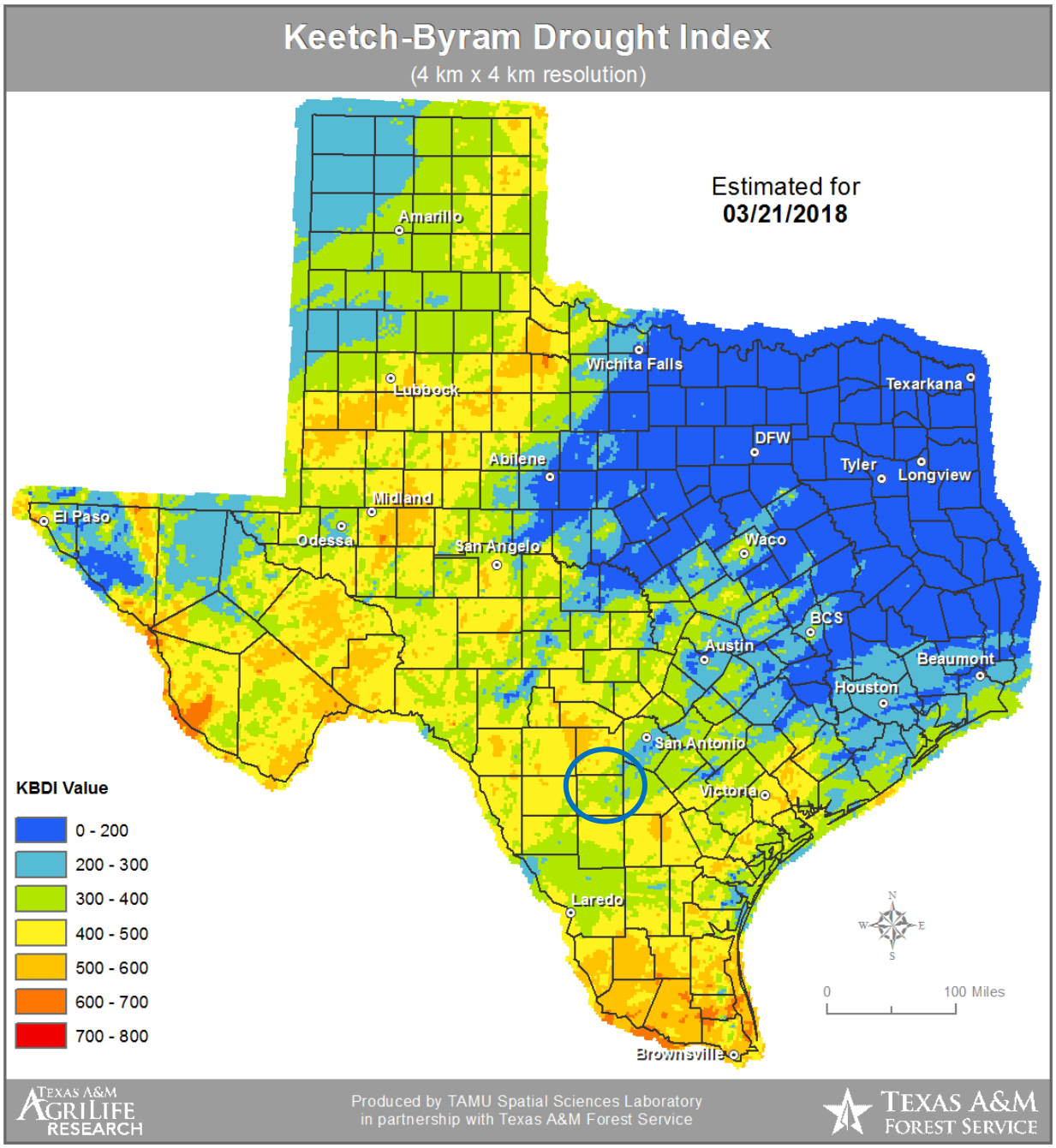


Figure 7-2. Keetch-Byram Drought Index, March 2018

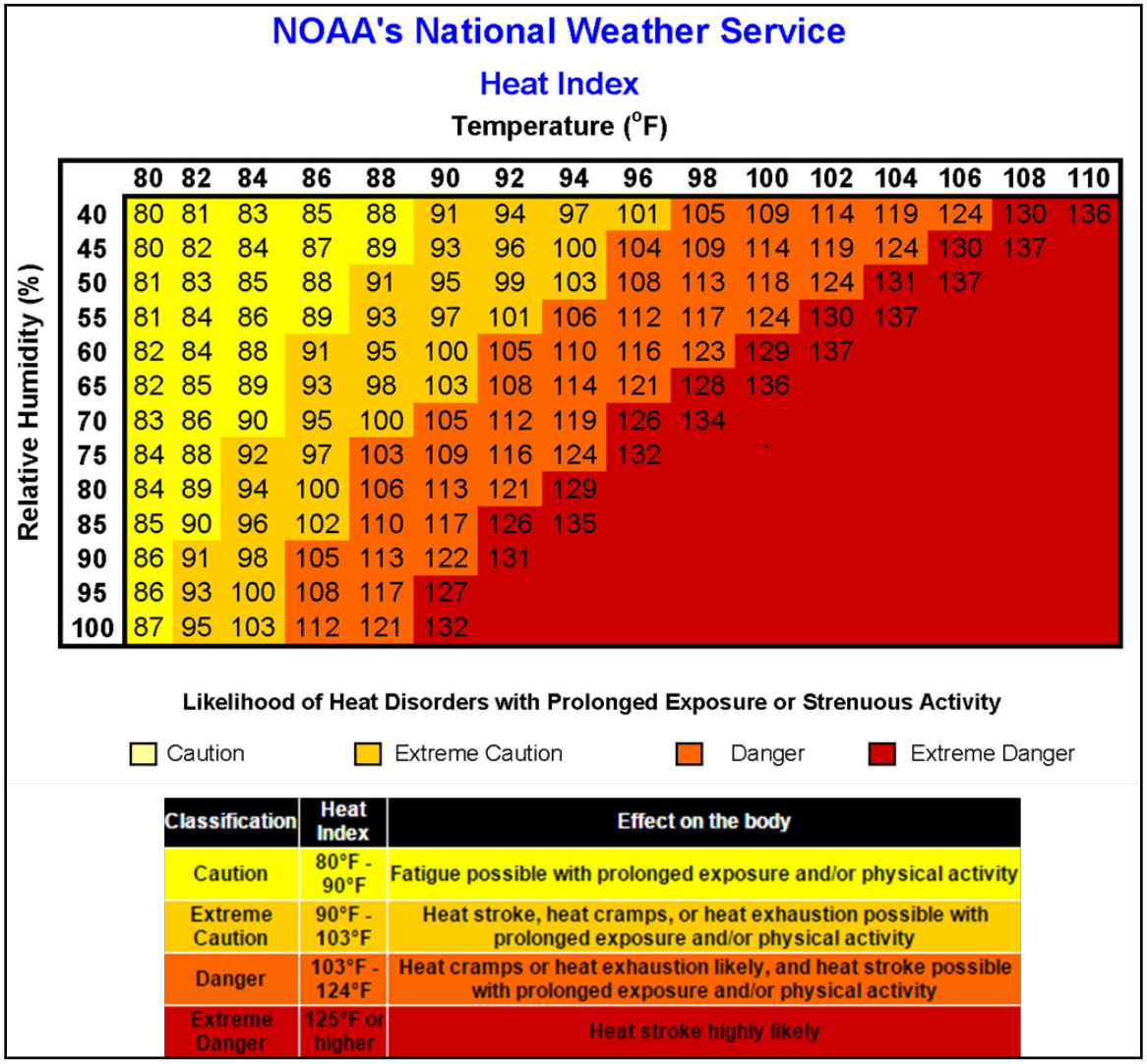
Note: Blue circle shows location of Frio County.

Extreme Heat

Heat index tables (see Figure 7-3) are commonly used to provide information about how hot it feels, which is based on the interactions between several meteorological conditions. Since heat index values were devised for shady, light wind conditions, exposure to full sunshine can increase heat index values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

The worst-case scenario for the Frio County planning area would be to see up to an extreme heat wave that lasts several weeks with 100° and above during the day with high humidity and the evening lows only dropping into the 90s°. In this scenario, people and animals do not get a chance to cool off their bodies and rest from the heat.

Source: NOAA NWS 2018



Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Classification	Heat Index	Effect on the body
Caution	80°F - 90°F	Fatigue possible with prolonged exposure and/or physical activity
Extreme Caution	90°F - 103°F	Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
Danger	103°F - 124°F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity
Extreme Danger	125°F or higher	Heat stroke highly likely

Figure 7-3. Heat Index Table

7.1.3 Past Events

Drought

According to the Texas Water Resources Institute and the NOAA NCEI storm event database, Frio County experienced seven years of drought conditions between 1996 and 2017 (1996, 1997, 2000, 2011, 2012, 2013, and 2014). No property damage amounts nor injuries/fatalities were recorded. One FEMA drought declaration was issued in September 1993 during an extreme heat event with severe lack of precipitation.

- **2014 Drought**—This year the Moderate Drought conditions started by March and continued until the fall.

- **2013 Drought**—Drought conditions persisted most of the year until fall. Then, beneficial rain fell during September and drought classifications were removed by the end of the year
- **2012 Drought**—The drought conditions persisted all year in South Central Texas.
- **2011 Drought**—Texas officially experienced the driest 12-month period in the state's history between October 2010 and September 2011 with an average rainfall of 11.18 inches. The drought conditions lasted the entire year. By July, the entire State of Texas area was in Extreme Drought conditions.
- **2000 Drought**—Drought conditions prevailed most of year with Extreme Drought conditions occurring in September.
- **1997 Drought**—Moderate Drought conditions continued into 1997 until May when sufficient rains occurred.
- **1996 Drought**—Moderate Drought conditions started in April and became Severe Drought conditions through the summer months. Then Moderate Drought conditions prevails the rest of the year.

USDA Disaster Declarations

Agriculture-related disasters and disaster declarations are common in the United States, and the USDA Farm Service Agency provides assistance for losses resulting from drought, flood, fire, freeze, tornadoes, pest infestation, and other natural disasters. Many counties have been designated disaster areas in the past several years of record crop production. The U.S. Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to them. Between 2012 and 2017, Frio County was included in 13 USDA secretarial disaster declarations (related to drought) (USDA 2017) as listed in Table 7-3.

Table 7-3. USDA Secretarial Disasters from Drought

Year	Type	Declaration Number
2015	Drought, high winds, wildfire, excessive heat, insects	S3791
2015	Drought, high winds, wildfire, excessive heat, insects	S3814
2015	Drought, high winds, wildfire, excessive heat, insects	S3913
2014	Drought, high winds, wildfire, excessive heat, insects	S3633
2014	Drought, high winds, wildfire, excessive heat, insects	S3693
2014	Drought	S3781
2013	Drought, high winds, wildfire, excessive heat, insects	S3465
2013	Drought, high winds, wildfire, excessive heat, insects	S3472
2013	Drought, high winds, wildfire, excessive heat, insects	S3489
2013	Drought, high winds, wildfire, excessive heat, insects	S3500
2013	Drought, high winds, wildfire, excessive heat, insects	S3531
2013	Drought	S3681
2012	Drought, high winds, wildfire, excessive heat, insects	S3288

Source USDA 2017
Note:
USDA U.S. Department of Agriculture

The Drought Impact Reporter

The NDMC developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Information comes from a variety of sources: online, drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media, and staff of government agencies. The Drought Impact Reporter contains information of 52 impacts from droughts that specifically affected Frio County between

2008 and 2017 (Drought Impact Reporter 2017) and these have a high probability of continuing. The following are the categories and reported number of impacts. Note that some impacts have been assigned to more than one category.

- Agriculture—38
- Energy—1
- Fire—10
- Plants and Wildlife—20
- Relief, Response, and Restrictions—13
- Society and Public Health—1
- Water Supply and Quality—15

Extreme Heat

According to the NOAA NCEI storm event database, no excessive heat days have ever been recorded in Frio County. High temperatures are common in Frio County with a summer average temperature around 97˚F.

Table 7-4 contains temperature summaries related to extreme heat for the Pearsall weather station. These temperatures occur throughout the planning area. In recent history, the month of August 2011, recorded the highest number of days over 90°F and the month of July 2001, was a close second.

Table 7-4. Monthly Highest Temperature Extremes for Planning Area, 1902-2012

Month	Monthly Highest Mean Temperature	Year Recorded	Number of Days > 90°F
January	59.7°F	1971	0.1
February	67.5°F	1962	0.5
March	71.9°F	1904	2.5
April	78.8°F	1967	7.8
May	82.8°F	1989	16.5
June	86.7°F	2011	25.6
July	88.4°F	2001	28.5
August	89.8°F	2011	29.0
September	85.0°F	1977	22.7
October	78.6°F	1962	9.2
November	67.8°F	1973	0.7
December	61.6°F	1970	0.0

Source: WRCC 2018
Notes:
Information from the Pearsall Weather Station
°F Degrees Fahrenheit
> Greater than

USDA Risk Management Agency

According to the USDA Risk Management Agency, payments for insured crop losses in Frio County as a result of excessive heat conditions between 2011 and 2017 caused $958,852 in crop losses that affected 2,879 acres. These claims occurred in 2011 and 2017.

7.1.4 Warning Time

Drought

Droughts are climatic patterns that occur over extended periods of time. Only generalized warnings can take place because there are numerous variables that scientists have correlated well enough to make accurate predictions. Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature.

Scientists at this time do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long these anomalies last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, and the accumulated influence of weather systems on the global scale.

Texas is semi-arid to humid sub-tropical, thus, drought is a regular and natural occurrence in the state. The main source of water supply in the state is precipitation and much of this occurs in the spring and fall. Some snowfall does occur in the wintertime. Although drought conditions are difficult to predict, low levels of spring precipitation may act as an indicator that drought conditions are occurring.

Extreme Heat

NOAA issues watch, warning, and advisory information for extreme heat. Extreme heat is a regular and natural occurrence in the state.

7.2 VULNERABILITY AND IMPACT

Drought

The impact of drought can be wide-reaching and may be economic, environmental, or societal. The most significant impacts associated with drought in Frio County are those related to water-intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. An ongoing drought may leave this area more prone to wildfires. Drought conditions can also cause soil to compact, increasing an area's susceptibility to flooding, and reduce vegetation cover, which exposes soil to wind and erosion. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted, water wells become less productive during drought and can dry up, and water levels in streams and groundwater decline.

Notable incidents that impacted Frio County from the Drought Impact Reporter (Drought Impact Reporter 2017) include:

- Fire danger rising
- Brown pastures
- Heavy irrigation, soil moisture low
- Cattle theft
- Livestock receiving supplemental feed
- Livestock being sold
- Emergency water restrictions

From the timeframe of 1996 to 2017, the planning area experienced seven drought periods, but no damages were recorded in the NCEI storm event database. All the planning partners are vulnerable to drought conditions. Frio County and the Cities of Dilley and Pearsall feel that this hazard has moderate to high impacts on their population, property, and economy.

Environmental impact from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the

drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Economic impact will be largely associated with industries that use water or depend on water for their business. For example, landscaping businesses were affected in the droughts of the past as the demand for service significantly declined because landscaping was not watered. Agricultural industries will be impacted if water usage is restricted for irrigation. The tourism sector may also be impacted.

Extreme Heat

No excessive heat records were available for the planning area in the NCEI storm event database.

All the planning partners are vulnerable to extreme heat. Frio County and the Cities of Dilley and Pearsall feel that this hazard has moderate to high impacts on their population, property, and economy.

According to the U.S. Environmental Protection Agency (EPA), young children (because they are more likely to be left in cars unattended), the elderly and people with physical or mobility constraints, cognitive impairments, economic constraints, and social isolation are more susceptible to the adverse effects of excessive heat events. Actual percentages of vulnerable populations are listed in Table 7-5 for each planning partner. Data were not available for individuals for physical, mobility, nor economic constraints.

Overall, Texas has an estimated 18.6% of greater risk population age groups. Frio County's greater risk population is around the state average at 18.8%.

Table 7-5. Populations at Greater Risk by Jurisdiction

Jurisdiction	Total Population	Population Under 5	Population 65 and Older	Percentage of Greater Risk Population
City of Dilley	4,358	8.3%	8.5%	16.8%
City of Pearsall	10,345	6.4%	11.0%	17.4%
Frio County	19,600	6.6%	12.2%	18.8%

Source: U.S. Census Bureau, 2016 5-Year American Community Survey

Agriculture

According to the 6-year period from the USDA's Risk Management Agency, the amount of claims paid for crop damage as a result of extreme heat in Frio County was $1,536,121. According to the 2016 Texas Insurance Profile from the USDA's Risk Management Agency, 88% of the insurable crops in Texas are insured with USDA crop insurance. To estimate losses to insurable crops that are not insured, the 88% crop insurance coverage was factored in to provide an adjusted estimate of losses. According to this calculation, estimated annualized losses are over $290,932 (see Table 7-6).

Considering the value of crops from the 2012 Census of Agriculture as baseline crop exposure, the estimated annual losses from extreme heat were determined to be low compared to the value of the insurable crops.

Table 7-6. Estimated Insurable Annual Crops Lost Resulting from Extreme Heat

6-Year Extreme Heat Insurance Paid	Adjusted 6-Year /Extreme Heat Losses (considering 88% insured)	Estimated Annualized Losses	2012 Value of Crops
$1,536,121	$1,745,592	$290,932	$183,672,000

Source: USDA 2012; USDA RMA 2016; USDA 2016

Community Perception of Vulnerability

See the first page of this chapter for a summary of hazard rankings for Frio County and the planning partners in this plan. Chapter 15 gives a detailed description of these rankings and Chapter 16.2 addresses mitigation actions for this hazard vulnerability.

7.3 PROBABILITY OF FUTURE EVENTS

Drought

The probability of a future drought in Frio County and the participating jurisdictions is "Medium," with an event possible every 2 to 3 years. According to information from the NOAA NCEI, the planning area had seven years of documented drought periods between 1996 and 2017. Based on this historical information, the probability of a future drought occurring in any given year is over 30%.

The Steering Committee members assessed the future probability on drought based on their jurisdictional knowledge. Frio County and the Cities of Dilley and Pearsall all ranked the probability of a future event as likely to occur within 25 years.

Extreme Heat

On average, Frio County and the participating jurisdictions have experienced 143 days per year where temperatures exceed 90°F so the probability of extreme heat events is expected to be very likely in any given year (based on the Pearsall station for WRCC). When temperatures reach 90ºF and above, people are vulnerable to heat cramps, heat exhaustion, and heat stroke. Pets and livestock are also vulnerable to heat-related injuries. Crops can be vulnerable as well.

Frio County and the participating jurisdictions can expect similar numbers of hot days in the future (143 days per year are highly likely).

The Steering Committee members assessed the future probability on extreme heat based on their jurisdictional knowledge. Frio County and the Cities of Dilley and Pearsall all ranked the probability of a future event as likely to occur within 25 years.

7.4 CLIMATE CHANGE IMPACTS

Drought

The long-term effects of climate change on regional water resources are unknown, but global water resources are already experiencing the following stresses without climate change:

- Growing populations
- Increased competition for available water
- Poor water quality
- Environmental claims
- Uncertain reserved water rights
- Groundwater overdraft
- Aging urban water infrastructure

With a warmer climate, droughts could become more frequent, more severe, and longer-lasting. The 2011 drought in Texas reached a record $7.62 billion in agriculture losses, making it the costliest drought in history. It was more than $3.5 billion higher than the 2006 drought loss estimate, which previously was the costliest drought on record in Texas (Texas A&M 2012). More frequent extreme events such as droughts could be more cause for concern than the long-term change in temperature and precipitation averages.

The best advice to water resource managers regarding climate change is to start addressing current stresses on water supplies and build flexibility and robustness into any system. Flexibility helps to ensure a quick

response to changing conditions, and robustness helps people prepare for and survive the worst conditions. With this approach to planning, water system managers will be better able to adapt to the impacts of climate change.

Extreme Heat

According to EPA's *What Climate Change Means for Texas* (EPA 2016), Texas can expect three to four times as many days per year above 100°F in the future and nighttime temperatures are rising substantially. This will cause certain populations including children, elderly, the sick, and the poor to be more vulnerable to heat stroke and dehydration and affect people's cardiovascular and nervous systems.

7.5 ISSUES

The following are extreme heat and drought-related issues:

- Identification and development of alternative water supplies.
- Utilization of groundwater recharge techniques to stabilize the groundwater supply.
- The probability of increased drought frequencies and durations due to climate change.
- The promotion of active water conservation even during non-drought periods.
- Increasing vulnerability to drought over time as demand for water from different sectors increases.
- The effects of climate change may result in an increase in frequency of extreme heat events.
- The effects of recent droughts have exposed the vulnerability of the planning area's economy to drought events.
- Wildlife habitat management for landowners.
- Human health impacts from droughts and extreme heat.
- Monitoring and evaluating risks to power supply and water rights.
- Development and update of mitigation- or response-based drought plans.

Chapter 8.
EARTHQUAKE

EARTHQUAKE HAZARD	
Jurisdiction	Earthquake
Frio County	13
City of Dilley	0
City of Pearsall	7
See Chapter 15 for more information on hazard ranking.	

DEFINITIONS

Earthquake — The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.

Epicenter — The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Fault — A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.

Focal Depth — The depth from the earth's surface to the hypocenter.

Hypocenter — The region underground where an earthquake's energy originates.

Liquefaction — The loss of strength in loosely packed, saturated sediments in response to strong shaking, potentially causing major damage during an earthquake.

8.1 HAZARD PROFILE

An earthquake is a sudden release of energy from the earth's crust that creates seismic waves. Tectonic plates become stuck, putting a strain on the ground. When the strain becomes so great that rocks give way, fault lines occur. At the earth's surface, earthquakes may manifest themselves by a shaking or displacement of the ground, which may lead to loss of life and destruction of property. Size of an earthquake is expressed quantitatively as magnitude and local strength of shaking as intensity. The inherent size of an earthquake is commonly expressed using a magnitude.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

Earthquakes can last from a few seconds to over 5 minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris, because the shocks shake, damage, or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides, or releases of hazardous material, compounding their disastrous effects.

Small, local faults produce lower magnitude quakes, but ground shaking can be strong and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

The severity of earthquakes is influenced by several factors, including the depth of the quake, the geology in the area, and the soils. The severity of soil liquefaction is dependent on the soil grain size, thickness, compaction, and degree of saturation.

8.1.1 Location

While Texas does face some earthquake hazard, this hazard is very small in comparison to many other states. The biggest threat appears to be from the Balcones Fault Zone, part of the Edwards Aquifer. The Balcones Fault Zone is located primarily north, northeast, and northwest of Frio County. A small portion of the Balcones Fault Zone is located on the northwestern portion of the County, close to Frio Town. Figure 8-1 shows the location of the Edwards Aquifer within the Balcones Fault Zone. According to the University of Texas at Austin, the Balcones Fault has been inactive for 15 million years and is considered one of the lowest-risk fault zones in the United States. There has been one recorded earthquake in the Balcones Fault Zone since 1900. The earthquake was a 3.0 magnitude earthquake in Comal County.

Two recorded earthquakes in Atascosa County in 2014 and 2015 were approximately 6 to 20 miles east of the Frio County border. Two events in January 2018 identified a 2.8 and 3.2 magnitude earthquake approximately 45 to 55 miles east of the Frio County border in Karnes and Wilson Counties.

In Central Texas, the hazard is generally low, but residents should be aware that small earthquakes can occur, including some that are theoretically triggered by oil or gas production. Elsewhere in Texas, earthquakes are exceedingly rare. However, the hazard level is not zero anywhere in Texas; small earthquakes are possible almost anywhere, and all regions face possible ill effects from very large, distant earthquakes.

Source: Clearwater Underground Water Conservation District 2017

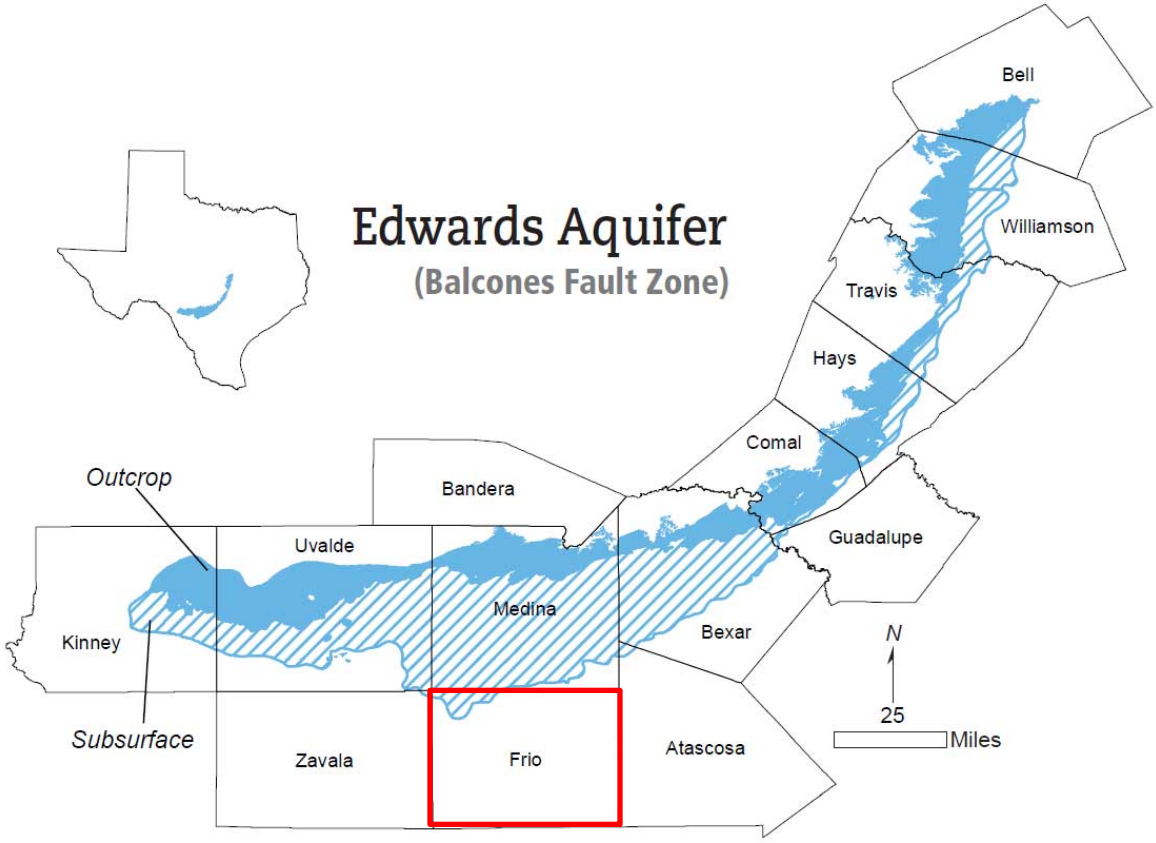


Figure 8-1. Edwards Aquifer, part of the Balcones Fault Zone

Note: Frio County is in the red square.

8.1.2 Extent

Earthquakes are typically classified in one of two ways: by the amount of energy released, measured as **magnitude**; or by the impact on people and structures, measured as **intensity**. The worst-case scenario for the Frio County planning area is an earthquake up to a greater than 5 magnitude with Mercalli intensity scale in the range of VI Strong.

Magnitude

Currently the most commonly used magnitude scale is the moment magnitude (M_w) scale, with the follow classifications of magnitude:

- Great $M_w > 8$

- Major M_w = 7.0 - 7.9
- Strong M_w = 6.0 - 6.9
- Moderate M_w = 5.0 - 5.9
- Light M_w = 4.0 - 4.9
- Minor M_w = 3.0 - 3.9
- Micro M_w < 3

Estimates of moment magnitude roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the M_w scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, M_w scale is now the most often used estimate of large earthquake magnitudes.

Intensity

Currently, the most commonly used intensity scale is the modified Mercalli intensity scale, with ratings defined in Figure 8-2 (USGS 1989):

Source: USGS 1989

Magnitude	Mercalli	Description	Earthquake Effects
2	I	Instrumental	Not felt except by a very few under especially favorable conditions.
	II	Feeble	Felt only by a few persons at rest, especially on upper floors of buildings.
3	III	Slight	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
	IV	Moderate	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
4	V	Rather Strong	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5	VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
	VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
6	VIII	Destructive	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
7	IX	Ruinous	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
	X	Disastrous	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
8	XI	Very Disastrous	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
	XII	Catastrophic	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Figure 8-2. Modified Mercalli Intensity Scale

8.1.3 Past Events

According to the USGS Earthquake Hazard Program, no earthquakes have been recorded originating in Frio County since 1847, (the earliest date data are available) (USGS 2018). Most past earthquakes in Texas have been of low magnitude and have mainly occurred in west Texas, or the Panhandle area (see Figure 8-3).

There are no known deaths or injuries from earthquakes near Frio County and the Cities of Dilley and Pearsall. Some of the past earthquake events in Texas were severe enough to cause minor property damage such as broken windows or contents falling from shelves. The very low probability of an event suggests that potential for these impacts is minimal. Based on recent low magnitude earthquakes in neighboring counties to Frio, there is a possibility Frio could feel the effects of neighboring earthquakes, though the impact would be minimal.

Source: UTIG, TDEM, and USDE 2013

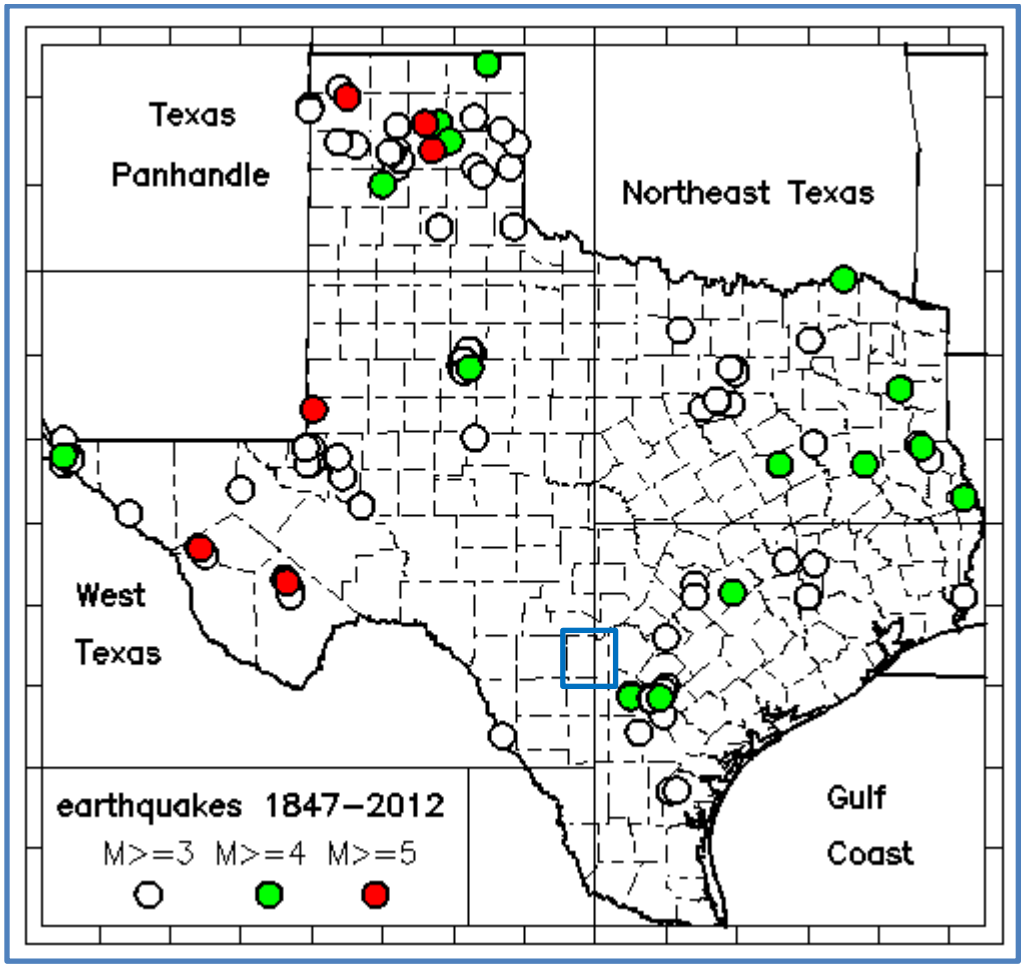


Figure 8-3. Past Texas Earthquakes with Magnitudes Exceeding M3

Notes: Approximate location of Frio County in blue square.
TDEM Texas Division of Emergency Management
USDE U.S. Department of Energy
UTIG University of Texas Institute for Geophysics

There are no reported earthquake events in Frio County. Earthquakes in neighboring Atascosa and Karnes Counties could be felt in Frio County. According to USGS, the following is a list of nearby earthquakes since 2014 (USGS 2018):

- February 12, 2018: 3.1M close to Karnes City, Texas (Karnes County) located approximately 60 miles west-southwest of the City of Pearsall.
- January 9, 2018: 2.8M with an epicenter north of Karnes City, Texas (Karnes County).
- January 7, 2018: 3.2M with an epicenter southwest of Poth, Texas (Wilson County) located approximately 72 miles east of the City of Pearsall.
- January 16, 2015: 2.8M in Jourdanton, Texas (Atascosa County) located approximately 34 miles west-southwest of the City of Pearsall.
- September 10, 2014: 3.2M in Charlotte, Texas (Atascosa County) located approximately 25 miles west-southwest of the City of Pearsall.

8.1.4 Warning Time

There is no current reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short but it could allow for someone to get under a desk, step away from a hazardous material they are working with, or shut down a computer system.

Part of what makes earthquakes so destructive is that they generally occur without warning. The main shock of an earthquake can usually be measured in seconds, and rarely lasts for more than a minute. Aftershocks can occur within the days, weeks, and even months following a major earthquake.

By studying the geologic characteristics of faults, geoscientists can often estimate when the fault last moved and estimate the magnitude of the earthquake that produced the last movement. Because the occurrence of earthquakes is relatively low to none in the county and the historical earthquake record is short, accurate estimations of magnitude, timing, or location of future dangerous earthquakes in Frio County are difficult to estimate.

8.2 VULNERABILITY AND IMPACT

All structures, people, and infrastructure within Frio County, and the Cities of Pearsall and Dilley, are vulnerable to earthquake damage, however there is a very low risk of occurrence. The potential shaking of the 500-year event in Frio County and the Cities of Dilley and Pearsall creates a "weak" perceived shaking with no potential damage on the USGS Instrumental Intensity Scale. While the probability of an event is rare, if an event were to occur, it would be of minimal magnitude with no damage.

No earthquake scenarios were selected for this plan because an earthquake event for the planning area is rare, according to the *2013 State of Texas Hazard Mitigation Plan*. Frio County and the Cities of Dilley and Pearsall can expect no loss of functionality for critical facilities and infrastructures, utility, transportation, and other essential services. Due to no previous earthquake events in the planning area and the rare likelihood that such an earthquake event may occur for Frio County and the participating jurisdiction, annualized economic losses were not figured.

Community Perception of Vulnerability

The Steering Committee members from the City of Dilley feels they have "no exposure" to earthquakes while Frio County and the City of Pearsall representatives believe they only have low risk to earthquakes.

See the first page of this chapter for a summary of hazard rankings for Frio County and the planning partners in this plan. Chapter 15 gives a detailed description of these rankings and Chapter 16.2 addresses mitigation actions for this hazard vulnerability.

8.3 PROBABILITY OF FUTURE EVENTS

The USGS has created ground motion maps based on current information about several fault zones. These maps show the peak ground acceleration (PGA) that has a certain probability (2% or 10%) of being

exceeded in a 50-year period, as shown on Figure 8-4. The PGA is measured in numbers of g's (the acceleration associated with gravity). The USGS ground motion map projects Frio County, including the Cities of Dilley and Pearsall, to have a peak acceleration of 0.02g. This intensity produces only a weak ground shaking and is likely to cause no damage. At this intensity, shaking might not be felt or felt indoors by a few persons, especially on upper floors. Hanging objects or doors may swing and trees, structures, or bodies of water may sway. Dizziness or nausea can also be experienced.

There is a low probability of an earthquake occurring in Frio County within the next 100 years. According to the USGS, there has been no recorded earthquake events in the Frio County planning area. Although it is possible for Frio County residents to feel a slight earthquake originating in other counties or a major earthquake in neighboring states.

According to the *2013 State of Texas Hazard Mitigation Plan* (SHMP), the probability of an earthquake in the Central Region of Texas is considered rare. This includes Frio County (SHMP 2013). Although a small event is possible, it would pose little to no risk for the area.

According to the USGS, the probability that a magnitude 5 or greater earthquake will occur in the planning area in the next few years is unlikely (event not possible in next 10 years). The USGS Earthquake Probability Mapping application estimates that the probability that a magnitude 5 or greater earthquake will occur in the next 500 years in Frio County and the Cities of Dilley and Pearsall is 2% or less. Overall, the probability of a damaging earthquake somewhere in Frio County is considered rare. Small earthquakes that cause no or little damage are more likely. The future probability of an earthquake event in Frio County and the Cities of Dilley and Pearsall is unlikely (event not probable in next 10 years).

Source: Frio County, USGS, ESRI 2018

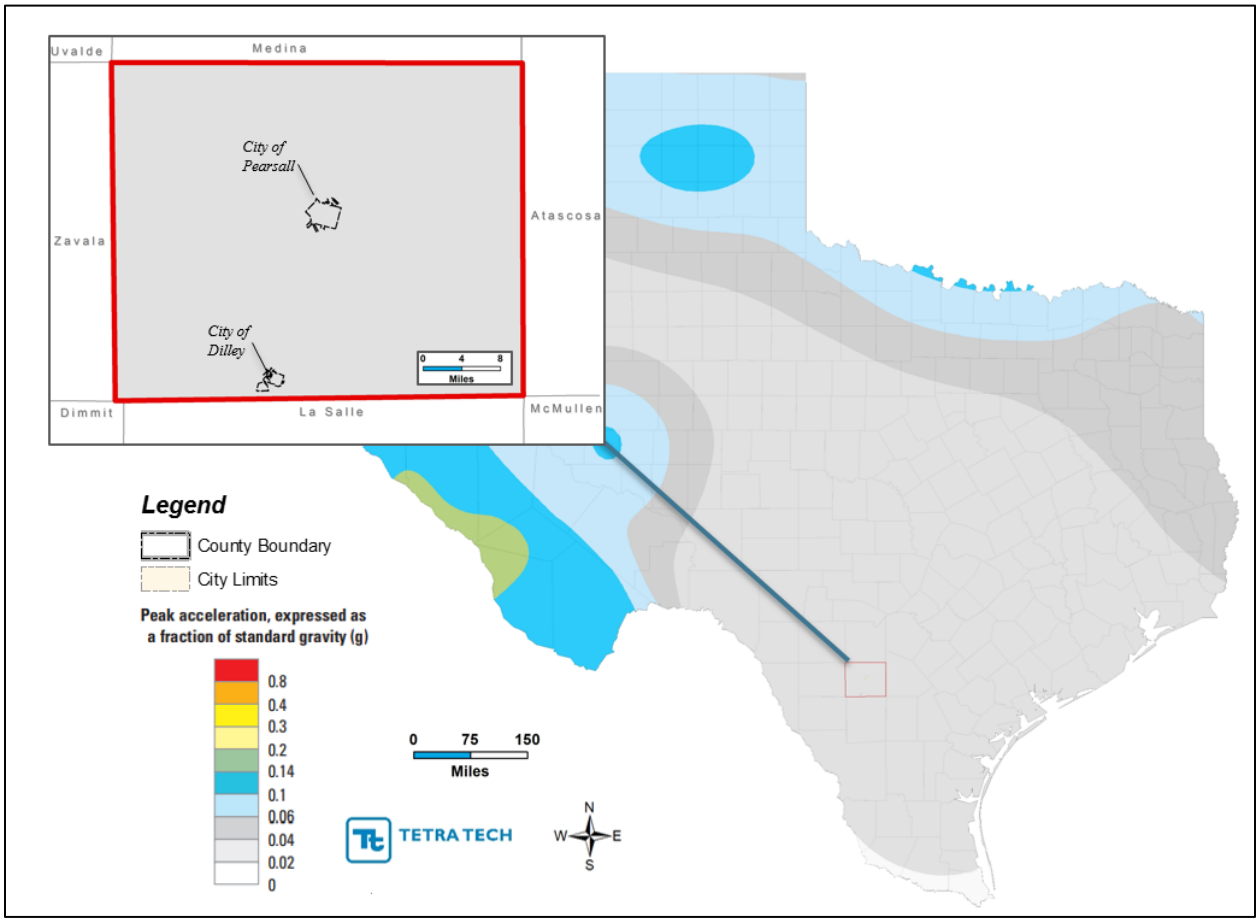


Figure 8-4. Earthquake Peak Ground Acceleration

8.4 CLIMATE CHANGE IMPACTS

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. National Aeronautics and Space Administration (NASA) and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes there (NASA 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity due to their increased saturation. Dams storing increased volumes of water because of changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

8.5 ISSUES

Important issues associated with an earthquake include but are not limited to the following:

- Many structures within the planning area were built prior to 1994, when seismic provisions became uniformly applied through building code changes.
- Critical facility owners should be encouraged to create or enhance continuity of operations plans using the information on risk and vulnerability contained in this plan.

- Geotechnical standards should be established that take into account the probable impacts from earthquakes in the design and construction of new or enhanced facilities.
- Earthquakes could trigger other natural hazard events such as dam failures which could severely impact the county.
- A worst-case scenario would be the occurrence of a large seismic event during a flood or high-water event. Failures could happen at multiple locations, increasing the impacts of the individual events.
- The cost of retrofitting buildings to meet earthquake seismicity standards may be cost-prohibitive.
- Information regarding liquefaction susceptibility of soils in the planning area is lacking.

Chapter 9.
FLOOD

FLOOD HAZARD	
Jurisdiction	Flood
Frio County	36
City of Dilley	6
City of Pearsall	28
See Chapter 15 for more information on hazard ranking.	

DEFINITIONS

Flood — The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain — The land area along the sides of a river that becomes inundated with water during a flood.

1-Percent-Annual-Chance (100-Year) Floodplain — The area flooded by the flood that has a 1-percent chance of being equaled or exceeded in a given year. The 1-percent-annual-chance flood is the standard used by most federal and state agencies.

0.2-Percent-Annual-Chance (500-Year) Floodplain — The area flooded by the flood that has a 0.2-percent chance of being equaled or exceeded in a given year.

Regulatory Floodway — Channel of a river or other water course and adjacent land areas that must be reserved for discharge of the base flood without cumulatively increasing water surface elevation more than a designated height. Communities must regulate development in these floodways to ensure no increases in upstream flood elevations.

Return Period — The average number of years between occurrences of a hazard (equal to the inverse of the annual likelihood of occurrence).

Riparian Zone — The area along the banks of a natural watercourse.

9.1 HAZARD PROFILE

Floods generally result from excessive precipitation, and the severity of a flooding event is typically determined by a combination of several major factors, including stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing and impervious surface. Generally, floods are long-term events that may last for several days.

Inland or riverine flooding, the primary type of flooding in Frio County because of its inland location, is a function of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. It is natural and inevitable as it is the overbank 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.

Texas has the most flash flood deaths of any state in the country. Although the Frio County planning area lies just south of the "Flash Flood Alley" area of Texas, it is still susceptible to flash flood events every year. Factors contributing to flash floods in the area include its location between the Rocky Mountains and the moisture-laden Gulf of Mexico. As weather systems stall and dissipate over Texas, they drop intense rains over small areas.

Flooding in the Frio County planning area is mostly caused by slow-moving thunderstorms, thunderstorms repeatedly moving over the same area, or heavy rains from hurricanes and tropical storms. Flash floods can occur within a few minutes or after hours of excessive rainfall. These rain events are most often microbursts, which produce a large amount of rainfall in a short amount of time. Flash floods, by their nature, occur suddenly but usually dissipate within hours. According to the NOAA, Frio County experienced approximately 60 flash flood events between 1980 and 2017 (NOAA 2018). Despite their sudden nature, the National Weather Service (NWS) is usually able to issue hazardous weather outlooks, watches, and warnings in advance of a flood.

9.1.1 Location

Frio County is a part of the Nueces River Basin in Texas (see Figure 9-1) which is a small basin that occupies a relatedly arid region of Texas. The basin does have an important role in supplying water to the coastal cities, including the City of Corpus Christi.

Frio County is named for the Frio River, which run from the northwestern corner of the county to the southeastern corner. The Frio River runs approximately 200 miles in the southcentral portion of Texas. The Frio River is a relatively small and gentle river, with a basin size approximately 18,900 square kilometers (in comparison to the Colorado River in Texas which has a basin size of 103,341 square kilometers).

Source: UTA, USGS, 2010

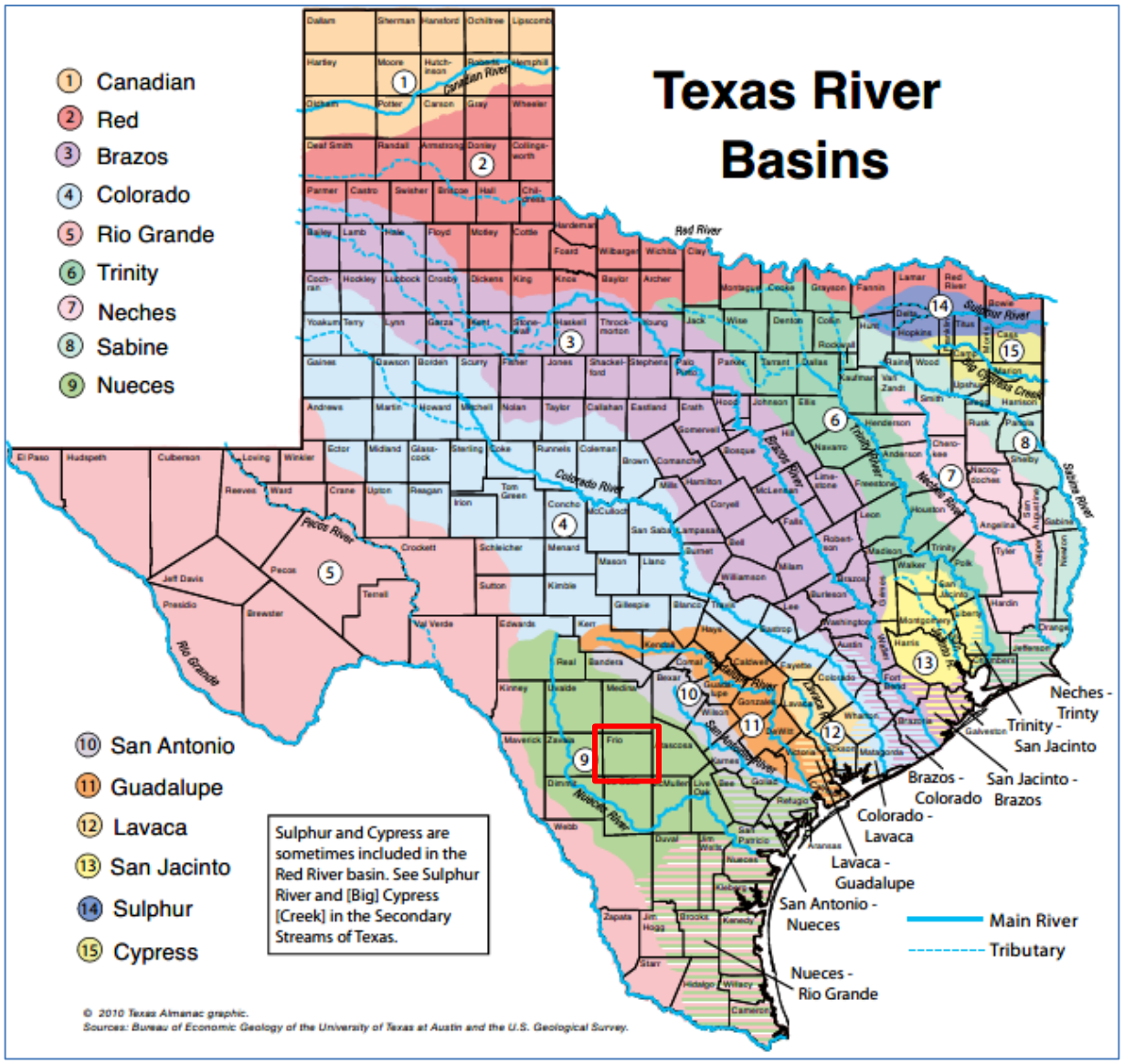


Figure 9-1. Texas River Basins

Note: Frio County is located within the red square.

The floodplain boundary extents for the creeks, streams, rivers, and lakes have not been mapped by FEMA in most areas of the county. There are no published FIRMs for Frio County. There are also no

updated FEMA Map Modernization Program providing Digital Flood Insurance Rate Maps, or DFIRMs. Flood boundaries and depth were generated by Hazus 4.0 Hydrology and Hydraulics Module. Figure 9-2 identifies areas within Frio County that are in the 100-year flood plain based on the county depth grid generated by Hazus at a 30-meter resolution. There is no indication a 500-year flood is likely in Frio County and therefore was not mapped. Figure 9-3 and Figure 9-4 identify areas within the Cities of Dilley and Pearsall respectively.

Frio County

The main flooding sources in Frio County include the following creeks and their tributaries: Hondo Creek, Elm Creek, and Live Oak Creek (west and south of Pearsall), Leona River (northwest of Dilley), Black Creek and San Miguel Creek (east of Pearsall and Dilley), and Cibolo Creek (west of Dilley).

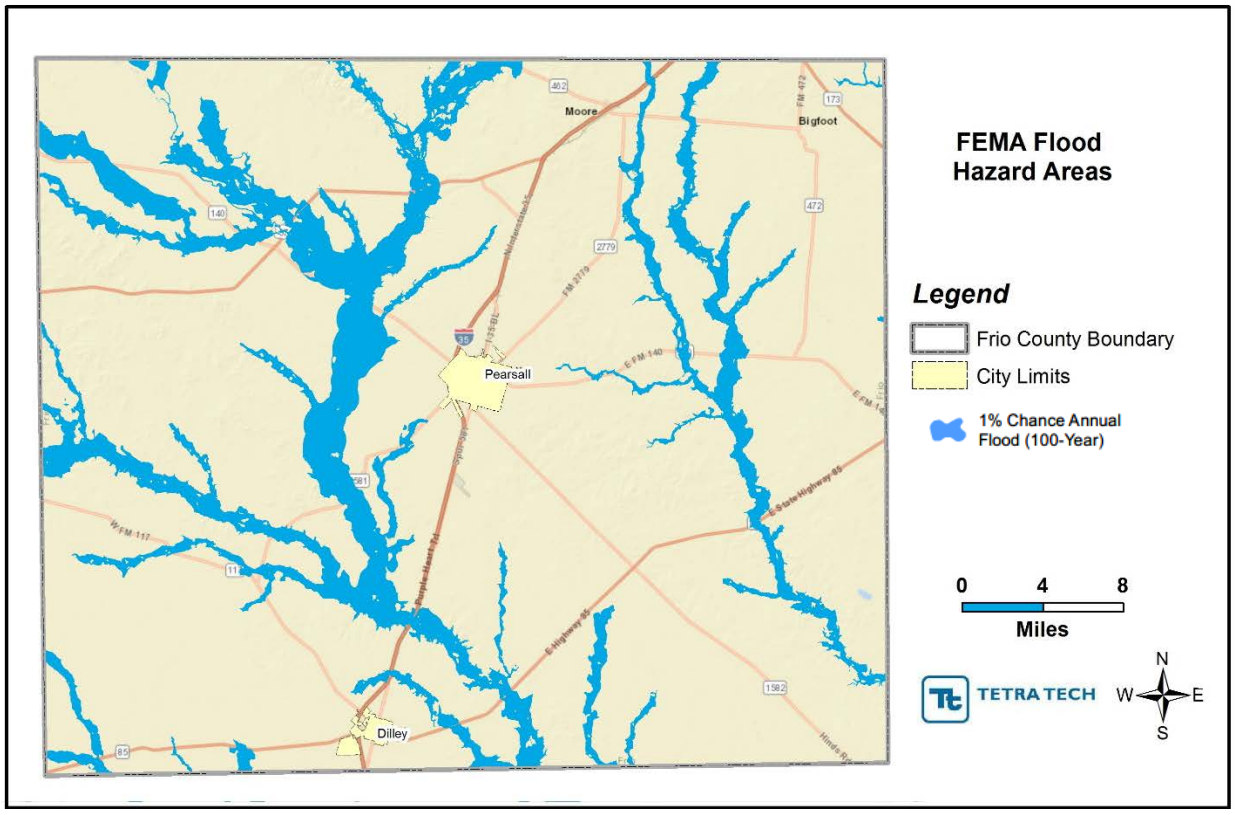


Figure 9-2. Frio County 100-Year Flood Area

City of Dilley

The City of Dilley is in the south-central portion of the County. This is no 100-year flood event likely to occur from swelling rivers, tributaries, or creeks in the City of Dilley.

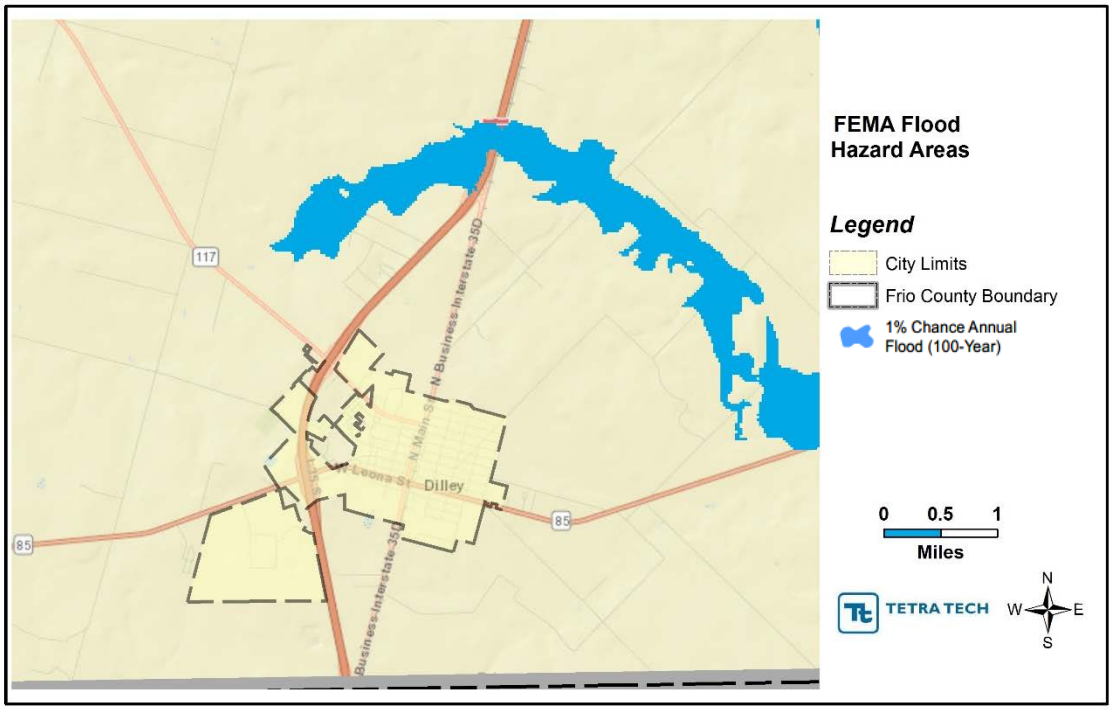


Figure 9-3. City of Dilley 100-Year Flood Area

City of Pearsall

The City of Pearsall is in the middle portion of the county. There is no 100-year flood event likely to occur from swelling rivers, tributaries, or creeks in the City of Pearsall.

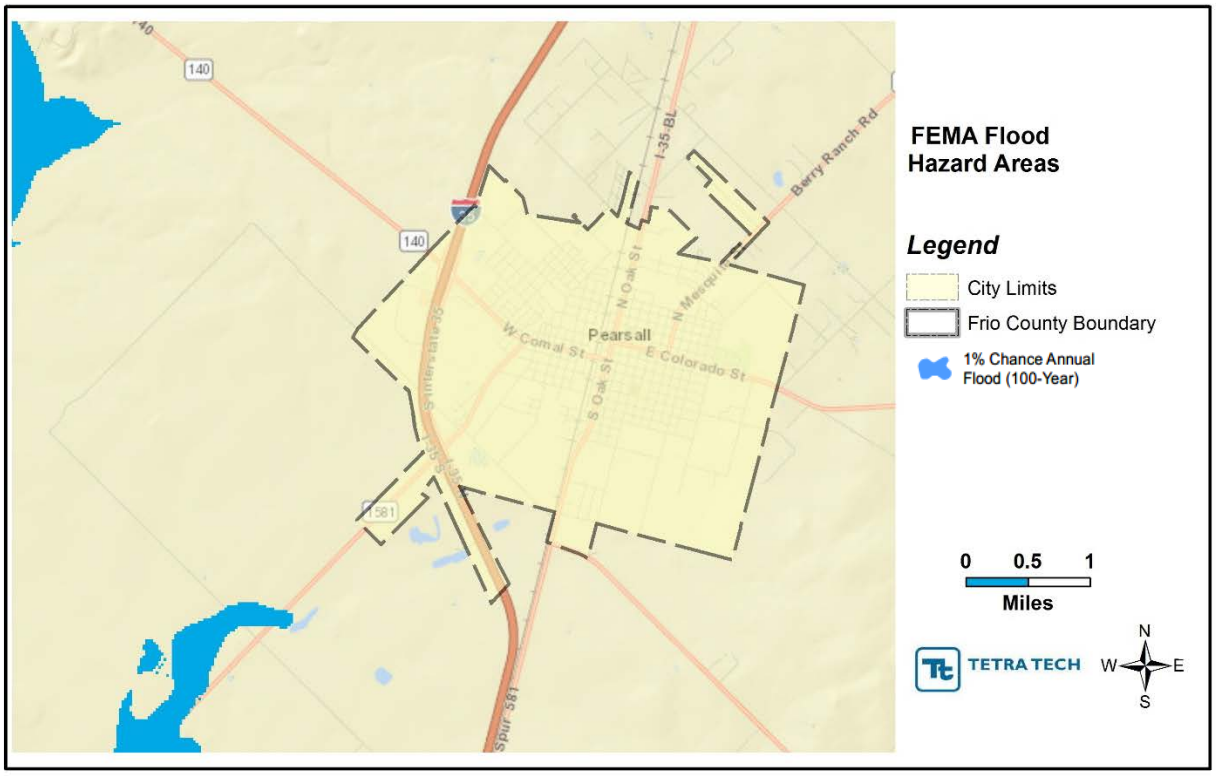


Figure 9-4. City of Pearsall 100-Year Flood Area

9.1.2 Extent

The extent of floods relates directly to the accumulation of water from precipitation, or the failure of man-made structures, such as dams or levees. Floods caused by precipitation are further classified as coming from: rain in a general storm system, rain in a localized intense thunderstorm, melting snow and ice, and hurricanes and tropical storms. Floods may also be caused by structural or hydrologic failures of dams or levees. A hydrologic failure occurs when the volume of water behind the dam or levee exceeds the structure ‘s capacity resulting in overtopping. Structural failure arises when the physical stability of the dam or levee is compromised due to age, poor construction and maintenance, seismic activity, rodent tunneling, or myriad other causes. For more information on floods resulting from dam refer to Chapter 6 of this plan.

Parts of Texas are in the “Flash Flood Alley.” This is the area along the Balcones Escarpment (from Austin south to San Antonio, then west to Del Rio) and is one of the nation’s three most flash flood-prone regions. Frio County lies just south of the “Flash Flood Alley.”

Flash floods can occur within a few minutes or after hours of excessive rainfall. Flash floods can roll boulders, tear out trees, destroy buildings and bridges, and carve out new channels. Rapidly rising water can reach heights of thirty feet or more. Flash flood-producing rains can also trigger catastrophic mudslides. Often there is no warning that flash floods are coming. 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.

Estimating the intensity and magnitude of a flood event is dependent upon the flood zone and location of the flood hazard area. FEMA categorizes areas on the terrain according to how the area will convey the discharge of flood water. The extent of flood damage can be expected to be greater in the areas where a

base flood can occur. A base flood is defined by FEMA as a flood having a 1-percent-annual-chance of being equaled or exceeded in any given year. This is the regulatory standard also referred to as the "100-year flood." The base flood is the national standard used by the NFIP and all federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development. Flood zones are the categories that are mapped on FIRMs. Table 9-1 provides a description of FEMA flood zones and the flood impact in terms of severity or potential harm.

The worst-case scenario for the Frio County planning area is to see up to a 1-percent-annual-chance flood with 3 to 7 feet of water.

Table 9-1. FEMA Flood Zones

Intensity	Zone	Description
High	Zone A	Zone A is interchangeably referred to as the 100-year flood, the 1-percent-annual-chance flood, or the Special Flood Hazard Area (SFHA), or more commonly, the base flood. Zone A is the area where the base flood will occur, and there constitutes a threat to the planning areas. Areas with a 1-percent-annual-chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.
Moderate to Low	Zone X	Area with a 0.2-percent-annual-chance (500-Year) floodplain — The area inundated by the flood that has a 0.2-percent chance of being equaled or exceeded in a given year.

Source: FEMA 2017
Note:
FEMA Federal Emergency Management Agency

Structures built in the Special Flood Hazard Area (SFHA) are subject to damage by rising waters and floating debris. Moving flood water exerts pressure on everything in its path and causes erosion of soil and solid objects. Utility systems such as heating, ventilation, air conditioning, fuel, electrical systems, sewage maintenance systems and water systems, if not elevated above the base flood elevation, may also be damaged.

The possible extent of flooding is also monitored by USGS river and lake gauges. There is one USGS gauge in Frio County. Figure 9-5 shows gauge readings, USGS 08205500, for Frio River in Derby, Texas (located between the Cities of Pearsall and Dilley along Interstate 35). The peak gauge reading was in 2015 (USGS 2018).

Source: USGS 2018

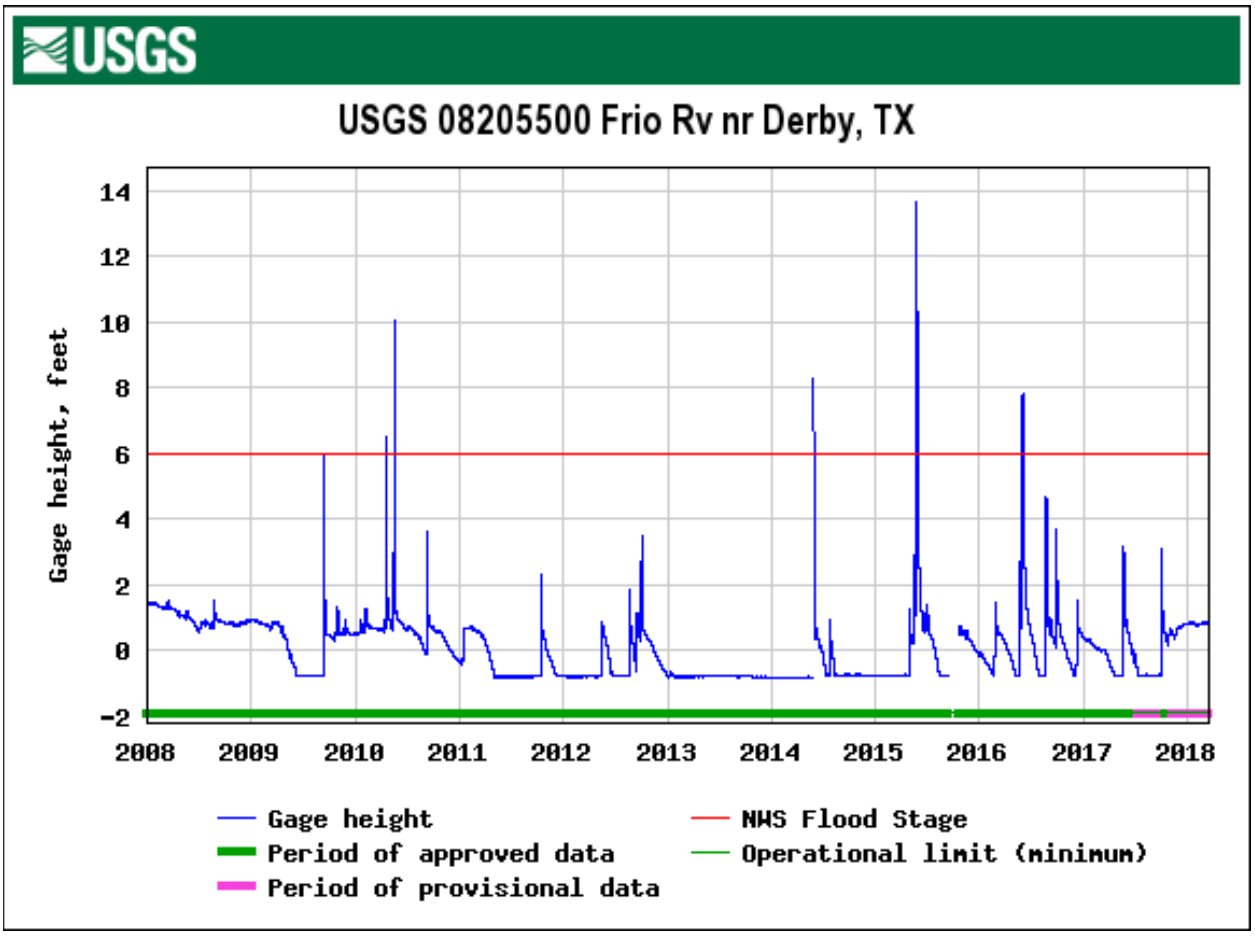


Figure 9-5. USGS Frio River Gage Height, 2008-2018

The NWS has various flash flood products that are issued to the public to provide information regarding the possible extent of upcoming and current flash flood threats (see Table 9-2).

Table 9-2. NWS Flash Flood Products

Product	What It Means	Recommended Action
Hazardous Weather Outlook	Will there be any threat of flash flooding in the next several days?	If there is a threat of flash flooding, check back later for updated forecasts and possible watches and warnings.
Flash Flood Watch	There is a threat of flash flooding within the next 48 hours, either as a result of heavy rain or the threat of a dam break.	Monitor weather conditions closely, especially if you live in an area prone to flash flooding.
Flash Flood Warning	There is an immediate threat for flash flooding in the warned area, especially in low-lying and poor drainage areas.	If you live in an area susceptible to flash flooding, be prepared to evacuate and head to higher ground. Be very cautious when driving in the warned area, especially at night or while it is still raining. You may not be able to see a flooded road until it is too late.
Areal Flood Warning	The threat of flash flooding is over, but there is still significant standing water in the affected area.	Areal flood warning will typically list locations and roads impacted by the flooding. Try to avoid these locations until the water has receded.

Source: NWS 2017

9.1.3 Past Events

The NOAA NCEI storm events database includes 72 flood and flash flood events that occurred in Frio County between 1996 and 2017, as listed in Table 9-3. Specific events described for Frio County and the

Cities of Dilley and Pearsall are counted and described below. Large flood storms may have effected additional jurisdictions. No flood-related deaths were reported during this time in the planning area.

Table 9-3. Historical Flood Events in Frio County

Location	Date	Type of Event	Estimated Damage Cost		Injuries
			Property	Crops	
Frio Town	5/20/2017	Flash Flood	$0	$0	0
Frio Town	8/21/2016	Flash Flood	$0	$0	0
Pearsall	6/2/2016	Flash Flood	$0	$0	0
Moore	5/23-24/2015	Flood	$100,000	$0	0
Otley	5/10/2012	Flash Flood	$0	$0	0
Otley	4/17/2010	Flash Flood	$0	$0	0
Pearsall	4/16/2010	Flash Flood	$0	$0	0
Moore And Pearsall	9/11/2009	Flash Flood	$0	$0	0
Big Spring	10/5/2008	Flash Flood	$0	$0	0
Derby	7/30/2007	Flood	$0	$0	0
Frio Town	7/29/2007	Flash Flood	$0	$0	0
Big Foot	7/26/2007	Flash Flood	$0	$0	0
Pearsall	7/25/2007	Flash Flood	$0	$0	0
Moore And Pearsall	7/24/2007	Flash Flood	$0	$0	0
Derby	7/22/2007	Flood	$0	$0	0
Divot	7/20/2007	Flash Flood	$0	$0	0
Pearsall	7/7/2007	Flash Flood	$0	$0	0
Dilley	7/6/2007	Flash Flood	$0	$0	0
Dilley	7/4/2007	Flash Flood	$0	$0	0
Frio Town	7/3/2007	Flash Flood	$0	$0	0
Moore	6/28/2007	Flash Flood	$0	$0	0
Pearsall	5/25/2007	Flash Flood	$0	$0	0
Frio Town	5/2/2007	Flash Flood	$0	$0	0
Pearsall	3/13/2007	Flash Flood	$0	$0	0
Moore	7/4/2006	Flash Flood	$0	$0	0
Moore	9/10/2005	Flash Flood	$0	$0	0
North Portion	5/15/2005	Flash Flood	$0	$0	0
East Portion	11/22/2004	Flash Flood	$0	$0	0
Frio (Zone)	11/18/2004	Flood	$0	$0	0
East Portion	11/16/2004	Flash Flood	$0	$0	0
Countywide	9/1/2004	Flash Flood	$0	$0	0
Frio (Zone)	8/23/2004	Flood	$0	$0	0
Countywide	8/22/2004	Flash Flood	$0	$0	0
Frio (Zone)	7/1/2004	Flood	$0	$0	0
Southeast Portion	6/30/2004	Flash Flood	$0	$0	0
Countywide	6/29/2004	Flash Flood	$0	$0	0
East Portion	6/25/2004	Flash Flood	$0	$0	0

Location	Date	Type of Event	Estimated Damage Cost		Injuries
			Property	Crops	
East Portion	6/23/2004	Flash Flood	$0	$0	0
Countywide	6/22/2004	Flash Flood	$0	$0	0
South Central Portion	6/9/2004	Flash Flood	$0	$0	0
Northwest Portion	6/8/2004	Flash Flood	$0	$0	0
North Portion	4/10/2004	Flash Flood	$0	$0	0
West Portion	4/4/2004	Flash Flood	$0	$0	0
West Portion	3/29/2004	Flash Flood	$5,000	$0	0
Countywide	10/12/2003	Flash Flood	$0	$0	0
Countywide	7/15/2003	Flash Flood	$5,000	$0	0
Countywide	7/5/2003	Flash Flood	$5,000	$0	0
Frio (Zone)	10/25/2002	Flood	$0	$0	0
Countywide	10/24/2002	Flash Flood	$5,000	$3,000	0
Frio Town	10/9/2002	Flash Flood	$2,000	$0	0
South Portion	9/15/2002	Flash Flood	$0	$0	0
Frio (Zone)	9/9/2002	Flood	$0	$0	0
Countywide	9/8/2002	Flash Flood	$700,000	$100,000	15
Countywide	7/16/2002	Flash Flood	$0	$0	0
Countywide	7/15/2002	Flash Flood	$0	$0	0
Countywide	7/3/2002	Flash Flood	$0	$0	0
Countywide	7/3/2002	Flash Flood	$0	$0	0
Northwest Portion	7/2/2002	Flash Flood	$0	$0	0
Southwest Portion	7/1/2002	Flash Flood	$0	$0	0
North Portion	4/7/2002	Flash Flood	$1,000	$5,000	0
Frio (Zone)	11/17/2001	Flood	$0	$0	0
North Portion	10/23/2000	Flash Flood	$2,000	$2,000	0
Countywide	8/24/1999	Flash Flood	$3,000	$0	0
Pearsall	6/24/1999	Flash Flood	$3,000	$0	0
Southwest Portion	8/6/1998	Flash Flood	$1,000	$0	0
Northeast Portion	6/29/1998	Flash Flood	$1,000	$0	0
Countywide	2/21/1998	Flash Flood	$3,000	$0	0
Dilley	1/6/1998	Flash Flood	$3,000	$0	0
Countywide	6/21/1997	Flash Flood	$3,000	$0	0
Countywide	5/27/1997	Flash Flood	$5,000	$0	0
Frio (Zone)	10/29/1996	Flood	$10,000	$1,000,000	0
Countywide	6/1/1996	Flash Flood	$0	$0	0
Total			$ $857,000	$1,020,000	15

The most notable past events from the NCEI storm events database (and confirmed by local data) in Frio County are described below:

- **May 24-25, 2015 – FEMA-DR-4223-TX**—The severe storms, tornadoes, straight-line winds and flooding affected a sizable portion of Texas over the month of May with several events including the events over Memorial Day weekend. Historical flash and river flooding occurred across portions of south central Texas. Widespread 6 to 8 inches of rainfall, with local 9 to 11 inches, and a maximum of 12 to 13 inches of rain fell in the head water of the Blanco River Basin (north of Frio County) over a 4 to 6 hour timeframe. Specifically, rainfall totals were 1 to 4 inches in Frio County on May 25. In Frio County, water was recorded as high as 3 to 4 feet in homes and businesses of the unincorporated area of Moore. The disaster designated over half the counties in Texas and the estimated FEMA cost was $213 million. Frio County was designated for FEMA's Individual and Public Assistance Programs. According to OEM, the County received $8,824 from FEMA's Public Assistance Program. The County adopted its floodplain ordinance exactly one year later (May 23, 2016) to conform to 44 CFR 60.3(a).

- **September 2002**—A large part of the highway from the City of Pearsall to the Atascosa County line received between 8 and 12 inches of rain. High water trapped people in their homes in the City of Pearsall and several cars were flooded out. Most schools in the City of Pearsall area were closed on Monday from blocked roads. Widespread damage was reported to FM140 and bridges along the highway as well as to roads in the City of Pearsall. Approximately $700,000 in property damage and $100,000 in crop damage, with 15 injuries were reported.

Figure 9-6. Debris from Moore Flooding, May 2015

Top Daily Rain Events

Table 9-4 lists the top 24-hour rain events from the Pearsall Climate Station, from 1902 to 2012 (most recent date that is available). Flash flooding can be caused by intense rainfall over a brief period.

Table 9-4. Highest 24-Hour Rain Events at Pearsall Climate Station by Month, 1902-2012

Month	Year	Amount (Inches)	Month	Amount (Inches)	Year
January	1992	2.57	July	5.37	1990
February	1991	2.71	August	7.84	1946
March	1922	3.66	September	6.56	1919
April	1946	4.27	October	6.76	1981
May	1950	4.20	November	3.1	1913

June	6.24	1961	December	3.50	1918

Source: WRCC 2018

USDA Risk Management Agency

According to USDA Risk Management Agency, payments for insured crop losses in Frio County as a result of excessive moisture conditions between 2011 and 2017 caused $1,609,564 in crop losses that affected approximately 4,480 acres.

9.1.4 Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger.

9.2 VULNERABILITY AND IMPACTS

Many of the areas exposed to flooding may not experience serious flooding or flood damage. This section describes vulnerabilities in terms of population, property, and critical facilities and infrastructure. The exposure and vulnerability analysis was performed at the census-block level. This methodology is likely to overestimate impacts from the modeled 1-percent-annual-chance flood event as it is assumed that both structures and the population are evenly spread throughout census blocks.

Hazus was used to assess the risk and vulnerability to flooding in the planning area. The model used census data at the block level and FEMA floodplain data, which has a level of accuracy acceptable for planning purposes. Where possible, the Hazus default data were enhanced using GIS data from local, state, and federal sources.

9.2.1 Exposure

Population

A geographic analysis of demographics (countywide) using the default Hazus model inventory identified populations vulnerable to the flood hazard as follows. These numbers are calculated assuming that the population/households are evenly distributed over the census blocks.

The following impacts on persons and households in Frio County were estimated for the 100-year flood event through the Hazus analysis:

During a 100-year flood event

- Displaced population = 47
- Persons requiring short-term shelter = 6

Population counts of those living in the floodplain within the planning area were generated by estimating the percent of residential buildings in each jurisdiction within the 1-percent-annual-chance flood hazard areas and multiplying this by the total population within the planning area. This approach yielded an estimated population in the planning area of 780 living within the 1-percent-annual-chance flood area (4.44% of the total planning area population).

Property

Table 9-5 summarizes the estimated value of exposed buildings in the planning area in the 1-percent-annual-chance flood area. The Hazus model inventory data estimated $5.6 million worth of building and contents exposure to the 1-percent-annual-chance flood area, representing 5.98% of the total replacement value of the planning area. No specific structure locations or information was provided by the County and a general assessment of the County was conducted. No specific locations are available.

Table 9-5. Exposure Within the 1-Percent-Annual-Chance Flood

	Value Exposed			% of Total Replacement Value	Population Exposed[a]	% of 2010 Total Population
	Structure	Contents	Total			
Frio County	$2.97M	$2.62M	$5.6M	5.98%	47	0.003%

Source: Hazus 2018
Note:

[a] Exposure numbers based on 2010 Census Block data multiplied by percentage of 100-year floodplain in each census block.

M Million

Critical Facilities and Infrastructure

Based on the inventory data on the depth grid for Frio County, Hazus did not identify any potential damage of the critical facilities located within the flood zone. There is no loss of use for any of the critical facilities during a flood event.

Impacts

Many of the areas exposed to flooding may not experience serious flooding or flood damage. This section describes impacts in terms of population, property, infrastructure, and agriculture. The analysis was performed at the census-block level. This methodology is likely to overestimate impacts from the modeled 1-percent-annual-chance flood event as it is assumed that both structures and the population are evenly spread throughout census blocks.

Population

Hazus estimates 47 people will be displaced from a 100-year flood event. Displacement includes households evacuated from within or very near to the inundated area. Of these, six people (out of the estimated 2010 population of 17,584), will seek temporary shelter.

Floods and their aftermath present numerous threats to public health and safety:

- **Unsafe food—**Floodwaters contain disease-causing bacteria, dirt, oil, human and animal waste, and farm and industrial chemicals. Their contact with food items, including food crops in agricultural lands, can make that food unsafe to eat. Refrigerated and frozen foods are affected during power outages caused by flooding. Foods in cardboard, plastic bags, jars, bottles, and paper packaging may be unhygienic with mold contamination.
- **Contaminated drinking and washing water and poor sanitation—**Flooding impairs clean water sources with pollutants. The pollutants also infiltrate into the groundwater. Flooded wastewater treatment plants can be overloaded, resulting in backflows of raw sewage. Private wells can be contaminated by floodwaters. Private sewage disposal systems can become a cause of disease if they overflow.
- **Mosquitoes and animals—**Floods provide new breeding grounds for mosquitoes in wet areas and stagnant pools. The public should dispose of dead animals that can carry viruses and diseases only in accordance with guidelines issued by local animal control authorities. Leptospirosis—a bacterial disease associated predominantly with rats—often accompanies floods in developing countries, although the risk is low in industrialized regions unless cuts or wounds have direct contact with disease-contaminated floodwaters or animals.
- **Mold and mildew—**Excessive exposure to mold and mildew can cause flood victims—especially those with allergies and asthma—to contract upper respiratory diseases, triggering cold-like symptoms. Molds grow in as short a period as 24 to 48 hours in wet and damp areas of buildings and homes that have not been cleaned after flooding, such as water-infiltrated walls, floors, carpets, toilets and bathrooms. Very small mold spores can be easily inhaled by human bodies and, in large enough quantities, cause allergic reactions, asthma episodes, and other respiratory problems. Infants, children, elderly people and pregnant women are considered most vulnerable to mold-induced health problems.

- **Carbon monoxide poisoning—**In the event of power outages following floods, some people use alternative fuels for heating or cooking in enclosed or partly enclosed spaces, such as small gasoline engines, stoves, generators, lanterns, gas ranges, charcoal or wood. Built-up carbon monoxide from these sources can poison people and animals.
- **Hazards when reentering and cleaning flooded homes and buildings—**Flooded buildings can pose significant health hazards to people entering them. Electrical power systems can become hazardous. Gas leaks can trigger fire and explosion. Flood debris—such as broken bottles, wood, stones and walls—may cause injuries to those cleaning damaged buildings. Containers of hazardous chemicals may be buried under flood debris. Hazardous dust and mold can circulate through a building and be inhaled by those engaged in cleanup and restoration.
- **Mental stress and fatigue—**People who live through a devastating flood can experience long-term psychological impact. The expense and effort required to repair flood-damaged homes places severe financial and psychological burdens on the people affected. Post-flood recovery can cause anxiety, anger, depression, lethargy, hyperactivity, and sleeplessness. There is also a long-term concern among the affected that their homes can be flooded again in the future.

Current loss estimation models such as Hazus are not equipped to measure public health impacts such as these. The best preparation for these effects includes awareness that they can occur, education of the public on prevention, and planning to deal with them during responses to flood events.

Property

Hazus calculates losses to structures from flooding by looking at depth of flooding and type of structure. Impacted structures are those with finished floor elevations below the flood event water surface elevation. These structures are the most likely to receive significant damage in a flood event. Using historical flood insurance claim data, Hazus estimates the percentage of damage to structures and their contents by applying established damage functions to an inventory. For this analysis, local data on facilities were used instead of the default inventory data provided with Hazus.

The impacts to the building structure from a flood event is estimated to be $2.97 million, while the content is estimated to be $2.62 million for Frio County. The total property loss is estimated to be $5.6 million, with approximately $4 million from residences (almost 70% of associated building damage).

Critical Facilities and Infrastructure

Hazus was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves, it estimates the percent of damage to the building and contents of critical facilities. This helps to gauge how long the planning area could have limited usage of facilities deemed critical to flood response and recovery. The Hazus critical facility results for 1-percent-annual-chance flood event is as follows:

- **1-percent-annual-chance flood event**— No critical facilities are estimated to be damaged or impacted.

Agriculture

According to the 6-year period from the USDA's Risk Management Agency, the amount of claims paid for crop damage as a result of excessive moisture in Frio County was $1,609,564. According to the 2016 Texas Insurance Profile from the USDA's Risk Management Agency, 88% of the insurable crops in Texas are insured with USDA crop insurance. To estimate losses to insurable crops that are not insured, the 88% crop insurance coverage was factored in to provide an adjusted estimate of losses. According to this calculation, estimated annualized losses are over $5,095 for the County (see Table 9-6).

Considering the value of crops from the 2012 Census of Agriculture as the baseline crop exposure, the estimated annual losses was determined to be low compared to the value of the insurable crops.

Table 9-6. Estimated Insurable Annual Crops Lost Resulting from Excessive Moisture

6-Year Excessive Moisture Insurance Paid	Adjusted 6-Year Losses (considering 88% insured)	Estimated Annualized Losses	2012 Value of Crops
$1,609,564	$1,829,050	$219,486	$109,089,000

Source: USDA 2012; USDA RMA 2016; USDA 2016

Community Perception of Vulnerability

The City of Dilley ranked flood as a "low" hazard and the jurisdictions of Frio County and City of Pearsall ranked flood as a "medium" hazard.

See the first page of this chapter for a summary of hazard rankings for Frio County and the planning partners in this plan. Chapter 15 gives a detailed description of these rankings and Chapter 16.2 addresses mitigation actions for this hazard vulnerability.

National Flood Insurance Program Participation

Table 9-7 provides details on NFIP participation for the communities in the planning area as well as the number of policies in force, amount of insurance in force, number of closed losses, and total payments for each jurisdiction, where applicable. The claims information is for the period from January 1, 1978, to September 30, 2017.

Participants in the NFIP must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

Frio County and the Cities of Dilley and Pearsall are all currently in good standing with the provisions of the NFIP. Compliance is monitored by FEMA regional staff and by the TWDB under a contract with FEMA. Maintaining compliance under the NFIP is a vital component of flood risk reduction. All planning partners have identified initiatives to maintain and continue their compliance and NFIP good standing.

Table 9-7. National Flood Insurance Program Statistics

Jurisdiction	NFIP Participation (Yes/No)	Current Effective Map Date	Policies in Force	Insurance in Force	Value of Claims Paid ($)
Frio County	Yes	N/A	4	$180,000	$2,069
City of Dilley	Yes	02/01/1988	1	$95,600	$399
City of Pearsall	Yes	05/19/1981	11	$2,023,200	$7,203

Source: FEMA NFIP CSB 2017; NFIP 2017
Notes:
N/A Not applicable
NFIP National Flood Insurance Program

Repetitive Loss

A **repetitive loss property** is defined by FEMA as an NFIP-insured property that has experienced the following since 1978, regardless of any changes in ownership:

- Two paid losses in excess of $1,000 within any rolling 10-year period

A **severe repetitive loss property** as defined as a "single-family property" (consisting of one to four residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which:

- Four or more separate claim payments have been paid under flood insurance coverage with the amount of each claims payments exceeding $5,000 and with cumulative amounts of such claims payments exceeding $20,000; or
- At least two separate claims payments have been made with the cumulative amount of such claims exceeding the fair market value of the property on the day before each loss.

There are no repetitive nor severe repetitive loss properties that meet the above definitions, within unincorporated Frio County nor any of the participating jurisdictions.

9.3 PROBABILITY OF FUTURE EVENTS

With the history of flooding in the planning area, it is likely that flooding of various levels will continue to occur. According to NCEI there were 72 events over the 22-year timeframe of 1996 through 2017 in the planning area. This translates to 100% probability of some type of flooding event (riverine or flash) occurring annually. Therefore, the probability rating is "high."

The Steering Committee members assessed the future probability on flood based on their jurisdictional knowledge. The likelihood of a flood event occurring is high and the County agreed with this. The City of Dilley thought that it is an unlikely probability for flooding to affect them. The City of Pearsall believed that flooding could affect their city in the next 100 years.

9.4 CLIMATE CHANGE IMPACTS

Use of historical hydrologic data has long been the standard practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management, and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness, and emergency response.

High frequency flood events (for example, 10-year floods) in particular will likely increase with a changing climate. Scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, floodways, and bypass channels, as well as the design of local sewers and storm drains.

9.5 ISSUES

The major issues for flooding are the following:

- Flash flooding that occurs with little or no warning will continue to impact the planning area.
- The duration and intensity of storms contributing to flooding issues may increase due to climate change.
- Flooding may be exacerbated by other hazards, such as wildfires.
- The promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.
- More information is needed on flood risk to support the concept of risk-based analysis of capital projects.
- Ongoing flood hazard mitigation will require funding from multiple sources.
- There needs to be a coordinated hazard mitigation effort between jurisdictions affected by flood hazards in the planning area.
- Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods.
- Existing floodplain-compatible uses such as agricultural and open space need to be maintained. There is constant pressure to convert these existing uses to more intense uses within the planning area during times of moderate growth.
- The economy affects a jurisdiction's ability to manage its floodplains. Budget cuts and personnel losses can strain resources needed to support floodplain management.

Chapter 10.
HURRICANE / TROPICAL STORM

HURRICANE / TROPICAL STORM HAZARD	
Jurisdiction	Hurricane / Tropical Storm
Frio County	24
City of Dilley	12
City of Pearsall	24
See Chapter 15 for more information on hazard ranking.	

DEFINITIONS

Hurricane — A tropical cyclone with maximum sustained surface winds (using the U.S. 1-minute average) of 64 knots (kt) (74 miles per hour [mph]) or more.

Tropical Storm — A tropical cyclone with maximum sustained surface wind speed (using the U.S. 1-minute average) ranging from 34 kt (39 mph) to 63 kt (73 mph).

Tropical Depression — A tropical cyclone with maximum sustained surface wind speed (using the U.S. 1-minute average) ranging from 4 kt (5 mph) to 63 kt (73 mph).

10.1 HAZARD PROFILE

According to NOAA, tropical cyclones are classified into three main categories (by intensity): hurricanes, tropical storms, and tropical depressions.

Hurricanes are any closed circulation developed around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere and whose diameter averages 10 to 30 miles across. A tropical cyclone refers to any such circulation that develops over tropical waters. The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere.

Hurricanes are areas of disturbed weather in the tropics with closed isobars and strong and very pronounced rotary circulation. An area of clear weather called an “eye” is present in the center of the circulation. To qualify as a hurricane, the wind speed is 74 miles per hour (mph) or more. Hurricanes are classified into categories based on wind speed and the potential damage they cause. Thunderstorm rain resulting in urban flooding, battering wave action, intense sea level rise, localized coastal erosion, and significant winds are associated with hurricanes.

A tropical storm is a tropical cyclone in which the maximum sustained surface wind speeds range from 39 to 73 mph. At this time the tropical cyclone is assigned a name. During this time, the storm itself becomes more organized and begins to become more circular in shape, resembling a hurricane.

10.1.1 Location

The City of Pearsall, Texas is over 150 miles inland from the Gulf of Mexico. A recorded event can occur anywhere in the planning area, moving inland from the Gulf of Mexico, but the hurricane events usually become tropical depressions or tropical storms by the time they reach the Frio County planning area.

10.1.2 Extent

Hurricanes and tropical storms are classified according to the Saffir-Simpson Hurricane Wind Scale from Category 1 to Category 5 by sustained wind intensity. Table 10-1 lists a description of each category.

A worst-case scenario for the Frio County planning area is a Category 4 hurricane with sustained winds of 130 mph or higher for this inland location.

Table 10-1. Saffir-Simpson Hurricane Wind Scale

Category	Sustained Winds (miles per hour)	Category
1	74-95	*Very dangerous winds will produce some damage:* Well-constructed frame homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110	*Extremely dangerous winds will cause extensive damage:* Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (Major)	111-129	*Devastating damage will occur:* Well-built frame homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (Major)	130-156	*Catastrophic damage will occur:* Well-built frame homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (Major)	157 or higher	*Catastrophic damage will occur:* A high percentage of frame homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: NOAA, National Hurricane Center 2017
Note: Other non-hurricane classifications are tropical storms (39-73 miles per hour) and tropical depressions (5-38 miles per hour)

10.1.3 Past Events

Due to Frio County and the Cities of Dilley and Pearsall's interior location (approximately 150 miles inland), it is not exposed directly to hurricanes. The hurricanes usually fade and downgrade to tropical storms or tropical depressions as they move away from the coast. According to NOAA, Frio County and the Cities of Dilley and Pearsall have not been directly struck by hurricanes between 1851 and 2017. Five tropical depression and one tropical storms have crossed paths over Frio County. Figure 10-1 illustrates historical tropical storm/depression paths affecting the planning area.

According to NOAA Historical Hurricane Tracks, past events and FEMA declarations in Frio County include:

September 21-25, 2005 – FEMA-DR-1606-TX and FEMA-EM-3261-DR: Hurricane Rita made landfall in southwestern Louisiana between Sabine Pass, Texas and Johnson's Bayou, Louisiana early Saturday morning, September 24, 2005. Hurricane Rita was the second major hurricane to strike the Louisiana coast that season (Hurricane Katrina was the first) and the third most intense hurricane ever recorded in the Atlantic Basin. Another significant hallmark of this event was the mass evacuations prompted by this storm in Texas and Louisiana. It is estimated that up to 2 million residents (most from the Houston/Galveston metro area) evacuated to avoid the effects of the storm. While Hurricane Rita peaked as a Category 5 hurricane out in the Gulf, the hurricane made landfall over Cameron Parrish as a Category 3 hurricane. This hurricane did not pass over Frio County, however Frio County was included in the FEMA declaration.

July 17, 2003 – FEMA-DR-1479-TX: Hurricane Claudette made landfall along the middle Texas coast near Port O'Connor on Tuesday, July 15, 2003 as a Category 1 Hurricane. Hurricane Claudette continued to move inland across Calhoun, southern Victoria and Goliad Counties through the afternoon and early evening hours, and weakened back to a tropical storm. Hurricane Claudette that evening moved over to just south of San Antonio. Although the hurricane did not have a path through Frio County, the County was included in DR-1479.

September 5-8, 2002 – FEMA-DR-1434-TX: Tropical Depression Fay made landfall on September 5, 2002. The storm crossed over Frio County as a Tropical Depression on September 8, 2002, at 10 to 15 mph.

August 21-23, 1998 – FEMA-DR-1239-TX: Tropical Depression Charley made landfall on August 21, 1998. The storm crossed over Frio County as a Tropical Depression on August 23, 1998, at 20 mph.

September 4-7, 1980: Tropical Depression Danielle made landfall as a Tropical Depression on September 4, 1980. The storm crossed over Frio County as a Tropical Depression on September 7, 1980, at 20 mph.

July 30-31, 1978: Tropical Depression Amelia made landfall on July 30, 1978. The storm was a tropical depression when it crossed Frio County on July 31, 1978, at 30 mph.

August 5-8, 1964: Tropical Depression Abby made landfall on August 5, 1964. The storm dissipated over Frio County on August 8, 1964, when it hit Frio County at 25 mph.

June 25, 1851: An unnamed hurricane made landfall as a Category 1 on June 25, 1851. The hurricane became a tropical storm and hit Frio County on June 26, 1851, at approximately 50 mph.

Historical events indicate that a hurricane will affect the Frio County planning area as tropical storms, hail, lightning, or related weather events (high winds, tornado). These hazards are discussed in more detail in Chapter 11.

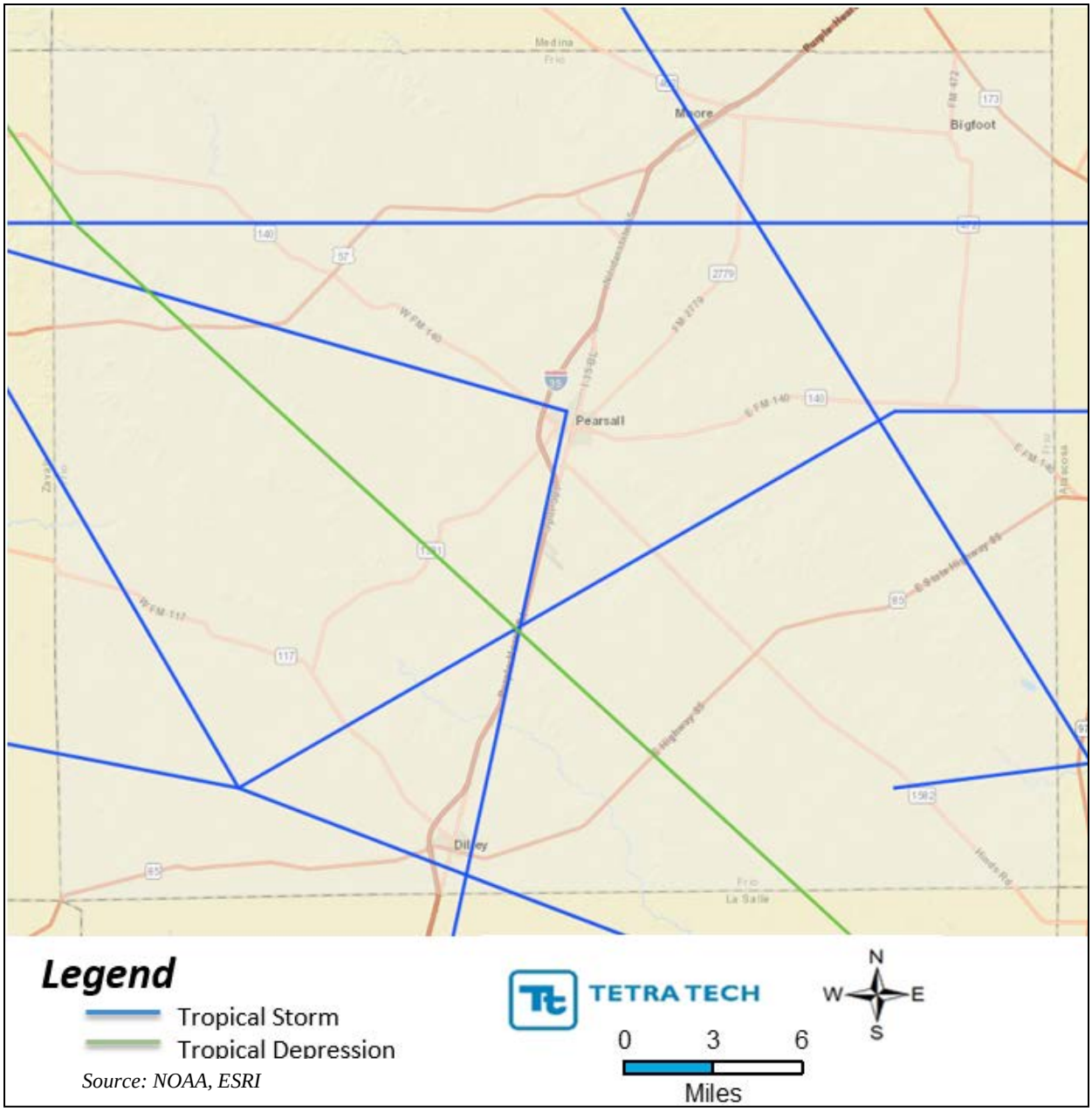


Figure 10-1. Historical Tropical Storm/Depression Paths in Frio County, 1850-2017

10.1.4 Warning Time

Meteorologists can often predict the likelihood and path of a hurricane or tropical storm. Meteorologists can give several days of warning before a storm. However, meteorologists cannot predict the exact time of onset, location, or severity of the storm. At times, warning for the onset of severe weather may be limited. People generally rely on weather forecasts issued for the City of Pearsall.

10.2 VULNERABILITY AND IMPACT

While hurricanes pose the greatest threat to life and property, tropical storms and depressions also can be devastating. Floods from heavy rains and severe weather, such as tornadoes, can cause extensive damage

and loss of life. Frio County and the Cities of Dilley and Pearsall do not have a high impact risk from hurricanes. The largest impact from a hurricane would be from high winds.

Historic events indicate that secondary impacts from a hurricane will affect Frio County and the Cities of Dilley and Pearsall as tropical depressions, tropical storms, hail, lightning, or related weather events (high winds, tornado). Major hurricanes in other parts of Texas can have societal impacts on Frio County as well. Frio County was not directly impacted by the devastation of Hurricane Harvey that hit Texas on August 25, 2017, and caused over $180 billion in damage. Yet, Frio County provided temporary housing for over 1,700 people that were displaced because of the hurricane.

The severe storm hazards are discussed in more detail in Chapter 11.

10.2.1 Exposure

Property, population, and the natural environment are all exposed to hurricanes and tropical storms, however, by the time such an event reaches Frio County it will be more closely classified as a tropical storm, depression, or related event (such as hail, high winds, or lightning). The entire population of the planning area would be affected by the tropical storm or tropical depression to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event. Table 10-2 lists the exposed structures and population to hurricanes, tropical storms, and tropical depressions in the Frio County planning area. Hazus divided Frio County into three Census Blocks.

Table 10-2. Frio County Building Exposure by Census Block

Census Block	Value Exposed			2016 Population Exposed
	Structure	Contents	Total	
Northwest County (Including a portion of the City of Pearsall)	$337,536,000	$203,329,000	$540,865,000	1,002
Southwest County (Including the City of Dilley)	$317,799,000	$187,588,000	$505,387,000	2,994
East County (Including a portion of the City of Pearsall)	$478,465,000	$282,000,000	$760,465,000	3,127
Total	$1,133,800,000	$672,917,000	$1,806,717,000	7,123

Source: Hazus 4.0

10.2.2 Impacts

The Hazus protocol was used to assess the vulnerability of the planning area to hurricanes and tropical storms. The model used U.S. Census data at the tract level and modeled storms initiated in the Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and eastern and central Pacific Ocean.

Hazus calculates losses to structures from hurricanes by considering wind speeds, winds tracks, and amount of precipitation. Using historical storm data, Hazus estimates probabilistic storm scenarios. The historical storm database contains precomputed wind fields and storm tracks for Category 3, 4, and 5 land falling hurricanes from 1900 to 2010. For this analysis, a probabilistic Hazus hurricane scenario was selected. Peak gust wind speeds for the 100-year probabilistic scenario are between 68 and 76 mph for the planning area (see Figure 10-3). Less than 1% of the buildings (mostly residential) are expected to sustain minor damages for this scenario.

Countywide, the economic loss estimated for this probabilistic hurricane scenario is approximately $1.6 million, which represents approximately 0.14% of the total replacement value of the building value for Frio County, including the Cities of Dilley and Pearsall. Table 10-3 lists the impact in terms of dollar losses for all the planning partners (mapped in Figure 10-2) and the estimated displaced population.

Table 10-3. Frio County Losses from 100-Year Probabilistic Hurricane Scenario by Census Block

Census Block	Estimated Losses by Replacement Value			% of Total Replacement Value	Estimated Displaced Population
	Structure	Contents	Total		
Northwest County (Including portion of Pearsall)	$287,301	$0	$287,301	0.03%	0
Southwest County (Including Dilley)	$658,580	$676	$659,256	0.06%	0
East County (Including portion of Pearsall)	$611,985	$0	$611,985	0.05%	0
Total	$1,557,866	$676	$1,558,542	0.14%	0

Source: Hazus 4.0
Note: Losses based on 2010 Census Block data analysis in Hazus 4.0

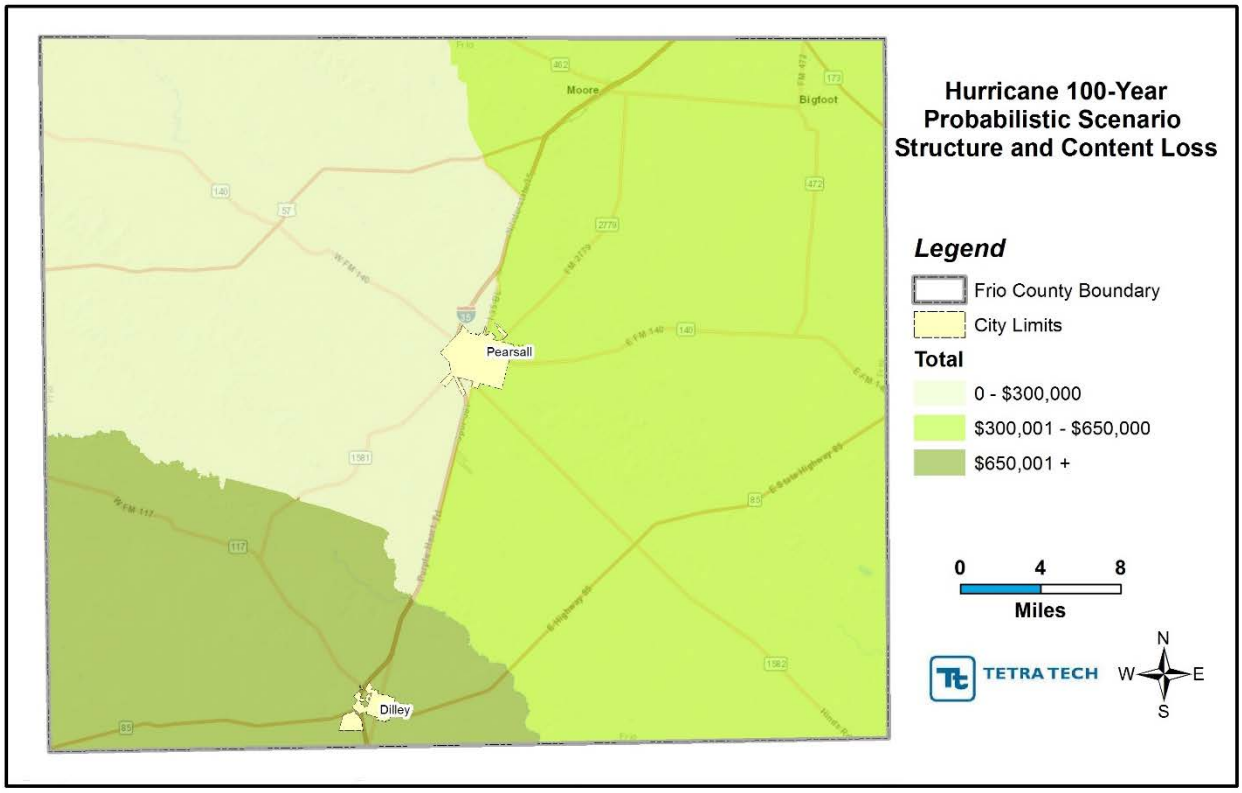


Figure 10-2. 100-Year Probabilistic Structure and Content Loss for Frio County

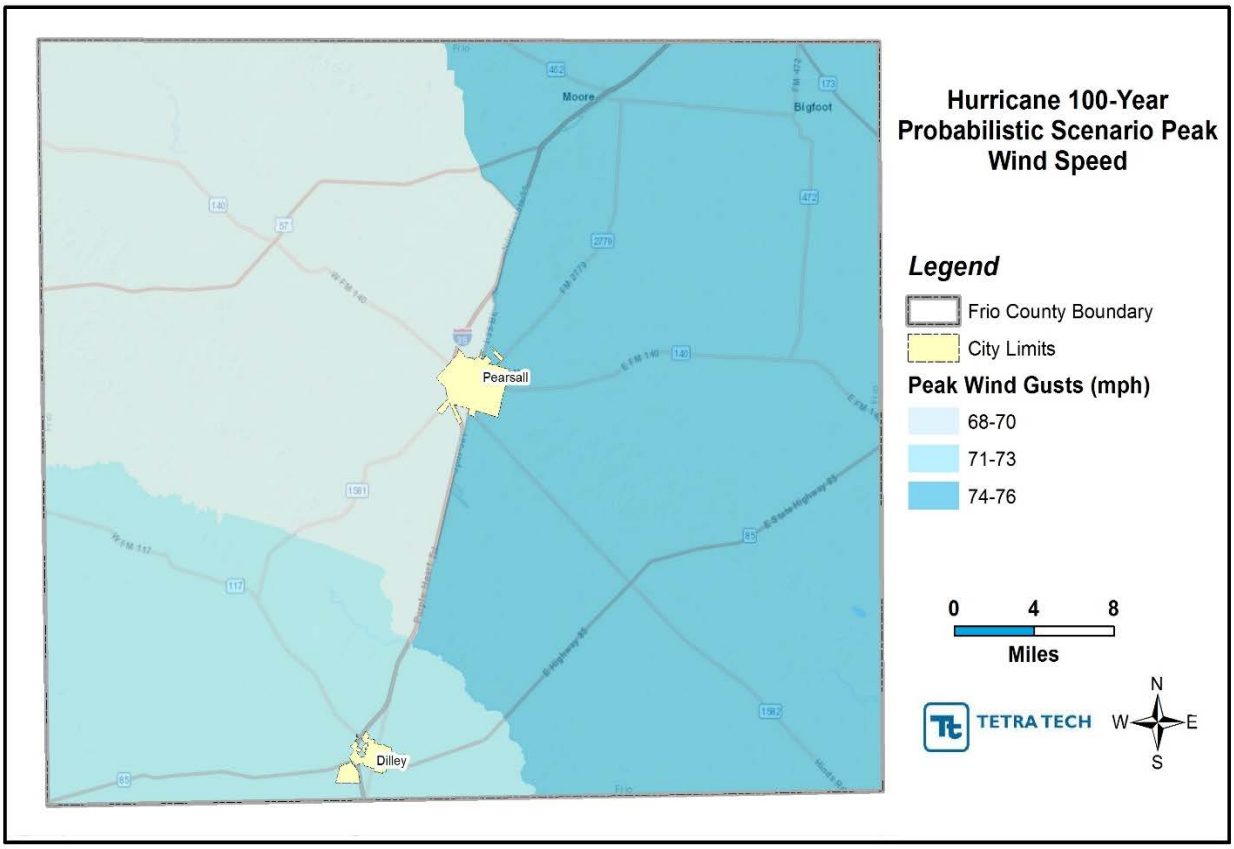


Figure 10-3. 100-Year Probabilistic Peak Wind Gusts for Frio County

Community Perception of Vulnerability

The City of Pearsall and Frio County ranked hurricane/tropical storm as a medium hazard and the City of Dilley ranked it as a low hazard.

See the first page of this chapter for a summary of hazard rankings for Frio County and the planning partners in this plan. Chapter 15 gives a detailed description of these rankings and Chapter 16.2 addresses mitigation actions for this hazard vulnerability.

10.3 PROBABILITY OF FUTURE EVENTS

Tropical storms are an annual event occurring from May through November in either the Gulf of Mexico or the Atlantic Ocean. The peak of the Atlantic hurricane season is in early- to mid-September. On average, approximately six storms reach hurricane intensity each year. Hurricanes appear to be less frequent during La Niña periods and more prevalent during strong El Niño periods. El Niño, and La Niña, its counterpart, refer to climate conditions in the Pacific Ocean that influence weather patterns in Texas. El Niño is associated with warmer sea surface temperatures and high air pressure systems, while La Niña is associated with cooler ocean temperatures and low air pressure systems. These changes in water temperature and air pressure systems occur in somewhat regular intervals, with El Niño periods having longer durations. The likelihood of a hurricane impacting Frio County is low. Tropical storms and tropical depressions are more likely to impact the County, but will not result in considerable damage to the County.

The Steering Committee members assessed the future probability of a hurricane/tropical storm based on their jurisdictional knowledge. Frio County and the City of Pearsall ranked the probability of a future event

as a medium probability of future occurrence. The City of Dilley ranked the probability of a future event as a low probability.

10.4 CLIMATE CHANGE IMPACTS

It is unclear whether climate change will increase or decrease the frequency of hurricanes and tropical storms, but warmer ocean surface temperatures and higher sea levels are expected to intensify their impacts. Hurricanes are subject to various climate change-related influences. Warmer sea surface temperatures could intensify tropical storm wind speeds, potentially delivering more damage if they make landfall. Based on sophisticated computer modeling, scientists expect a 2 to 11% increase in average maximum wind speed, with increased frequency of intense storms. Rainfall rates during these storms are also projected to increase by approximately 20%.

In addition, sea level rise is likely to make future coastal storms, including hurricanes, more damaging. Globally averaged, the sea level is expected to rise by 1 to 4 feet during the next century, which will amplify coastal storm surge.

10.5 ISSUES

Important issues associated with a hurricane / tropical storm include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as tropical storms.
- Redundancy of power supply must be evaluated.
- The potential for isolation after a severe storm event is high.
- Flash flooding that occurs with little or no warning will continue to impact the planning area.
- Roads and bridges blocked by debris or otherwise damaged might isolate populations.
- The impacts of climate change on the frequency and severity of hurricanes and tropical storms are not well understood.

Chapter 11.
SEVERE STORM (HAIL, LIGHTNING AND WIND)

HAIL, LIGHTNING and WIND RANKING			
Jurisdiction	HAIL	LIGHTNING	WIND
Frio County	48	33	33
City of Dilley	10	10	6
City of Pearsall	24	27	24
See Chapter 15 for more information on hazard ranking.			

11.1 HAZARD PROFILE

A thunderstorm is a rain event that contains thunder, hail, lightning and wind. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (kt) (58 mph), or tornadoes. For this hazard mitigation plan, each component of a thunderstorm (lightning, hail, and winds) will be profiled below. Thunderstorms or severe storms are not Texas State Hazards per the *2013 State of Texas Hazard Mitigation Plan* (SHMP 2013). "Thunderstorm" is used in this section as a descriptive term to qualify hail, wind, and lightning atmospheric events. Thunderstorms are described below for general reference information and not a profiled hazard.

DEFINITIONS

Severe Local Storm — Small-scale atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms, and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Thunderstorm — A storm featuring heavy rains, strong winds, thunder and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are also dangers associated with thunderstorms. Lightning is a serious threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.

Windstorm — A storm featuring violent winds. Windstorms tend to damage ridgelines that face into the wind.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder. Thunderstorms have three stages (see Figure 11-1):

The **developing stage** of a thunderstorm is marked by a cumulus cloud that is being pushed upward by a rising column of air (updraft). The cumulus cloud soon looks like a tower (called towering cumulus) as the updraft continues to develop. There is little to no rain during this stage but occasional lightning. The developing stage lasts about 10 minutes.

The thunderstorm enters the **mature stage** when the updraft continues to feed the storm, but precipitation begins to fall out of the storm, and a downdraft begins (a column of air pushing downward). When the downdraft and rain-cooled air spread out along the ground, they form a gust front, or a line of gusty winds. The mature stage is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The storm occasionally has a black or dark green appearance.

Eventually, a large amount of precipitation is produced and the updraft is overcome by the downdraft beginning the **dissipating stage**. At the ground, the gust front moves out a long distance from the storm and cuts off the warm moist air that was feeding the thunderstorm. Rainfall decreases in intensity, but lightning remains a danger.

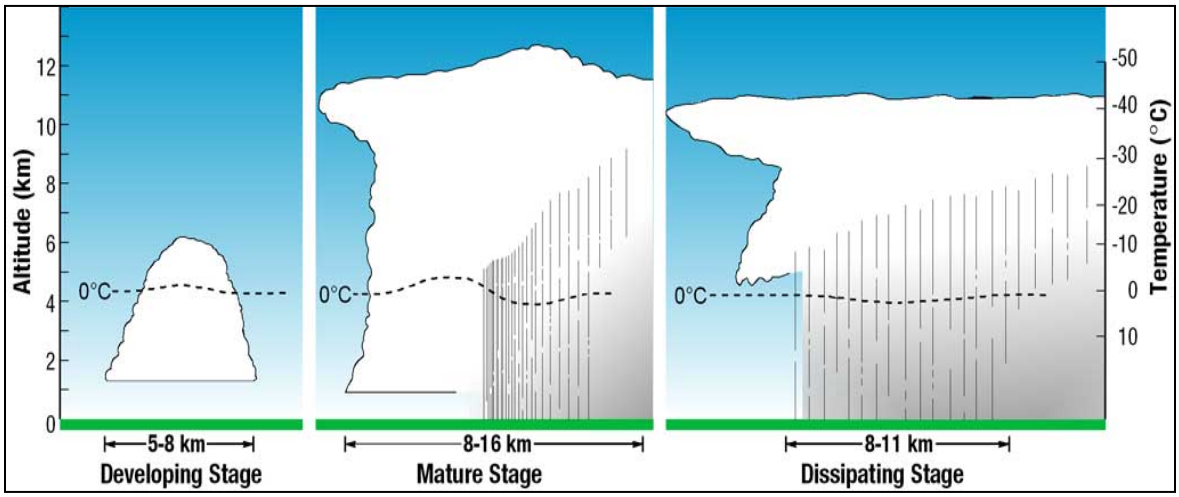


Figure 11-1. Thunderstorm Life Cycle

Notes:
°C Degrees Celsius
Km Kilometer

Hail

Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Recent studies suggest that super-cooled water may accumulate on frozen particles near the back-side of a storm as they are pushed forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground.

At the time when the updraft can no longer support the hailstone, it will fall to the earth. For example, a 1/4" diameter or pea-sized hail requires updrafts of 24 mph, while a 2 3/4" diameter or baseball-sized hail requires an updraft of 81 mph. The largest hailstone recorded in the United States was found in Vivian, South Dakota on July 23, 2010, measuring 8 inches in diameter, almost the size of a soccer ball. Soccer-ball-sized hail is the exception, but even small pea-sized hail can do damage.

Hailstorms in Texas cause damage to property, crops, and the environment, and kill and injure livestock. In the United States, hail causes more than $1 billion in damage to property and crops each year. Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are the other types of property most commonly damaged by hail.

The NWS classifies hail as non-severe and severe based on hail diameter size. Descriptions and diameter sizes are provided in Table 11-1.

Lightning

Lightning is an electrical discharge between positive and negative regions of a thunderstorm. When lightning strikes, electricity shoots through the air and causes vibrations creating the sound of thunder. Lightning is a dangerous and unpredictable weather hazard in the United States and in Texas. Each year, lightning is responsible for deaths, injuries, and millions of dollars in property damage, including damage to buildings, communications systems, power lines, and electrical systems. Lightning also causes forest and brush fires as well as deaths and injuries to livestock and other animals.

Intra-cloud lightning is the most common type of discharge. Usually, it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers.

Although not as common, cloud-to-ground lightning is the most damaging and dangerous form of lightning. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat.

Wind

The NWS wind speed threshold for a severe thunderstorm is a surface wind speed of 58 mph or greater. There are seven types of damaging winds:

- **Straight-line winds**—Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.
- **Downdrafts**—A small-scale column of air that rapidly sinks toward the ground.
- **Downbursts**—A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst of damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts**—A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- **Gust front**—A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- **Derecho**—A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-cooled air). The word “derecho” is of Spanish origin and means “straight ahead.” Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.
- **Bow Echo**—A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

11.1.1 Location

Severe storm events (hail, lightning, and wind) have the potential to happen anywhere in the planning area.

Hail

Hailstorms vary tremendously in terms of size, location, intensity, and duration but are considered frequent occurrences throughout the Frio County planning area. It is assumed that all the jurisdictions are uniformly exposed to hail events just as they are exposed to the thunderstorms that produce the hail events.

Lightning

Lightning strikes in association with thunderstorms vary in terms of size, intensity, duration, and impacts, but are considered frequent occurrences throughout the Frio County planning area. It is assumed that all the jurisdictions are uniformly exposed to thunderstorm events and the associated impact lightning. According to information calculated from Vaisala's National Lightning Detection Network, the planning area can experience 2 to 4 lightning strikes per square kilometer per year within orange shaded area (Figure 11-2). The dispersion of lightning strikes in Frio County is assumed to be uniform across the planning area although elevation and local topography may play a role.

Source: Vaisala 2016

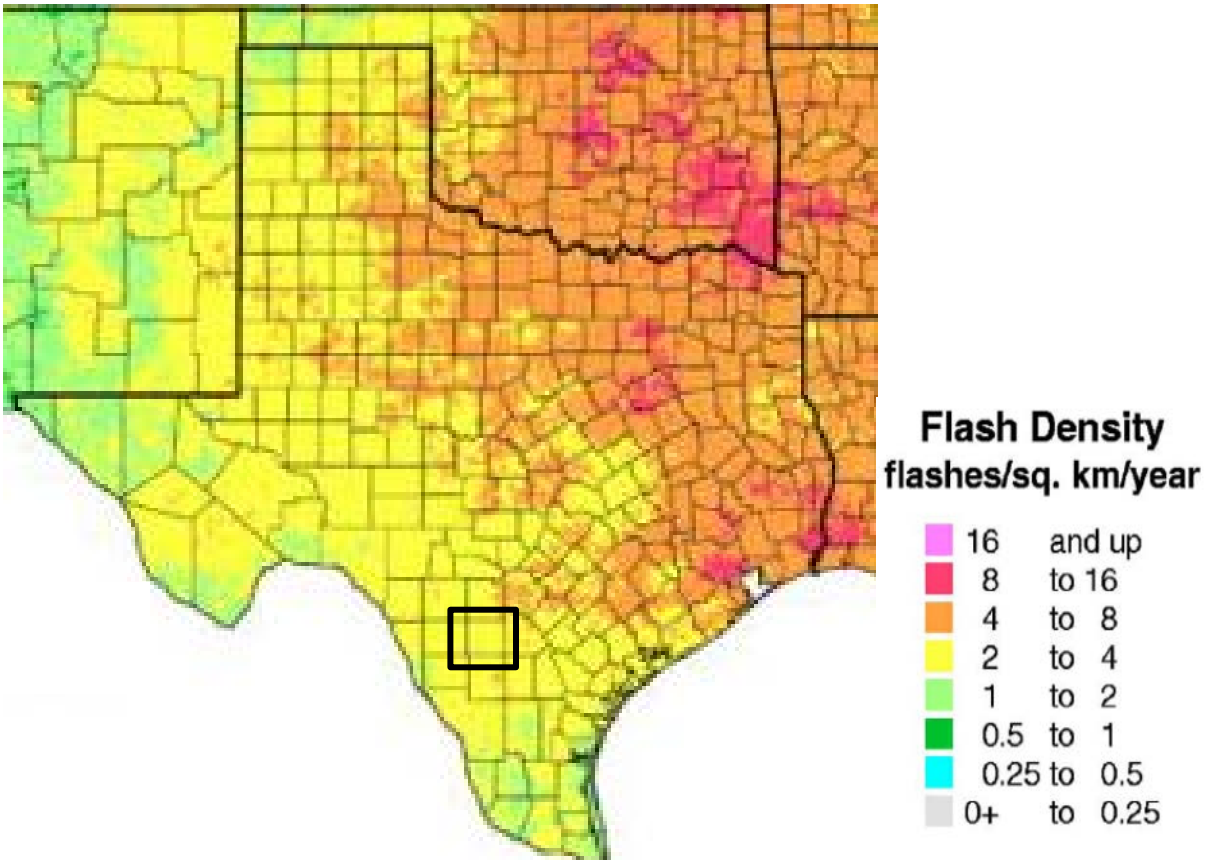


Figure 11-2. Lightning Density Scale in Texas

Note: Black square indicates approximate location of Frio County.

Wind

The entire Frio County planning area is exposed to high winds. Windstorms vary in terms of size, intensity, duration, and impact. High winds associated with thunderstorms are frequent occurrences throughout the planning area. They could cause damage over 100 miles from the center of storm activity. Winds impacting walls, doors, windows, and roofs, may cause structural components to fail. Figure 11-3 shows the U.S. wind zones and that Frio County is located in Zone III which can have winds up to 200 mph.

Source: FEMA P-361 2015

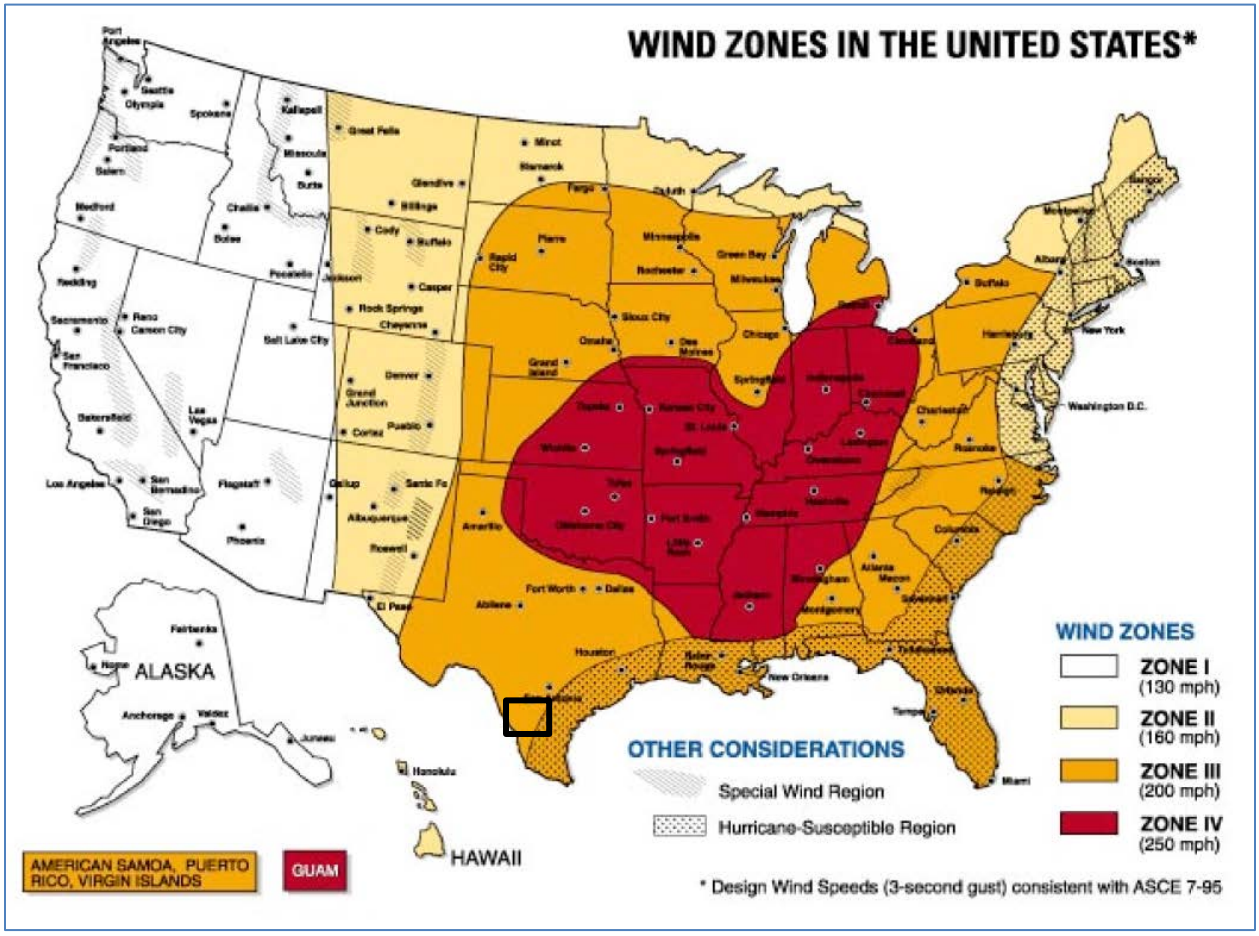


Figure 11-3. Wind Zones in the U.S.

Note: Black square indicates approximate location of Frio County.

11.1.2 Extent

Hail

The NWS classifies a storm as "severe" if there is hail three-quarters of an inch in diameter (approximate size of a penny) or greater, based on radar intensity or as seen by observers. The intensity category of a hailstorm depends on hail size and the potential damage it could cause, as depicted in the Hail Intensity and Magnitude Scale in Table 11-1.

Table 11-1. Hail Intensity and Magnitude Scale

Size Code	Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
H0	Hard Hail	5-9	0.2-0.4	Pea	No damage
H1	Potentially Damaging	10-15	0.4-0.6	Mothball	Slight general damage to plants, crops
H2	Significant	16-20	0.6-0.8	Marble, grape	Significant damage to fruit, crops, vegetation
H3	Severe	21-30	0.8-1.2	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	31-40	1.2-1.6	Pigeon's egg	Widespread glass damage, vehicle bodywork damage

H5	Destructive	41-50	1.6-2.0	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	51-60	2.0-2.4	Hen's egg	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	61-75	2.4-3.0	Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
H8	Destructive	76-90	3.0-3.5	Large orange > Soft ball	Severe damage to aircraft bodywork
H9	Super Hailstorms	91-100	3.6-3.9	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100	4.0+	Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: NOAA 2017
Note:
mm millimeters

Lightning

The extent for lightning can be expressed in terms of the number of strikes in an interval. NOAA categorizes lightning activity levels (LAL) on a scale from 1 to 6. LAL rankings reflect the frequency of cloud-to-ground lightning either forecast or observed as defined in Table 11-2.

Table 11-2. NOAA Lightning Activity Levels

LAL	Cloud and Storm Development	Lightning Strikes per 15 Minutes
1	No thunderstorm	0
2	Cumulus clouds are common but only a few reach the towering cumulus stage. A single thunderstorm must be confirmed in the observation area. The clouds produce mainly virga (streaks of water drops or ice particles falling out of a cloud and evaporating before reaching the ground), but light rain will occasionally reach the ground. Lightning is very infrequent.	1-8
3	Towering cumulus covers less than two-tenths of the sky. Thunderstorms are few, but two to three must occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.	9-15
4	Towering cumulus covers two to three-tenths of the sky. Thunderstorms are scattered and more than three must occur within the observation area. Moderate rain is common and lightning is frequent.	16-25
5	Towering cumulus and thunderstorms are numerous. They cover more than three-tenths and occasionally obscure the sky. Rain is moderate to heavy and lightning is frequent and intense.	>25
6	Dry lightning, similar to LAL 3 except thunderstorms are dry.	

Source: NOAA 2017
Notes:
LAL Lightning activity levels
NOAA National Oceanic and Atmospheric Administration

The NOAA NCEI does not include the LAL for the historical lightning events included in Table 11-2. According to the National Lightning Detection Network, Frio County can experience an average of 2 to 4 lightning strikes per square kilometer per year which equates to 3.8 strikes per hour or 0.4 strikes per minute. This would put Frio County in the LAL 2 range.

Wind

The strength of thunderstorm winds can vary from a light breeze to over 100 mph. Windstorms produced by cold fronts and gravity waves have been known to produce winds over 60 mph. The Beaufort wind scale exhibits the range in impacts of wind speeds as shown in Table 11-3.

Thunderstorm winds can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. Wind storms in the Frio County planning area are rarely life threatening, but do disrupt daily activities, cause damage to buildings, and structures,

and increase the potential for other hazards, such as wildfires. Winds can also cause trees to fall, particularly those killed by insects or wildfire, creating a hazard to property or those outdoors.

Table 11-3. Beaufort Wind Scale

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On the Water	On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-20 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (13-20 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Whole trees in motion, resistance felt walking against wind
9	41-47	Strong Gale	High waves (20 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (20-30 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	Exceptionally high waves (30-45 ft), foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	

Source: NOAA 2017
Notes:
Ft feet
WMO World Meteorological Organization

A worst-case scenario for the Frio County planning area is up to a severe storm event with H10 category hailstones the size of melons, with lightning activity levels greater than 25 strikes per 15 minutes, and high winds in the 48-55 knots range causing considerable structural damage.

11.1.3 Past Events

Since 1965, Frio County has been included in one Presidential Disaster (DR) Declaration for severe storms in the planning area (see Table 3-1). The one declaration is identified as FEMA-DR-4223-TX. Some of the damages that resulted in the declarations were from tornadoes and flooding that accompanied a severe storm. Frio County was mainly affected by flooding in the unincorporated Moore community.

The NOAA NCEI reported 222 total thunderstorm events for the Frio County planning area from January 1996 through December 2017. Of the reported events, there was approximately $614,000 in property damage and no injuries or fatalities.

Table 11-4. Thunderstorm Summary for Frio County (1996-2017)

Hazard type	Total Events	Events with Damage	Property Damage	Injuries	Fatalities
Hail	70	3	$14,000	0	0
Lightning	0	0	$0	0	0
Wind	152	15	$600,000	0	0
Totals	222	18	$614,000	0	0

Source: NCEI 2017

Hail

Table 11-5 shows the number of events and maximum size hail recorded by jurisdiction in Frio County.

Table 11-5. Hail Historical Events Summary for Frio County (1996-2017)

Jurisdiction	Number of Events	Maximum Size (inches)	Property Damage	Crop Damage	Injuries	Fatalities
City of Dilley	10	1.75	$0	$0	0	0
City of Pearsall	27	3.50	$7,000	$100,000	0	0
Unincorporated County	34	2.75	$0	$0	0	0
Total	71		$7,000	$100,000	0	0

Source: NCEI 2017

Notable past events in the Frio County planning area are described below:

- **March 30, 1997**—Recorded 2.5-inch hail in the City of Pearsall destroyed approximately 5,000 acres of crops resulting in $5,000 in property damage and $100,000 in crop damage. See below for wind damage associated with this event.

Lightning

According to National Lightning Detection Network, the Frio County planning area experiences an average of 2 to 4 lightning strikes per day. The NCEI's storm events database as well as locally available data, indicated there were no casualty nor injury reports from lightning in the Frio County planning area between 2008 and 2017. Table 11-6 shows there has been no historical recorded lightning events by jurisdiction. Since severe thunderstorms are accompanied with lightning, it is assumed that lightning occurs, but just not recorded or have any damaging events. Lightning strikes can cause house fires, electrical fires, wildfires and even fatalities.

Table 11-6. Lightning Historical Events Summary for Frio County (1996-2017)

Jurisdiction	Number of Events	Property Damage	Crop Damage	Injuries	Fatalities
City of Dilley	0	$0	$0	0	0
City of Pearsall	0	$0	$0	0	0
Unincorporated County	0	$0	$0	0	0
Total	0	$0	$0	0	0

Source: NCEI 2017

Winds

High winds occur year-round in the Frio County planning area. In the spring and summer, which are generally warm and humid in Texas, high winds often accompany severe thunderstorms. The NCEI reported 152 wind events for the Frio County planning area from January 1996 through December 2017. Table 11-7 shows the number of events and maximum wind speed recorded by jurisdiction.

Table 11-7. Wind Historical Events Summary for Frio County (1996-2017)

Jurisdiction	Number of Events	Maximum Wind (kt/mph)	Property Damage	Crop Damage	Injuries	Fatalities
City of Dilley	3	55 / 63	$105,000	$0	0	0
City of Pearsall	8	52 / 60	$185,000	$55,000	0	0
Unincorporated County	141	80 / 92	$270,000	$60,000	0	0
Total	152		$560,000	$115,000	0	0

Source: NCEI 2017
Notes:
Kt Knots
Mph Miles per hour

Notable past events in the Frio County planning area are described below:

- **May 18, 1999—**Brief but widespread downbursts of severe winds blew down trees and knocked over power lines in Dilley resulting in approximately $100,000 in property damage.
- **March 30, 1997—**Crops were damaged and power lines were knocked down in and near Pearsall by high winds, resulting in approximately $20,000 in property damage and $50,000 in crop damage. See above for Hail damage associated with this event.

Although these high winds may not be life-threatening, they can disrupt daily activities, cause damage to building and structures, and increase the potential damage of other hazards. Wind resource information is shown in Table 11-8 as a proxy for typical wind speeds. Wind resource information is estimated by the National Renewable Energy Laboratory (NREL) to identify areas that are suitable for wind energy applications. The wind resource is expressed in terms of wind power classes, ranging from Class 1 (lowest) to Class 7 (highest). Each class represents a range of mean wind power density or approximate mean wind speed at specified heights above the ground (in this case, 50 meters above the ground surface). Table 11-8 identifies the mean wind power density and speed associated with each classification. Figure 11-4 shows the wind power class potential density for Frio County classified as “Poor” to “Marginal.”

Table 11-8. Wind Power Class and Speed

Rank	Wind Power Class	Wind Power Density at 50 meters (W/m^2)	Wind Speed at 50 meters (mph)
Poor	1	0-200	0-12.5
Marginal	2	200-300	12.5-14.3
Fair	3	300-400	14.3-15.7
Good	4	400-500	15.7-16.8
Excellent	5	500-600	16.8-17.9
Outstanding	6	600-800	17.9-19.7
Superb	7	800-2,000	19.7-26.6

Source: NREL Wind Energy Resource Atlas of the United States
Notes:
mph Miles per hour
W/m^2 Watts per square meter

Source: NREL Wind Energy Resource 2012

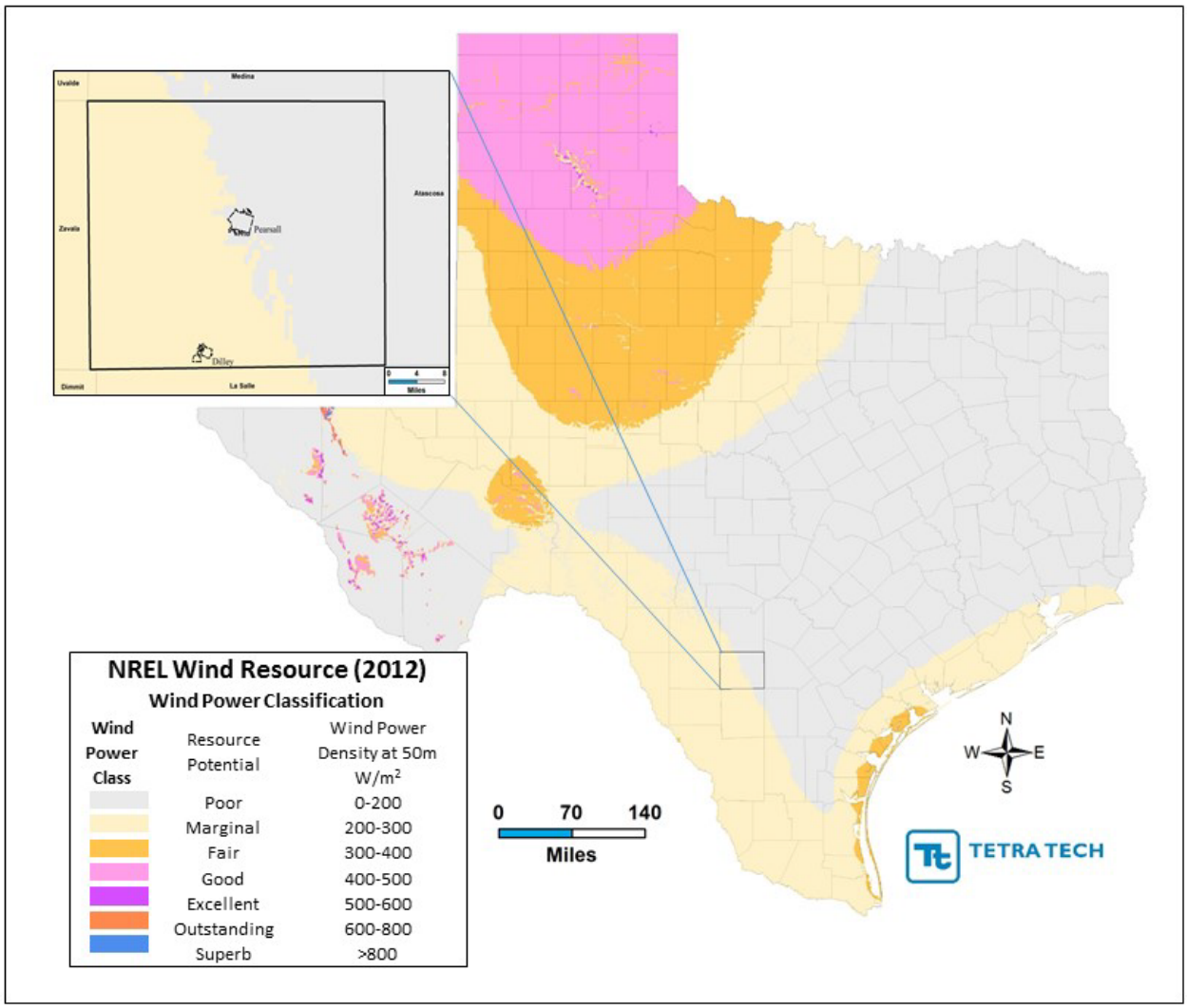


Figure 11-4. Texas Wind Power

11.1.4 Warning Time

Meteorologists can often predict the likelihood of a severe storm. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time. Weather forecasts for the planning area are reliable. However, at times, the warning for the onset of severe weather may be limited.

11.2 VULNERABILITY AND IMPACTS

11.2.1 Exposure

In general, assets in the entire planning area are vulnerable to thunderstorms, hail, lightning and wind including people, crops, vehicles, and built structures. Certain areas are more exposed due to geographic location and local weather patterns. Populations with large stands of trees or overhead power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding. It is not uncommon for residents living in more remote areas of the county to be isolated after

such events. Table 10-2 in the Hurricane / Tropical Storm Chapter shows that there is $1.8 billion in exposed property within Frio County.

It is estimated that most of the residential structures were built without the influence of a structure building code with provisions for wind loads. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact the building's protective envelope (doors, windows, and walls), the result can be roof or building component failures and considerable structural damage.

These buildings are considered to be exposed to the hail, lightning, and wind hazards, but structures in poor condition or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. The frequency and degree of damage will depend on specific locations.

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. Land use policies identified in master plans and enforced through zoning code and the permitting process also address many of the secondary impacts of the severe weather hazard. With these tools, the planning partnership can be well equipped to deal with future growth and the associated impacts of severe weather.

11.2.2 Impacts

Loss estimations for hail, lightning and wind hazards are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss). Table 11-9 lists the property loss estimates for hail, lightning and wind events. These annualized losses are less than $50,000 annually and can be deemed "negligible." Negligible loss hazards are still included despite minimal annualized losses because of the potential for a high value damaging event.

Table 11-9. Loss Estimates for Hail, Lightning, and Wind Events in Frio County

	Annual Rate of Occurrence	Average Loss Expectancy	Annualized Loss
Hail			
Frio County	3.55	$18,992	$5,350
Lightning			
Frio County	0	$0	$0
Wind			
Frio County	7.6	$33,750	$4,440

Lightning strikes can damage electronic equipment located inside buildings. However, structural damage can also occur when a lightning strike causes a building fire. In addition, lightning strikes can cause damage to crops if fields burn. Communications equipment and warning transmitters and receivers can also be knocked out by lightning strikes. There have not been any fatalities in Frio County from lightning strikes.

Thunderstorm winds and hail can cause damage to property, vehicles, trees, and crops.

Community Perception of Vulnerability

Frio County ranked hail as high and wind and lightning as medium hazards. The City of Dilley ranked hail, lighting, and wind as low hazards. The City of Pearsall ranked hail and lightning as medium and winds as a low hazard.

See the first page of this chapter for a summary of hazard rankings for Frio County and the planning partners in this plan. Chapter 15 gives a detailed description of these rankings and Chapter 16.2 addresses mitigation actions for this hazard vulnerability.

11.3 PROBABILITY OF FUTURE EVENTS

Since lightning accompanies thunderstorms, it can be assumed that lightning occurred and did not get reported within the NCEI database.

Based on NCEI data, there have been 70 hail events and 152 thunderstorm wind events. This translates to an annual average of 3.55 and 7.6 events per year, respectively. Based on this history, damaging hail and thunderstorm wind occur likely once per year.

The Steering Committee members from Frio County ranked the probability of hail, lightning, and wind as high probability of occurrence. The City of Dilley members ranked hail and lightning as medium probability of occurrence and wind as a low probability. The City of Pearsall ranked hail as a medium, lighting as a high, and wind as a low probability of occurrence.

11.4 CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. NCEI states the U.S. has sustained 219 weather and climate disasters since 1980 where the damages/costs reached or exceeded $1 billion (including consumer price index adjustments to 2017). The total cost of these 219 events exceeds $1.5 trillion (this includes the initial cost estimates for Hurricanes Harvey, Irma and Maria) (NOAA 2018).

According to Southern Climate Impacts Planning Program concerning Texas, growing evidence points to stronger summer storm systems. Studies have not been done to conclude that severe storms, including hail, lightning, and strong winds, are increasing. However, with summer temperatures becoming warmer and humidity levels increasing, an increase in the likelihood of these hazards is plausible (Southern Climate Impacts Planning Program [SCIPP] 2017).

11.5 ISSUES

Important issues associated with a severe weather in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as windstorms.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- The potential for isolation after a severe storm event is high.
- There is limited information available for local weather forecasts.
- The lack of proper management of trees may exacerbate damage from high winds.

Chapter 12.
TORNADO

TORNADO HAZARD	
Jurisdiction	TORNADO
Frio County	21
City of Dilley	6
City of Pearsall	54
See Chapter 15 for more information on hazard ranking.	

DEFINITIONS

Tornado — Funnel clouds that generate winds up to 500 mph. They can affect an area up to three-quarters of a mile wide, with a path of varying length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale (ranging from F0 to F5), or the Enhanced Fujita Scale.

12.1 HAZARD PROFILE

A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The visible sign of a tornado is the dust and debris that is caught in the rotating column made up of water droplets. Tornadoes can be induced by hurricanes. The following are common ingredients for tornado formation:

- Very strong winds in the mid and upper levels of the atmosphere
- Clockwise turning of the wind with height (that is, from southeast at the surface to west aloft)
- Increasing wind speed in the lowest 10,000 feet of the atmosphere (for example, 20 mph at the surface and 50 mph at 7,000 feet)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

Tornadoes can form from individual cells within severe thunderstorm squall lines. They also can form from an isolated super-cell thunderstorm. Weak tornadoes can sometimes occur from air that is converging and spinning upward, with little more than a rain shower occurring in the vicinity.

Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 miles per hour, and damage paths can be more than 1 mile wide and 50 miles long. Tornadoes have been known to lift and move objects weighing more than 300 tons a distance of 30 feet, toss homes more than 300 feet from their foundations, and siphon millions of tons of water from water bodies. Tornadoes also generate a tremendous amount of flying debris or “missiles,” which often become airborne shrapnel that causes additional damage. If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, roofs, and walls. However, less spectacular damage is much more common.

12.1.1 Location

Recorded tornadoes in the planning area are typically small to average size and short-lived. They can occur anywhere in the Frio County planning area. Figure 12-1 shows the location of previous tornado events in the Frio County planning area from 1950 to 2017.

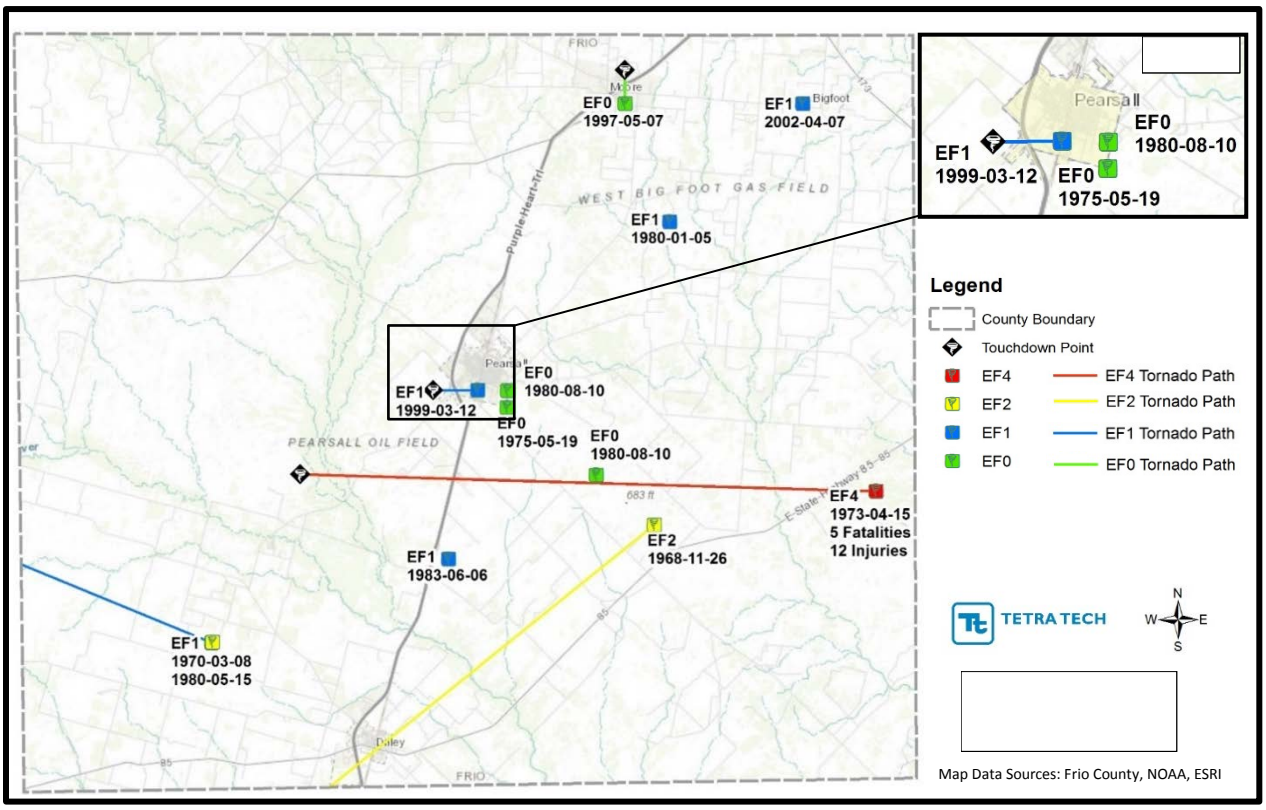


Figure 12-1. Tornado Events in Frio County (1950-2017)

12.1.2 Extent

The Enhanced Fujita Scale, or EF Scale (Table 12-1), is the current scale for rating the strength of tornadoes in the United States; magnitude is estimated via the damage left behind. Implemented in February 2007, it replaced the Fujita Scale. The scale has the same basic design as the original Fujita Scale, six categories from zero to five, representing increasing degrees of damage. The new scale considers how most structures are designed, and is thought to be more accurate representation of the surface wind speeds in the most violent tornadoes.

The worst-case scenario for the Frio County planning area is to see up to an EF5 tornado in a densely developed and populated area.

Table 12-1. Enhanced Fujita Scale

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

Enhanced Fujita Category	Wind Speed (mph)	Potential Damage
EF5	>200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 yards; high-rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NOAA
Notes:
EF Enhanced Fujita
mph miles per hour

12.1.3 Past Events

Since 1965, Frio County has not been included in any Presidential Disaster (DR) Declarations for tornadoes.

There have been three tornados in or near the City of Pearsall since 1970 (Figure 12-1).

The NCEI recorded 3 tornados that touched down in the Frio County planning area from January 1996 through December 2017. Of these events, there was $10,000 in recorded property damage and no injuries or fatalities (see Table 12-2.)

Table 12-2. Tornado Historical Events Summary (1996-2017)

Jurisdiction	Number of Events	Highest Magnitude	Property Damage	Crop Damage	Injuries	Fatalities
City of Dilley	0	N/A	N/A	$0	0	0
City of Pearsall	1	EF1	$0	$0	0	0
Unincorporated County	2	EF1	$10,000	$0	0	0
Total	3		$10,000	$0	0	0

Source: NCEI 2017
Notes:
EF Enhanced Fujita
N/A Not Applicable

Notable past tornado events in the Frio County planning area are described below:

- **April 7, 2002**—A small EF1 tornado touched down briefly near a home, destroying several trees, but not damaging the house itself in northeastern Frio County. There was still $10,000 worth of property damage reported.
- **April 15, 1973**—A large EF4 tornado touched down west of Interstate 35 and crossed most of the County before dissipating. The large tornado killed 5 people and injured 12. This is the largest and most destructive tornado to hit Frio County.

12.1.4 Warning Time

The NOAA Storm Prediction Center issues tornado watches and warnings for Frio County. Watches and warnings are described below:

- Tornado Watch—Tornadoes are possible. Remain alert for approaching storms. Watch the sky and stay tuned to NOAA all hazards weather radio, commercial radio, or television for information.
- Tornado Warning—A tornado has been sighted or indicated by weather radar. Take shelter immediately.

Once a warning has been issued, residents may have only a matter of seconds or minutes to seek shelter.

12.2 VULNERABILITY AND IMPACTS

12.2.1 Exposure

In general, assets in the entire planning area are vulnerable to tornadoes including people, crops, vehicles, and built structures. Certain areas are more exposed due to geographic location and local weather patterns.

All buildings are exposed to tornadoes, but structures in poor condition, modular homes or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. The frequency and degree of damage will depend on specific locations.

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. Land use policies identified in master plans and enforced through zoning codes and the permitting process also address many of the secondary impacts of the severe weather hazard. With these tools, the planning partnership can be well equipped to deal with future growth and the associated impacts of severe weather.

12.2.2 Impacts

Loss estimation for tornadoes is not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss). Table 12-3 lists the property loss estimates for tornado events, which are included with hail, lightning, and wind losses. These annualized losses are less than $1,000 annually and can be deemed "negligible." Negligible loss hazards are still included despite minimal annualized losses because of the potential for a high-value damaging event.

Table 12-3. Loss Estimates for Tornado Events

	Annual Rate of Occurrence	Average Loss Expectancy	Annualized Loss
Frio County	0.14	$75	$454

The damage caused by strong tornadoes can be extensive for site-built homes as well as manufactured homes. The NWS research of tornado sites has shown that manufactured homes are more susceptible.

The EF scale identifies wind speeds that would destroy structures. For single-family, site-built homes, winds in excess of 170 mph (EF4) are needed. For a single-wide manufactured home, that drops to 127 mph (EF2), and for a double-wide manufactured home, 134 mph (EF2).

The highest number of manufactured homes within the planning area is in the unincorporated portion of the county, followed by the City of Pearsall. Table 12-4 lists the number of manufactured homes along with the ratio of manufactured homes as compared to the number of housing units in each jurisdiction.

Table 12-4. Manufactured Homes by Jurisdiction

Jurisdiction	Total Housing Units	Manufactured Homes	Manufactured Homes to Housing Ratio
City of Dilley	902	225	24.90%
City of Pearsall	2,850	411	14.40%
Frio County	5,888	1,526	25.90%

Source: U.S. Census Bureau, 2016 5-Year American Community Survey

Community Perception of Vulnerability

The City of Dilley ranked the threat of tornado to be low. Frio County ranked the threat of a tornado to be medium and the City of Pearsall ranked the threat of a tornado to be high.

See the first page of this chapter for a summary of hazard rankings for Frio County planning partners in this plan. Chapter 15 gives a detailed description of these rankings and Chapter 16.2 addresses mitigation actions for this hazard vulnerability.

12.2.3 Probability of Future Events

Tornadoes may occur in any month and at any hour of the day, but they occur with the greatest frequency during the late spring and early summer months, and between the hours of 4:00 pm and 8:00 pm.

Table 12-2 lists three recorded tornadoes rated EF1. Therefore, on average, a small sized tornado can occur anywhere in the County every 10 to 15 years.

Both Frio County and the City of Pearsall believed that the probability was high for tornadoes. The City of Dilley felt that tornado events are low probability of occurrence.

12.3 CLIMATE CHANGE IMPACTS

Climate change impacts on the frequency and severity of tornadoes are unclear. According to the Center for Climate Change and Energy Solutions, "Researchers are working to better understand how the building blocks for tornadoes—atmospheric instability and wind shear—will respond to global warming. It is likely that a warmer, moister world would allow for more frequent instability. However, it is also likely that a warmer world would lessen chances for wind shear. Recent trends for these quantities in the Midwest during the spring are inconclusive. It is also possible that these changes could shift the timing of tornadoes or regions that are most likely to be hit" (Center for Climate and Energy Solutions no date).

12.4 ISSUES

Important issues associated with a tornado in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to tornadoes.
- Availability of tornado safe rooms in public buildings.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- Roads and bridges blocked by debris or otherwise damaged might isolate populations.
- Warning time may not be adequate for residents to seek appropriate shelter or such shelter may not be widespread throughout the planning area.
- The impacts of climate change on the frequency and severity of tornadoes are not well understood.
- Building codes may need to be updated so buildings can withstand strong wind loads or provisions may be added for tornado shelters in high risk areas.

Chapter 13.
WILDFIRE

WINTER STORM HAZARD	
Jurisdiction	
Frio County	36
City of Dilley	6
City of Pearsall	6
See Chapter 15 for more information on hazard ranking.	

DEFINITIONS

Conflagration — A fire that grows beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions, excessive fuel buildup, and explosions are usually the elements behind a wildfire conflagration.

Interface Area — An area susceptible to wildfires and where wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.

Wildfire — Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

13.1 HAZARD PROFILE

A wildfire event can rapidly spread out of control and occurs most often in the summer and early fall, when the brush is dry and flames can move unchecked through a highly vegetated area. Wildfires can start as a slow burning fire along the forest floor, killing and damaging trees. The fires often spread more rapidly as they reach the tops of trees, with wind carrying the flames from tree to tree. Usually, dense smoke is the first indication of a wildfire.

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. It often begins unnoticed and spreads quickly, lighting brush, trees and homes on fire. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson.

Texas has seen a significant increase in the number of wildfires in the past 30 years, which included wildland and interface or intermix fires. Wildland fires are fueled almost exclusively by natural vegetation while interface or intermix fires are urban/wildland fires in which vegetation and the built-environment provide the fuel.

Fire hazards present a considerable risk to vegetation and wildlife habitats. Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in areas designated as wildland urban interface (WUI) areas, where development is adjacent to densely vegetated areas.

Texas has seen a huge increase in the number of wildfires in the past 30 years. From January 2005 through December 2014, TFS recorded 160,063 fires that burned over 9.4 billion acres. Of those fires, 79% of them were within two miles of a community.

Fire Protection in Frio County

Fire protection in Frio County is primarily serviced by volunteer fire departments. The City of Dilley and the City of Pearsall have volunteer fire department with at least one paid officer. The Bigfoot Volunteer Fire Department and Moore Volunteer Fire Department also service Frio County.

Vegetation Classes in Frio County

General vegetation for Frio County is described in Table 13-1. The most common vegetation classes in the county is shrub\scrub, comprising approximately 54% of the acreage in the county.

Table 13-1. Vegetation Classes in Frio County

Class	Acres	% of Area
Barren Land (Rock/Sand/Clay)	485	0.1%
Developed Land	15,531	2.8%
Developed Open Space	26,948	3.5%
Crops and Pasture/Hay	229,266	30%
Grassland	48,692	6.4%
Marsh	126	0%
Mixed Forest	27,870	3.6%
Shrub/Scrub	409,616	53.6%
Water	268	0%
Total	758,802	100%

Source: TxWRAP 2017

13.1.1 Location

Texas is one of the fastest growing states in the nation. Much of this growth is occurring in the WUI area, where structures and other human improvements meet and mix with undeveloped wildland or vegetative fuels. Population growth within the WUI substantially increases the risk from wildfires. For Frio County, TxWRAP estimated that 9,357 people or almost 60% of the total county population live within the WUI. The WUI layer reflects housing density depicting where humans and their structures meet or intermix with wildland fuels. Approximately 52,517 acres of Frio County are located as part of the WUI.

The TxWRAP report for Frio County and the Cities of Dilley and Pearsall maps the WUI Response Index, which is a rating of the potential impact of a wildfire on people and their homes. The key input, WUI, reflects housing density (houses per acre) consistent with Federal Register National standards (Figure 13-1). The TxWRAP report states that the location of people living in the WUI and rural areas is essential for defining potential wildfire impacts to people and homes.

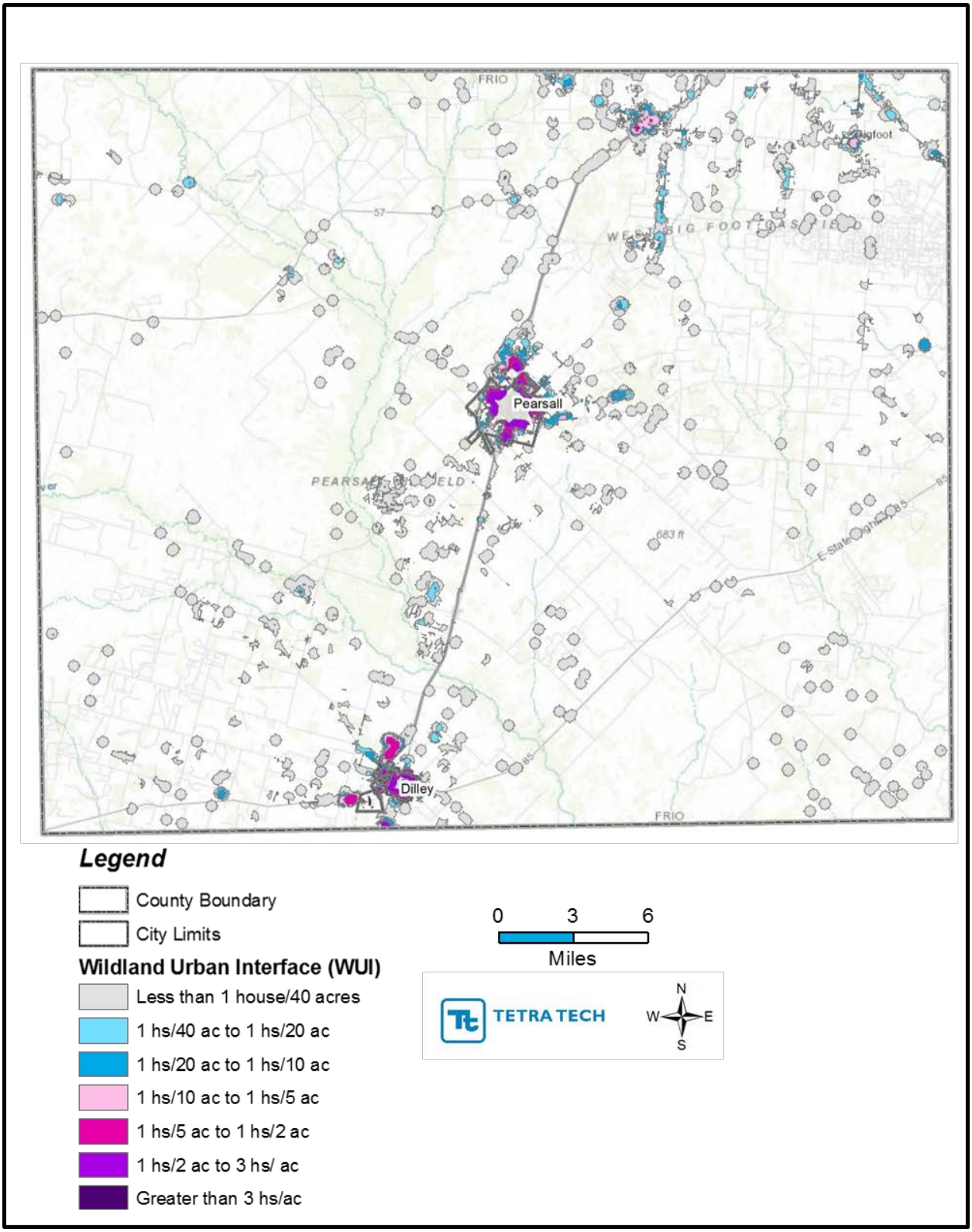


Figure 13-1. Frio County Wildland Urban Interface

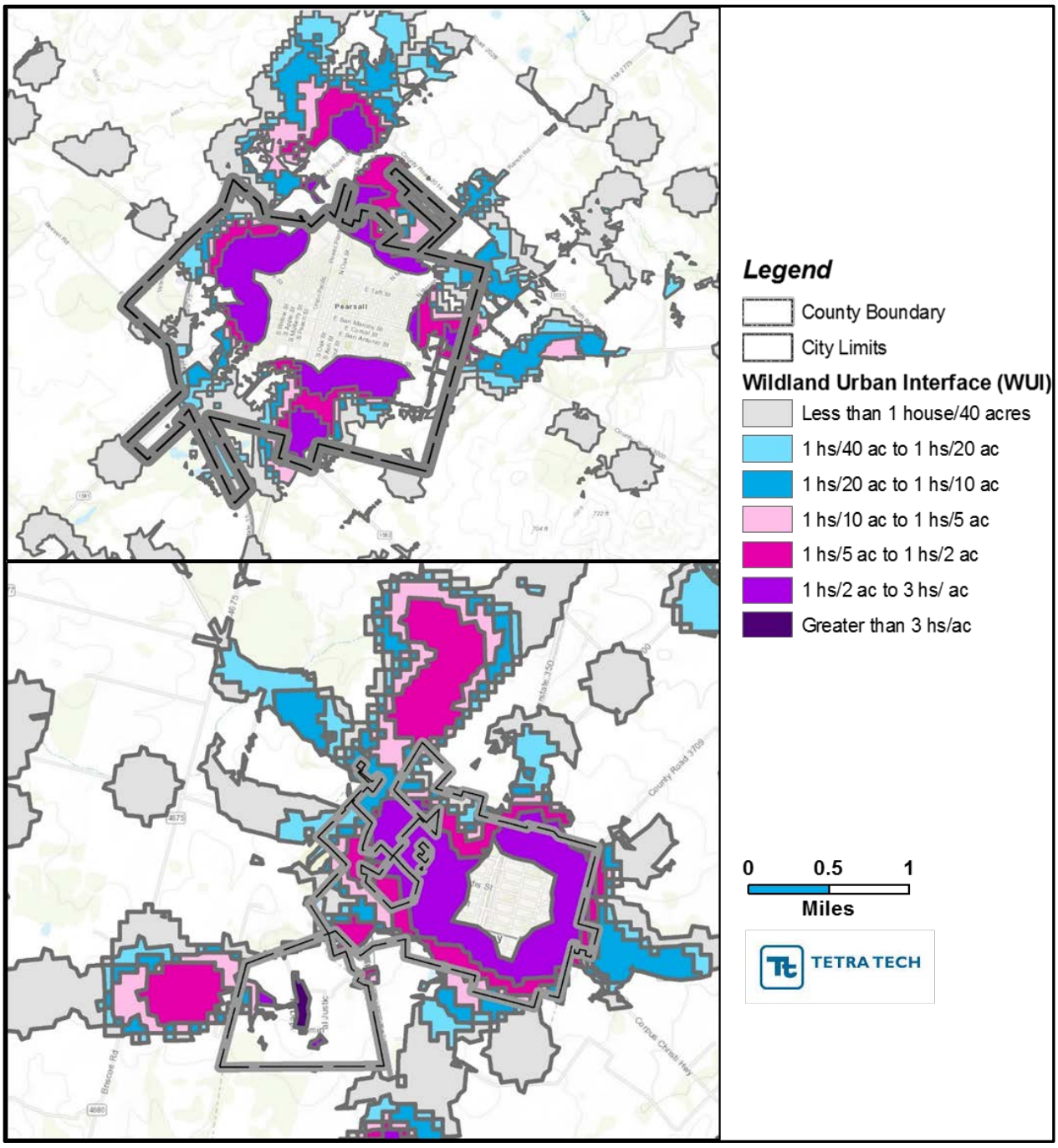


Figure 13-2. Cities of Dilley and Pearsall Wildland Urban Interface

13.1.2 Extent

The TxWRAP report for Frio County maps the Fire Intensity Scale (FIS) specifically identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist based on a weighted average of four percentile weather categories. The minimum class, Class 1, represents very low wildfire intensities and the maximum class, Class 5, represents very high wildfire intensities as seen in Table 13-2. The majority of Frio County is identified as a very low to low on the FIS as seen in Figure 13-3 and all the municipal planning partners' FIS can be viewed in Figure 13-3.

The worst-case scenario for the Frio County planning area is to see up to a Class 5 Wildfire with very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds and a great potential for harm or damage to life and property.

Table 13-2. Texas Forest Service Fire Intensity Ratings

Class	Wildfire Intensity Ratings	Description of Fire
Class 1	Very Low	Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and nonspecialized equipment.
Class 2	Low	Small flames, usually less than 2 feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.
Class 3	Moderate	Flames up to 8 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozers and plows are generally effective. Increasing potential for harm or damage to life and property.
Class 4	High	Large flames, up to 30 feet in length; short-range spotting common; medium-range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property
Class 5	Very High	Very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.

Source: TFS 2017

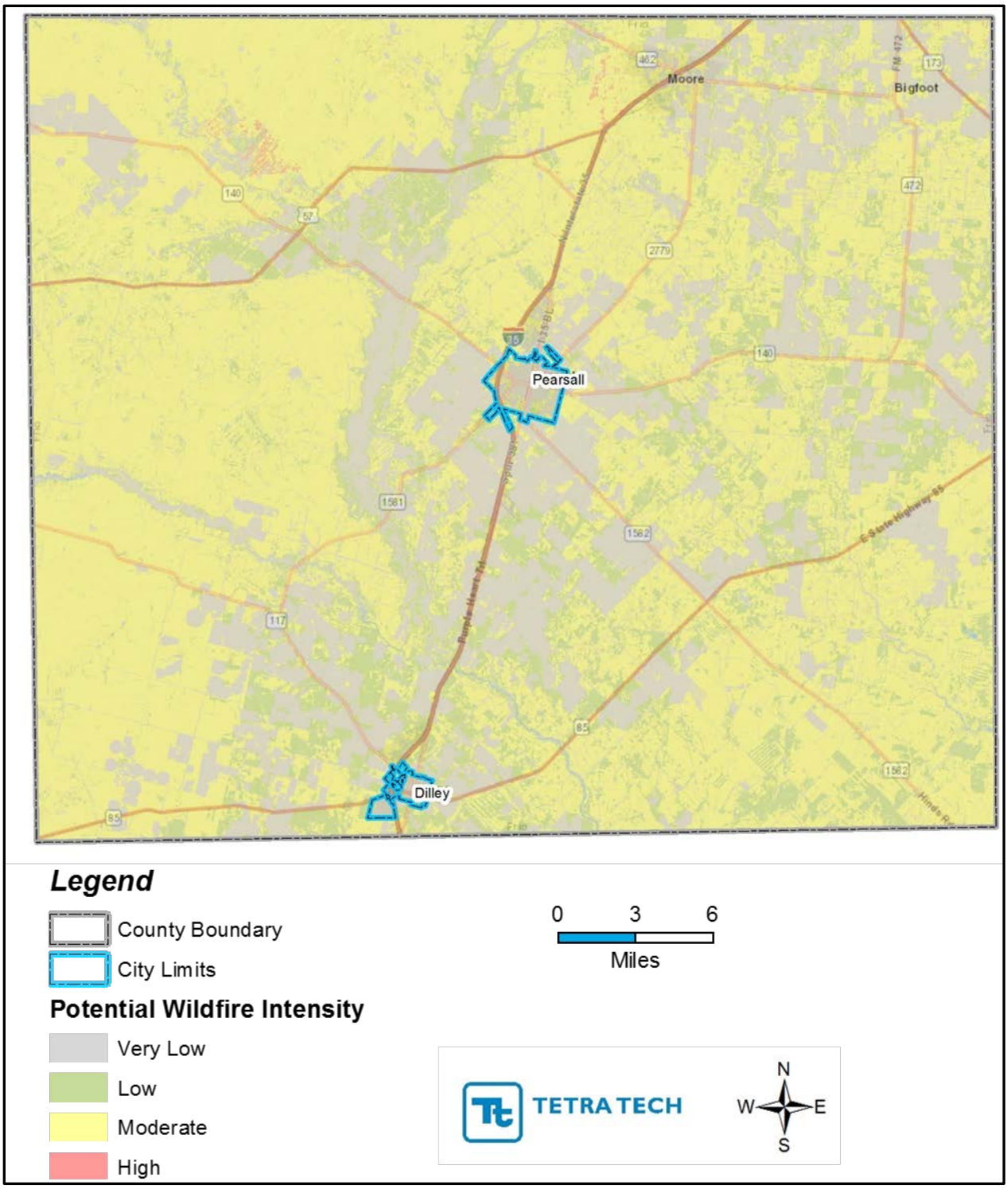


Figure 13-3. Frio County Wildfire Intensity

13.1.3 Past Events

Significant wildfires are not common in Frio County and do not occur annually. The USGS Federal Wildland Fire Occurrence Database identified one wildfire in Frio County between 1980 and 2016.

- The wildfire occurred on December 8, 1986, and was identified to be human-caused. The wildfire was in the Lower Rio Grande Valley National Wildlife Refuge on the northeastern portion of Frio County.

According to FEMA, three declarations have been made regarding wildfire activity in Frio County:

- FEMA-DR-1999-TX Incident began on April 6, 2011. The combination of warm to hot temperatures and breezy to windy weather made conditions favorable for significant wildfires across West Texas. This wildfire declaration included 52 Texas counties for public assistance and debris removal.
- FEMA-EM-3284-TX Incident began March 14, 2008 for 184 Texas counties due to wildfire threat. In Texas, 1,558,008 acres of land burned in 2008, which is 37% of the burned acres nationally that year.
- FEMA-DR-1624-TX Extreme wildfire threat began on November 27, 2005.

13.1.4 Warning Time

Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Because fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable NWS lightning warnings are available on average 24 to 48 hours before a significant electrical storm.

If a fire does break out and spreads rapidly, residents may need to evacuate within days or hours. A fire's peak burning period generally is between 1:00 p.m. and 6:00 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time.

13.2 VULNERABILITY AND IMPACTS

Structures, aboveground infrastructure, critical facilities, agricultural area (crops and structures), and natural environments are all vulnerable to the wildfire hazard.

13.2.1 Exposure

Property

Loss estimations for wildfire hazard are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss) on historical events, statistical analysis and probability factors. These were applied to the building-related exposure values of Frio County to create a value and building content loss. Table 13-3 lists the loss estimates for the general building stock for jurisdictions that have an exposure to a wildfire risk category.

Table 13-3. Comparison of Building-Related Exposure in Hazard Areas

Frio County	Very Low Potential Wildfire Intensity	Low Potential Wildfire Intensity	Moderate Potential Wildfire Intensity	High Potential Wildfire Intensity
Total Area (Acres)	18,452	116,844	449,461	1,471
Value of Building and Contents	$2.0 B	$1.0 M	$1.8 M	$20 K

Source: TxWRAP 2017
Notes:
B Billion
M Million

Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable during wildfire events. In the event of wildfire, there would likely be little damage to most infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Power lines are the most at risk from wildfire because most poles are made of wood and susceptible to burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire typically does not have a major direct impact on bridges, but it can create conditions in which bridges are obstructed.

Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

- **Soil Erosion**—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- **Spread of Invasive Plant Species**—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- **Disease and Insect Infestations**—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- **Destroyed Endangered Species Habitat**—Catastrophic fires can have devastating consequences for endangered species.
- **Soil Sterilization**—Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called "fire regimes," include temporal attributes (frequency and seasonality), spatial attributes (size and spatial complexity), and magnitude attributes (intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

13.2.2 Impacts

Loss estimates for wildfire hazard are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss) on historical events. No estimated loss occurrence values were able to be calculated because of infrequency of wildfires in Frio County, as well as no reported loss values.

Community Perception of Vulnerability

The jurisdictions of Frio County ranked wildfire as a medium hazard. The Cities of Dilley and Pearsall ranked it a low hazard impact.

See the first page of this chapter for a summary of hazard rankings for Frio County planning partners in this plan. Chapter 15 gives a detailed description of these rankings and Chapter 16.2 addresses mitigation actions for this hazard vulnerability.

13.3 PROBABILITY OF FUTURE EVENTS

The threat of wildfire is a constant in Texas. Wildfires become especially dangerous when wildland vegetation begins to intermix with homes. Based on previous events and historical records, there is low to

medium chance of a large (over 50 acres) wildfire occurring in the unincorporated Frio County and varying factors will determine if they burn into the interface areas of the municipalities.

The Cities of Dilley and Pearsall ranked the wildfire probability threat as low, while Frio County ranked it as a high probability. Frio County outside of the Cities of Dilley and Pearsall has a higher chance of a wildfire, though it will likely be away from populations that could be impacted.

With more and more people living in the WUI, it is increasingly important for local officials to plan and prepare for wildfires. CWPPs are a proven strategy for reducing the risk of catastrophic wildfires and protecting lives and property.

TFS encourages Texas counties and communities to develop and adopt CWPPs to better prepare their region and citizens for wildfires. Planning for wildfires should take place long before a community is threatened. Once a wildfire ignites, the only option available to firefighters is to attempt to suppress the fire before it reaches a community. A CWPP is unique in that it empowers communities to share the responsibility for selecting the best strategies for protection against wildfire.

The Texas CWPP calls for communities to:

- Know their environment (WUI), assets at risk, fire occurrence and behavior, and overall wildfire risks
- Adopt mitigation strategies from wildfire preventions to fuels reduction to capacity building
- Create and adopt recovery plan strategies

13.4 CLIMATE CHANGE IMPACTS

Fire in western ecosystems is affected by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot, dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Historically, drought patterns in the West and Midwest are related to large-scale climate patterns in the Pacific and Atlantic Oceans. The El Niño–Southern Oscillation in the Pacific varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region.

Climate scenarios project summer temperature increases between 3.6 to 9°F and precipitation decreases of up to 15% by 2100. Such conditions would exacerbate summer drought and further promote wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called “fertilization effect”—could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, if sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the U.S. because of climate change.

13.5 ISSUES

The major issues for wildfire are the following:

Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones.

- Future growth into interface areas should continue to be managed.

- Area fire districts need to continue to train on WUI events.
- Vegetation management activities should be enhanced.
- Regional consistency of higher building code standards should be adopted such as residential sprinkler requirements and prohibitive combustible roof standards.
- Fire department water supply in high-risk wildfire areas.
- Expand certifications and qualifications for fire department personnel. Ensure that all firefighters are trained in basic wildfire behavior, basic fire weather, and that all company officers and chief level officers are trained in the wildland command and strike team leader level.
- Both the natural and man-made conditions that contribute to the wildland fire hazard are tending to worsen through time.
- Conservative forestry management practices have resulted in congested forests prone to fire and disease.
- The continued migration of inhabitants to remote areas of the county increases the probability of human-caused ignitions from vehicles, grills, campfires, and electrical devices.

Chapter 14.
WINTER WEATHER

WINTER STORM HAZARD	
Jurisdiction	
Frio County	24
City of Dilley	6
City of Pearsall	6
See Chapter 15 for more information on hazard ranking.	

DEFINITIONS

Freezing Rain — The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to 6 tons of ice, creating a threat to power and telephone lines and transportation routes.

Severe Local Storm — Small-scale atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms, and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Winter Storm — A storm having significant snowfall, ice, or freezing rain; the quantity of precipitation varies by elevation.

14.1 HAZARD PROFILE

A severe winter storm event is identified as a storm with snow, ice, or freezing rain—all of which can cause significant problems for area residents. Although rare in east Texas, winter weather does occasionally occur. January is the month when snow, sleet, or freezing rain is most likely to be observed; yet, winter weather conditions can occur at any time during the winter and early spring months. The leading cause of death during winter storms is transportation accidents. Hypothermia and frostbite are other dangers from very cold winter temperatures.

Extreme cold often accompanies a winter storm or is left in its wake. It is most likely to occur in the winter months of December, January, and February. Prolonged exposure to the cold can cause frostbite or hypothermia and can become life-threatening. Infants and the elderly are most susceptible. Pipes may freeze and burst in homes or buildings that are poorly insulated or without heat. Extreme cold can disrupt or impair communications facilities.

14.1.1 Location

Frio County and the planning partners are susceptible to winter storms; blizzard conditions are primarily in the form of freezing rain, sleet, or ice. Ice accumulation becomes a hazard by creating dangerous travel conditions especially when jurisdictions do not pre-treat the roads and people do not have all-weather tires on their vehicles.

According to the weather station in the City of Pearsall, the planning area experiences an average of 21 freezing days. Table 3-2 shows the annual average minimum, maximum, and mean temperature distribution from the Pearsall weather station.

14.1.2 Extent

Figure 14-1 and Figure 14-2 are two indices used to measure winter storms. The first is the wind chill temperature index (see Figure 14-1). This index describes the relative discomfort or danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Source: NOAA, NWS

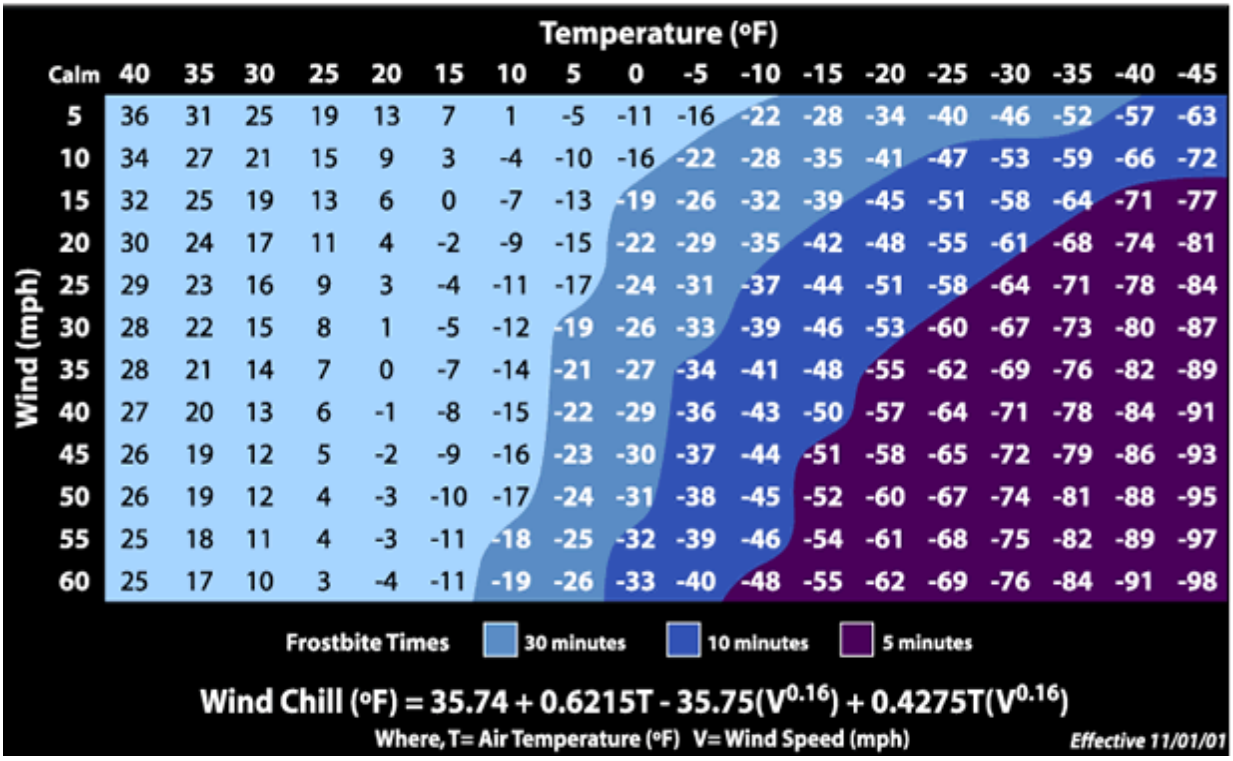


Figure 14-1. National Weather Service Wind Chill Chart

A wind chill watch is issued by the NWS when wind chill warning criteria are possible in the next 12 to 36 hours. A wind chill warning is issued for wind chills of at least -25°F in the Midwest.

The worst-case scenario for the Frio County planning area and participating jurisdictions is the combination of -5°F air temperatures and 25 mph winds that can create up to -31°F wind chill. This will result in frost bite within 30 minutes of exposure and lead to hypothermia if precautions are not taken.

The second index is the Sperry-Piltz Ice Accumulation Index, or SPIA Index, which is an ice accumulation and damage prediction index (see Figure 14-2). It is a tool to be used by the NWS, FEMA as well as other agencies and communities for risk management and winter weather preparedness.

The second worst-case scenario involves the Frio County planning area and participating jurisdictions receiving up to one-inch of ice.

Source: SPIA 2009

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

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

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

Figure 14-2. Sperry-Piltz Ice Accumulation Index or SPIA Index

14.1.3 Past Events

Since 1965, Frio County has been included in one Presidential Disaster (DR) Declarations for a severe winter storm.

- FEMA-DR-850-TX. The deep freeze occurred from December 21-24, 1989 and was declared on January 9, 1990.

NCEI recorded two winter weather events within the Frio County area from January 1996 through December 2017, and all the planning partners are exposed to the same weather events. Of these events, there was no recorded property damage and no injuries or fatalities (see Table 14-1.)

Table 14-1. Winter Weather Historical Events Summary in Frio County (1996-2017)

Year	Number of Events per Year	Property Damage	Crop Damage	Injuries	Fatalities
2011	1	$0	$0	0	0
1997	1	$0	$0	0	0
Total	2	$0	$0	0	0

Source: NCEI 2017

Frio County and the planning partners do not experience severe winter weather events consistently, but winter storms can affect the planning area. There have not been any Category 5 (SPIA Index) ice events in Frio County. Weather events for Frio County and participating communities have been in the 0-2 Index. SPIA Index events of 0 to 2 can expect ice accumulation up to 0.75 inch and winds less than 35 mph.

There have been no recorded or measurable amounts of snowfall in Frio County (1996-2017).

On January 2, 2018, the City of Dilley experienced sleet and freezing rain, with temperatures around freezing. Figure 14-3 shows frost covering crops in Dilley.

Figure 14-3. Frost on Crops in Dilley on January 2, 2018

USDA Risk Management Agency

According to the USDA Risk Management Agency, payments for insured crop losses in Frio County as a result of freeze conditions between 2011 and 2016 caused $170,167 in annualized crop losses that affected 308 acres.

14.1.4 Warning Time

Meteorologists can often predict the likelihood of a severe winter storm. When forecasts are available, they can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

14.2 VULNERABILITY AND IMPACTS

The entire planning area is vulnerable to the effects of winter storms. Hazardous driving conditions caused by snow and ice on highways and bridges lead to many traffic accidents and can impact the response of emergency vehicles. The leading cause of death during winter storms is transportation accidents. About 70% of winter-related deaths occur in automobiles due to traffic accidents and about 25% are from people caught outside in a storm. During winter storms, emergency services such as police, fire, and ambulance

are unable to respond due to road conditions. Emergency needs of remote or isolated residents for food or fuel, as well as for feed, water and shelter for livestock are unable to be met. The probability of utility and infrastructure failure increases during winter storms due to freezing rain accumulation on utility poles and power lines. People, pets, and livestock are also susceptible to frostbite and hypothermia during winter storms. Those at risk are primarily either engaged in outdoor activity or the elderly. Schools often close during extreme cold or ice conditions to protect the safety of children and bus drivers. Citizens' use of kerosene heaters and other alternative forms of heating may create other hazards such as structural fires and carbon monoxide poisoning.

14.2.1 Exposure

Vulnerable populations are the elderly, low income, linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe winter weather events and could suffer more secondary effects from the hazard. Commuters who are caught in storms may be particularly vulnerable. Stranded commuters may be vulnerable to carbon monoxide poisoning or hypothermia.

14.2.2 Impacts

The total property loss reported by the NCEI from winter storms was $0.

Buildings with overhanging tree limbs are more vulnerable to damage during winter storms. Businesses can experience loss of income as a result of closure during winter storms.

Loss of Use

Overhead power lines and infrastructure are also vulnerable to damage from winter storms. In particular, ice accumulation during winter storm events can cause damage to power lines due to the ice weight on the lines and equipment, as well as damage caused to lines and equipment from falling trees and tree limbs weighted down by ice. Potential losses would include cost of repair or replacement of damaged facilities, and lost economic opportunities for businesses. Secondary effects from loss of power could include burst water pipes in homes without electricity during winter storms. Public safety hazards include risk of electrocution from downed power lines. Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard.

The electric power loss of use estimates provided below were calculated using FEMA's Standard Values for Loss of Service for Utilities published in the June 2009 Benefit-Cost Analysis Reference Guide. These figures are used to provide estimated costs associated with the loss of power in relation to the populations in Frio County's jurisdictions. The loss of use estimates for power failure associated with winter storms are provided as the loss of use cost per person, per day of loss. The estimated loss of use provided for each jurisdiction represents the loss of service of the indicated utility for 1 day for 10% of the population. These figures do not consider physical damages to utility equipment and infrastructure.

Table 14-2. Loss of Use Estimates for Power Failure (One Day)

Jurisdiction	2016 Population	Estimated Affected Population (10%)	Electric Loss of Use Estimate ($126 per person per day)
City of Dilley	4,248	425	$53,550
City of Pearsall	10,064	1,006	$126,756
Unincorporated County	4,644	464	$58,464
Total	18,956	1,895	$238,770

Agriculture

According to the 6-year period from the USDA's Risk Management Agency, the amount of claims paid for crop damage as a result of winter weather conditions in Frio County was $170,167. According to the 2016 Texas Insurance Profile from the USDA's Risk Management Agency, 88% of the insurable crops in Texas are insured with USDA crop insurance. To estimate losses to insurable crops that are not insured, the 88% crop insurance coverage was factored in to provide an adjusted estimate of losses. According to this calculation, estimated annualized losses are over $65,605 (see Table 14-3).

Considering the value of crops from the 2012 Census of Agriculture as baseline crop exposure, the estimated annual loss was determined to be negligible compared to the value of the insurable crops.

Table 14-3. Estimated Insurable Annual Crops Lost Resulting from Freeze Conditions

6-Year Freeze Conditions Insurance Paid	Adjusted 6-Year Losses (considering 88% insured)	Estimated Annualized Losses	2012 Value of Crops
$170,167	$193,372	$12,819	$183,672,000

Source: USDA 2012; USDA RMA 2016; USDA 2016

Community Perception of Vulnerability

See the first page of this chapter for a summary of hazard rankings for Frio County and the planning partners in this plan. Chapter 15 gives a detailed description of these rankings and Chapter 16.2 addresses mitigation actions for this hazard vulnerability.

14.3 PROBABILITY OF FUTURE EVENTS

Table 14-1 lists two recorded winter weather events between 1996 and 2017. Therefore, on average, a winter weather event occurs once every decade and this occurrence may decrease as temperatures rise in the planning area.

The Cities of Dilley and Pearsall feel that there is low probability of winter storms in the future. Frio County feel the probability is medium and winter weather is likely to occur within 100 years.

14.4 CLIMATE CHANGE IMPACTS

The SCIPP information for Texas indicates temperatures increasing by another 3 to 9°F by 2100 and thus less frequent cold winter temperatures (SCIPP 2017).

If this trend continues, future occurrences of the extreme cold/wind chill aspects of winter weather should decrease. In addition, high winter temperatures bring higher probability of rain, rather than ice or snow. As a result, the amount of precipitation falling as snow should decrease.

14.5 ISSUES

Important issues associated with a winter storm in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to winter weather, particularly freezing temperatures, high winds, and ice.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- Future efforts should be made to identify populations at risk and identify special needs during winter storm events.

Chapter 15.
PLANNING AREA RISK RANKING

A risk ranking was performed for the hazards of concern described in this plan. This risk ranking assesses the probability of each hazard's occurrence as well as its likely impact on the people, property, and economy of the planning area. The risk ranking was conducted by the Steering Committee based on the hazard risk assessment presented during the second Steering Committee meeting, community survey results, and personal and professional experience with hazards in the planning area. The results are used in establishing mitigation priorities. The hazard rankings were used in establishing mitigation action priorities.

15.1 PROBABILITY OF OCCURRENCE

The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence:

- High (Probability Factor = 3)—Hazard event is likely to occur within 25 years
- Medium (Probability Factor = 2)—Hazard event is likely to occur within 100 years
- Low (Probability Factor = 1)—Hazard event is not likely to occur within 100 years
- No exposure (Probability Factor = 0)—There is no probability of occurrence

The assessment of hazard frequency is generally based on past hazard events in the planning area. The Steering Committee assigned the probabilities of occurrence for each hazard, as shown in Table 15-1.

Table 15-1. Probability of Hazards

Jurisdiction	Frio County Probability Factor	City of Dilley Probability Factor	City of Pearsall Probability Factor
Dam Failure	1	0	1
Drought	3	3	3
Extreme Heat	1	0	1
Earthquake	3	3	3
Flood	3	1	2
Hail	3	2	2
High Winds	3	1	1
Hurricane/Tropical Storm	2	1	2
Lightning	3	2	3
Tornado	3	1	3
Wildfire	3	1	1
Winter Storm	2	1	1

15.2 IMPACT

Hazard impacts were assessed in three categories based on impacts to: people, property, and the local economy. Numerical impact factors were assigned as follows:

- **People**—Values were assigned based on the percentage of the total ***population exposed*** to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people who live in a hazard zone will be equally impacted when a hazard event occurs. It should be noted that planners can use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows:
  - High (Impact Factor = 3)—50% or more of the population is exposed to a hazard

  - Medium (Impact Factor = 2)—25% to 49% of the population is exposed to a hazard
  - Low (Impact Factor = 1)—24% or less of the population is exposed to the hazard
  - No impact (Impact Factor = 0)—None of the population is exposed to a hazard

- **Property**—Values were assigned based on the percentage of the total ***assessed property value*** exposed to the hazard event:
  - High (Impact Factor = 3)—30% or more of the total assessed property value is exposed to a hazard
  - Medium (Impact Factor = 2)—15% to 29% of the total assessed property value is exposed to a hazard
  - Low (Impact Factor = 1)—14% or less of the total assessed property value is exposed to the hazard
  - No impact (Impact Factor = 0)—None of the total assessed property value is exposed to a hazard

- **Economy**—Values were assigned based on total impact to the economy from the hazard event and activities conducted after the event to restore the community to previous functions. Values were assigned based on the number of days the hazard impacts the community, including impacts on tourism, businesses, road closures, or government response agencies.
  - High (Impact Factor = 3)—Community impacted for more than 7 days
  - Medium (Impact Factor = 2)—Community impacted for 1 to 7 days
  - Low (Impact Factor = 1)—Community impacted for less than 1 day
  - No impact (Impact Factor = 0)—No community impacts estimated from the hazard event

The impacts of each hazard category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the economy was given a weighting factor of 1. The impacts for each hazard are summarized in Table 15-2, Table 15-3, and Table 15-4. The total impact factor shown on the tables equals the impact factor multiplied by the weighting factor.

Table 15-2. Impact on People from Hazards

Jurisdiction	Frio County Total Impact Factor	City of Dilley Total Impact Factor	City of Pearsall Total Impact Factor
Dam Failure	3	0	3
Drought	6	3	9
Extreme Heat	6	0	3
Earthquake	9	9	9
Flood	6	3	6
Hail	9	3	6
High Winds	6	3	3
Hurricane/Tropical Storm	6	3	6
Lightning	6	3	6
Tornado	3	3	9
Wildfire	6	3	3
Winter Storm	6	3	3

Table 15-3. Impact on Property from Hazards

Jurisdiction	Frio County Total Impact Factor	City of Dilley Total Impact Factor	City of Pearsall Total Impact Factor
Dam Failure	2	0	2
Drought	4	4	6
Extreme Heat	4	0	2
Earthquake	6	2	6
Flood	4	2	6
Hail	6	2	4
High Winds	4	2	2
Hurricane/Tropical Storm	4	2	4
Lightning	4	2	2
Tornado	2	2	6
Wildfire	4	2	2
Winter Storm	4	2	2

Table 15-4. Impact on Economy from Hazards

Jurisdiction	Frio County Total Impact Factor	City of Dilley Total Impact Factor	City of Pearsall Total Impact Factor
Dam Failure	2	0	1
Drought	3	3	3
Extreme Heat	1	0	2
Earthquake	3	3	3
Flood	2	1	2
Hail	1	0	2
High Winds	1	1	1
Hurricane/Tropical Storm	2	1	2
Lightning	1	0	1
Tornado	2	1	3
Wildfire	2	1	1
Winter Storm	2	1	1

15.3 RISK RATING AND RANKING

The total risk rating for each hazard was calculated by multiplying the probability factor by the sum of the weighted impact factors for people, property, and economy, as summarized in Table 15-5. Based on these ratings, a priority of high, medium, low, or no exposure was assigned to each hazard. The hazards ranked as being of highest concern vary by jurisdiction but generally include drought, extreme heat, and hail.

The City of Dilley ranked Dam Failure and Earthquake hazards as having “No Exposure” and thus no mitigation actions were developed for those hazards (see Table 15-5).

Table 15-5. Total Hazard Risk Rating Calculations

Hazard Event	Frio County	City of Dilley	City of Pearsall
Dam Failure	7	0	6
Drought	39	30	54
Extreme Heat	54	42	54
Earthquake	11	0	7
Flood	36	6	28
Hail	48	10	24
High Winds	33	6	6
Hurricane/Tropical Storm	24	6	24
Lightning	33	10	27
Tornado	21	6	54
Wildfire	36	6	6
Winter Storm	24	6	6

Note:
Total Risk Rating = Probability x Impact Weighted Sum (Total Impact Factor People + Total Impact Factor Property + Total Impact Factor Economy)

No Exposure
Low
Medium
High

PART 3
MITIGATION STRATEGY AND PLAN MAINTENANCE

Chapter 16.
MITIGATION STRATEGY

16.1 GUIDING PRINCIPLE AND GOALS

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.6(c)(3)(i)). The Steering Committee established a guiding principle, a set of goals, and measurable objectives for this plan, based on data from the preliminary risk assessment and the results of the public involvement strategy. The guiding principle, goals, and actions in this plan all support each other. Goals were selected to support the guiding principle. Actions were prioritized based on the action meeting multiple objectives.

16.1.1 Guiding Principle

A guiding principle focuses the range of actions to be considered. This is not a goal because it does not describe a hazard mitigation outcome, and it is broader than a hazard-specific objective. The guiding principle for the Frio County Hazard Mitigation Plan is as follows:

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

16.1.2 Goals

The following plan goals were determined by the Steering Committee:

- **Goal 1:** Minimize loss of life, and damage to property, the economy and natural resources from natural hazards.
- **Goal 2:** Increase public understanding, support and demand for hazard mitigation.
- **Goal 3:** Build and integrate local mitigation capabilities to encourage individual safety, reduce damage to public buildings and facilitate continuity of emergency services.
- **Goal 4:** Maintain the natural and man-made systems in the county to protect our communities from natural hazards.

16.2 AREA-WIDE MITIGATION ACTIONS AND IMPLEMENTATION

The Steering Committee reviewed a menu of hazard mitigation alternatives that present a broad range of alternatives to be considered for use in the planning area, in compliance with 44 CFR Section 201.6(c)(3)(ii)). The menu provided a baseline of mitigation alternatives that are backed by a planning process, are consistent with the planning partners' goals and are within the capabilities of the partners to implement. The Steering Committee reviewed the full range of actions as well as the county's ability to implement the variety of mitigation actions. Hazard mitigation actions recommended in this plan were selected from among the alternatives presented in the menu as well as other projects known to be necessary.

16.2.1 Recommended Mitigation Actions

The Steering Committee planning partners identified actions that could be implemented to provide hazard mitigation benefits. Table 16-1 lists the recommended mitigation actions identifying the mitigation action number, title, description, mitigation action ranking, hazards mitigated, action type, applicable goals, responsible department to administer the action, estimated cost, potential funding sources, timeline in months, and benefit to the community (high, medium or low). All the hazards profiled in this plan are addressed by more than one mitigation action, except for the City of Dilley that ranked Dam Failure and Earthquake hazard as "No Exposure."

Mitigation types used for this categorization are as follows:

- Local Plans and Regulations (LPR)—These actions include government authorities, policies, or codes that influence the way land and buildings are being developed and built.
- Structure and Infrastructure Projects (SIP)—These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.
- Natural Systems Protection (NSP)—These are actions that minimize damage and losses, and also preserve or restore the functions of natural systems.
- Education and Awareness Programs (EAP)—These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These initiatives may also include participation in national programs, such as StormReady and FireWise Communities.

Mitigation action worksheets were developed to provide more information for each recommended mitigation action, including the specific problem being mitigated, alternative actions considered, whether the action applies to existing or future development, the benefits or losses avoided, the department, position, office or agency responsible for implementing the action, the local planning mechanism, and potential funding sources. These worksheets were developed to provide a tool for the planning partners to apply for grants or general funds to complete the mitigation action. An example worksheet for Frio County is shown in Figure 16-1. These worksheets are kept on file with the county and cities and can be a valuable resource for annual progress updates and reports.

Frio County
Mitigation Action Worksheet

Please complete one worksheet per action with as much detail as possible, using the instructions provided and FEMA examples.

Name of Jurisdiction: _____ **Mitigation Action #:** _____

Mitigation Action Title: _____

Assessing the Risk	
Hazard(s) addressed: (check all that apply)	☐All Hazards ☐Dam Failure ☐Drought ☐Earthquake ☐ Extreme Heat ☐Flood ☐ Hail ☐ High Winds ☐Hurricane/Tropical Storm ☐ Lightning ☐Tornado ☐Wildfire ☐ Winter Storm
Specific problem being Mitigated (describe why action is needed)	
Evaluation of Potential Alternatives	
Alternatives Considered (name of project and reason for not selecting)	1.
	2.
	3.
Action/Project Intended for Implementation	
Describe how action will be implemented (main steps involved)	
Action/Project Type	☐Local Plans and Regulations ☐Structure and Infrastructure Project ☐Natural Systems Protection ☐Education and Awareness Programs
Applicable Goals (refer to list of goals)	☐Goal #1 ☐Goal #2 ☐Goal #3 ☐Goal #4 ☐Goal #5
Applies to existing or future development	☐ Existing Development ☐Future Development ☐ Both Existing and Future Development ☐Not Applicable
Describe benefits (losses avoided)	☐Life Safety ☐Damage Reduction ☐Other Describe:
Estimated Cost	☐ < $10,000; ☐$10,000 to $100,000; ☐>$100,000 Other Amount: $
Plan for Implementation	
Responsible Department	
Local Planning Mechanism (check all that apply)	☐Capital Improvement Plan ☐Comprehensive Plan ☐Building Code ☐Ordinance ☐Other:
Potential Funding Sources	
Timeline for Completion (in months)	
Reporting on Progress (to be implemented after FEMA approval)	
Status/Comment	☐Not Started ☐In-progress ☐Delayed ☐Completed ☐No Longer Required Comment:
Completed by: (name, title, phone #) Date:	

Figure 16-1. Sample Mitigation Action Worksheet

16.2.2 Benefit/Cost Review and Prioritization

The action plan must be prioritized according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Assistance (HMA) Grant Program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

Fourteen criteria were used to assist in evaluating and prioritizing the mitigation initiatives. For each mitigation action, a numeric rank (0, 1, 2, 3, 4) was assigned for each of the 14 evaluation criteria defined as follows:

- Definitely Yes - 4
- Maybe Yes - 3
- Unknown/Neutral - 2
- Probably No - 1
- Definitely No - 0

The 14 evaluation/prioritization criteria are:

1. Life Safety—How effective will the action be at protecting lives and preventing injuries? The numeric rank for this criterion is multiplied by 2 to emphasize the importance of life safety when evaluating the benefit of the action.
2. Property Protection—How significant will the action be at eliminating or reducing damage to structures and infrastructure? The numeric rank for this criterion is multiplied by 2 to emphasize the importance of property protection when evaluating the benefit of the action.
3. Cost-Effectiveness—Will the future benefits achieved by implementing the action, exceed the cost to implement the action?
4. Technical—Is the mitigation action technically feasible? Will it solve the problem independently and is it a long-term solution? Eliminate actions that, from a technical standpoint, will not meet the goals.
5. Political—Is there overall public support for the mitigation action? Is there the political will to support it?
6. Legal—Does the jurisdiction have the authority to implement the action?
7. Fiscal—Can the project be funded under existing program budgets (i.e., is this action currently budgeted for)? Or would it require a new budget authorization or funding from another source such as grants?
8. Environmental—What are the potential environmental impacts of the action? Will it comply with environmental regulations?
9. Social—Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?
10. Administrative—Does the jurisdiction have the personnel and administrative capabilities to implement the action and maintain it or will outside help be necessary?
11. Multi-hazard—Does the action reduce the risk to multiple hazards?
12. Timeline—Can the action be completed in less than 5 years (within our planning horizon)?

13. Local Champion—Is there a strong advocate for the action or project among the jurisdiction's staff, governing body, or committees that will support the action's implementation?
14. Other Local Objectives—Does the action advance other local objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of other plans and programs?

The numeric results of this exercise are shown on the mitigation action worksheets. An example worksheet for is shown in Figure 16-2. These results were used to identify the benefit of the action to the community as low, medium, or high priority. Table 16-1 shows the benefit of each mitigation action.

The Steering Committee used the results of the benefit/cost review and prioritization exercise to rank the mitigation actions in order of priority, with 1 being the highest priority. The highest priority mitigation actions are shown in red on Table 16-1, medium priority actions are shown in yellow and low priority actions are shown in green.

Prioritization Worksheet

Mitigation Action #: _____

Mitigation Action Title: _____

Criteria	Numeric Rank: Definitely Yes = 4, Maybe Yes = 3, Unknown/Neutral = 2, Probably No = 1, Definitely No = 0		Provide brief rationale for numeric rank when appropriate
1. Will the action result in Life Safety?		x 2 =	
2. Will the action result in Property Protection?		x 2 =	
3. Will the action be Cost-Effective? (future benefits exceed cost)			
4. Is the action Technically feasible			
5. Is the action Politically acceptable?			
6. Does the jurisdiction have the Legal authority to implement?			
7. Is Funding available for the action?			
8. Will the action have a positive impact on the natural Environment?			
9. Is the action Socially acceptable?			
10. Does the jurisdiction have the Administrative capability to execute the action?			
11. Will the action reduce risk to more than one hazard (Multi-Hazard)?			
12. Can the action be implemented Quickly?			
13. Is there an Agency/Department Champion for the action?			
14. Will the action meet other Community Objectives?			
Total			
Priority: Low = <35, Medium = 35-49, High = >50	☐Low ☐Medium ☐High		

Figure 16-2. Example Benefit/Cost Review and Prioritization Worksheet

Table 16-1. Recommended Mitigation Actions by Jurisdiction

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
FRIO COUNTY											
1	All Hazards Education for Homeowners	Post material on the effects of hazards to homeowners on the county website and Facebook sites. Publish articles concerning hazards in the local newspaper. Provide handouts at all county offices and satellite buildings.	1	Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather	●	G3	Office of Emergency Management	$5,000	County Budget	60	High
2	Retrofit Water Systems in County Buildings	Retrofit existing plumbing fixtures with water-saving devices. Install water-saving devices on all new county structures.	5	Drought	●	G4	Road & Bridge Maintenance	$10,000	County Budget and Grants	60	Medium
3	Retrofit Existing County Buildings	Replacement of roofing material and exterior siding with hail-resistant materials along with a cool roofing product that reflects sunlight and heat away from building. Anchoring of roof mounted equipment such as air conditioning units and portable buildings/offices to mitigate against earthquake, tornado, and wind damage. Installation of window film to reduce injury from shattered glass from thunderstorms and hurricanes. Adding insulation to walls and attic to protect building from winter wintry weather.	4	Earthquake, Extreme Heat, Hail, Hurricane/ Tropical Storm, Tornado, Wind, Winter Weather	●	G4	Road & Bridge Maintenance	$100,000	County Budgets and Grants	60	High

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
4	Electrical Protection on County Buildings	Install lightning rods and grounding devices on all county buildings. Install surge protection equipment on all critical electronic equipment.	6	Hurricane/ Tropical Storm, Lightning	●	G4	Road & Bridge Maintenance	$80,000	County Budget and Grants	60	High
5	Water Source Mapping & Property Owner MOU	Map rural water sources that are on privately owned property. Create MOUs with property owners to allow access to and use of water supplies for wildfire fighting.	3	Wildfire	●	G1, G2	Office of Emergency Management (mapping) Commissioners Court (MOUs/agreements)	$10,000	County Budgets	60	High
6	Adopt Higher Standard Flood Ordinance	Flood mapping is not available for the unincorporated areas of the county. Flooding from hurricanes/tropical storms, dam failure can result in the loss of life and property of local residents. FEMA has designed Frio County as a priority county for LiDAR and mapping to be completed in, but it has not be scheduled to date.	2	Dam Failure, Flood, Hurricane/ Tropical Storm	●	G1, G2	Commissioners Court	$10,000	County Budget and Grants	60	High
7	Purchase and Install Permanent Back-up Generator for Courthouse	County courthouse does not have a back-up generator, where an EOC is located. An extended power loss would cause disruption to county services as well as EOC operations. Frio County will purchase and install a permanent back-up generator in the event of extended power loss for the courthouse.	7	Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather	●	G2, G4	Office of Emergency Management	$100,000	County Budget, HMGP Grant	60	Medium
CITY OF DILLEY											
1	Purchase and Install Permanent Back-up Generator for City Hall	City Hall does not have a back-up generator and that is where an EOC is located. An extended power loss would cause disruption to city services as well as EOC operations. The city will purchase and install a permanent back-	4	Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado,	●	G2, G4	City Manager	$100,000	City Budget, HMGP Grant	60	Medium

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		up generator in the event of extended power loss for City Hall.		Wildfire, Wind, Winter Weather							
2	Conduct Public Outreach to Educate Homeowners on Mitigation Measures for Their Homes	The public needs reminders about mitigation measures to protect their home from natural hazards as storm events have become more intense, and droughts and extreme heat periods last longer.	3	Drought, Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather	●	G2, G3, G5	City Manager	$5,000	City Budget	60	Medium
3	Implement Drought and Extreme Heat Contingency Plan	The city is most impacted by drought and extreme heat conditions as these conditions are prevalent most years. Thus, a contingency plan for water usage is needed. The city will create and implement a drought and extreme heat contingency plan to create water conservation stages for users based on water availability.	1	Drought, Extreme Heat	●	G2, G3, G5	City Manager	$40,000	City Budget, Grants	60	Medium
4	Implement Box Fan Campaign for Residents	The city will create a donations campaign to give box fans to residents in need. The city cannot purchase these fans for residents, but they can lead the campaign and team with civic groups such as the Knights of Columbus, Chamber of Commerce and Society of St. Vincent de Paul to gather donations and distribute fans.	2	Extreme Heat	●	G2	City Manager	No cost	Donations	36	Medium
CITY OF PEARSALL											
1	Update IBC to 2015 Version	The city will adopt and enforce the measures and guidelines of IBC 2015. This will ensure the safety of natural hazards and incorporate these stricter building codes into other planning efforts	4	Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Hail,	●	G2, G4	Public Works, Police	No cost	City Budget	60	High

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		such as the Master Plan. The stricter codes can mitigate the identified hazards, such as tornado, high wind, and impact-resistant materials (windows, doors, roof bracings) by: dry-proofing public buildings for flooding; upgrading to higher standard insulation for extreme heat and winter storms; installing lighting rods and grounding systems on public buildings; retrofitting to low-flow plumbing and replacing landscaping with drought and fire resistant plants; creating stricter codes for hail and fire-resistant roofing and siding; and implementing higher standards for foundations.		Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather							
2	Purchase and Install Permanent Back-up Generator for Wastewater Treatment Facility	The city will purchase and install a permanent back-up generator in the event of extended power loss for the wastewater treatment facility.	5	Dam Failure, Earthquake, Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado, Wildfire, Wind, Winter Weather	●	G2, G4	Public Works	$100,000	City Budget	6	High
3	Conduct Public Outreach to Educate Homeowners on Mitigation Measures for Their Homes	Information on methods and materials homeowners can use to minimize the hazards to property and human life; information posted and available in newspaper, on city website, and on marquees throughout the city.	2	Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Hail, Hurricane/ Tropical Storm, Lightning, Tornado,	●	G2, G3, G5	Public Works	$5,000	City Budget	60	High

Action No.	Title	Description	Mitigation Action Ranking	Hazards Mitigated	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
				Wildfire, Wind, Winter Weather							
4	Maintain Storm Drainage System	The drainage system collects debris in culverts and becomes ineffective in containing flood waters during rain events. The Public Works Department will maintain the storm drainage system by clearing debris and cutting and mowing vegetation in drainage ditches at least twice a year.	1	Dam Failure, Flood, Hurricane/ Tropical Storm	●	G2, G4	Public Works	$20,000	City Budget	60	High
5	Drought and Extreme Heat Contingency Plan	The Public Works Department will update their Drought Contingency Plan, dated September 2011 to include extreme heat and update the 5 Stages Shortage conditions water usage limits and water impacts. Then city ordinance will be updated with latest information.	3	Drought, Extreme Heat	●	G1, G3, G4, G5	Public Works	$60,000	City Budget	48	Medium

LEGEND

Action Type: ● Education and Awareness Programs ● Structure and Infrastructure Projects ● Local Plans and Regulations ● Natural Systems Protection

Notes:

EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
HMGP	Hazard Mitigation Grant Program
IBC	International Building Code
LiDAR	A surveying technology that measures distance by illuminating a target with a laser light
MOU	Memorandum of Understanding

Chapter 17.
PLAN ADOPTION AND MAINTENANCE

17.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). For multi-jurisdictional plans, each jurisdiction requesting approval must document that is has been formally adopted. All planning partners fully met the participation requirements specified by the Steering Committee and will seek Disaster Mitigation Act of 2000 (DMA) compliance under this plan. The plan will be submitted for review to the Texas Division of Emergency Management (TDEM) and then to the Federal Emergency Management Agency (FEMA) Region VI for review and pre-adoption approval. Once pre-adoption approval has been provided, all planning partners will formally adopt the plan. All partners understand that DMA compliance and its benefits cannot be achieved until the plan is adopted. Copies of the resolutions adopting this plan for all planning partners can be found in Appendix D.

17.2 PLAN MAINTENANCE STRATEGY

A hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.6(c)(4)): monitoring, evaluating, schedule, process, and continued public participation. This chapter details the formal process that will ensure that the Frio County Hazard Mitigation Plan remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every 5 years. The chapter also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

17.2.1 Monitoring and Evaluating

The annual plan maintenance Steering Committee meetings will include representation from each of the participating jurisdictions, multiple departments within Frio County, and interested stakeholders. As with the Steering Committee all interested and affected entities within the communities are encouraged to participated. With adoption of this plan, the designated Steering Committee members will be tasked with plan monitoring, evaluation and maintenance. The Steering Committee, led by the Frio County Emergency Management Coordinator, agree to:

- Meet annually to monitor and evaluate the implementation of the plan
- Act as a forum for hazard mitigation issues
- Disseminate hazard mitigation ideas and activities to all participants
- Pursue the implementation of high priority, low- or no-cost recommended actions
- Maintain vigilant monitoring of multi-objective, cost-share, and other funding opportunities to help the community implement the plan's recommended actions for which no current funding exists
- Monitor and assist in implementation and update of this plan
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters
- Report on plan progress and recommended changes to the Frio County Commissioners' Court and governing bodies of participating jurisdictions
- Inform and solicit input from the public

The Steering Committee is an advisory body and can only make recommendations to county- and city-elected officials. Its primary duty is to see the plan successfully carried out and to report to the community governing boards and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, hearing stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information in areas accessible to the public.

17.2.2 Plan Maintenance Schedule

The Steering Committee will meet annually to monitor progress, discuss recent hazard events and changes in development that impact vulnerability, and update the mitigation strategy. The Frio County Emergency Management Coordinator will be responsible for initiating the plan reviews with the Steering Committee and plan to combine with other regularly schedule emergency management meetings.

In coordination with the other participating jurisdictions, a 5-year written update of the plan will be submitted to TDEM and then to FEMA Region VI per Requirement §201.6(c)(4)(i) of the DMA, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule.

17.2.3 Plan Maintenance Process

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions, and/or
- Increased vulnerability as a result of new development (and/or annexation).

The annual reviews and updates to this plan will include the following:

- Consider changes in vulnerability due to action implementation
- Summary of any natural hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement and feedback received from the community
- Re-evaluation of the action plan to evaluate whether the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation
- Monitor the incorporation of the Mitigation Plan into planning mechanisms
- Provide information for a press release that will be issued to the local media
- Inform planning partner governing bodies of the progress of actions implemented during the reporting period
- Uses of the progress report will be at the discretion of each planning partner. A template to guide the planning partners in preparing an annual progress report is available in Appendix H. Annual progress reporting is not a requirement specified under 44 CFR. However, it may enhance the

planning partnership's opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize a planning partner's compliance under the DMA, it may jeopardize its opportunity to partner and leverage funding opportunities with the other partners.

To best evaluate the mitigation strategy during plan review, the participating jurisdictions will follow the following process:

- A representative from the responsible office identified in each mitigation action will be responsible for tracking and reporting the action status on an annual basis to the jurisdictional Steering Committee member and providing input on any completion details or whether the action still meets the defined goals and is likely to be successful in reducing vulnerabilities.
- If the action does not meet identified goals, the jurisdictional Steering Committee member will determine what additional measures may be implemented, and an assigned individual will be responsible for defining action scope, implementing the action, monitoring success of the action, and making any required modifications to the plan.
- As part of the annual review process, the Frio County Emergency Management Coordinator will provide the updated Mitigation Strategy with the status of each mitigation action to the County Board of Supervisors and County Department Heads as well as all City Managers requesting that the mitigation strategy be incorporated, where appropriate in other planning mechanisms.

Changes will be made to the plan to accommodate for actions that have failed or are not considered feasible after a review of their consistency with established criteria, time frame, community priorities, or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will be reviewed as well during the monitoring and update of this plan to determine feasibility of future implementation. Updating of the plan will be by written changes and submissions, as the Steering Committee deems appropriate and necessary, and as approved by the Frio County Board of Supervisors and the governing boards of the other participating jurisdictions.

17.2.4 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Frio County OEM and other methods as appropriate. The OEM will not only house the final plan, it will become the one-stop shop for information regarding the plan, the partnership and plan implementation. Copies of the plan will be distributed to the public library system in Frio County. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new Steering Committee. This strategy will be based on the needs and capabilities of the planning partnership at the time of the update. This strategy will include the use of local media outlets within the planning area to notify the public of the implementation, monitoring, and evaluation of the plan. The public will be invited to participate in each stage by attending meetings and providing feedback to the planning team and Steering Committee members. The Steering Committee may include community stakeholders, such as prominent businesses, local action groups, etc.

17.3 INCORPORATION INTO EXISTING PLANNING MECHANISMS

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The existing Frio County regulations, ordinances, and plans (including the Frio County Emergency Operations Plan), and the jurisdictional comprehensive plans are integral parts of this plan. The county and planning partners, through adoption of comprehensive plans and zoning ordinances, have planned for the impact of natural hazards.

Frio County and the Cities of Dilley and Pearsall do not have standing formal planning mechanisms such as a Comprehensive Plan or Capital Improvements Plan through which formal integration of mitigation

actions can be documented. As a result, activities that occur in these jurisdictions are developed through annual budget planning, regular City Council Meetings and other community forums rather than a formal planning process. Planning mechanisms that do exist within the participating jurisdictions include:

- Various ordinances of participating jurisdictions, including floodplain management ordinances in NFIP-participating communities; and
- Frio County Emergency Operations Plan.

For a detailed summary of planning mechanisms and other mitigation-related capabilities, see Chapter 3.

In Frio County, the general statue process for integration includes a request by a county departmental supervisor, elected official or other interested party. Once a request is initiated, the item is placed on the Commissioner's Court agenda, compliant with all County required procedures which includes posting in the Courthouse as well as the Frio County Commissioner's website for public access. The item is discussed as part of the Commissioners normal agenda. Discussion is then open to the public in attendance at the Commissioner's Court public meeting compliant with the provisions of the Texas Open Meeting Act, Texas Government Code, Chapter 551. The proposal is then voted on by the Commissioner's Court which may or may not be the same meeting the proposal was first introduced at.

In the participating Cities of Dilley and Pearsall, the general statue process for integration is initiated via an action request by a city departmental supervisor, city manager, elected official or other interested party. The City Clerk or City Secretary coordinators action items and completes the City Council's agenda which is posted for public access per each city's statue. The item is discussed at the City Council's public meeting, including receipt of public comment per the provisions of the Texas Open Meeting Act, Texas Government Code, Chapter 551. The proposal is then voted on by the City Council which may or may not be the same meeting the proposal was first introduced at.

Table 17-1. Strategies to Integrate Plan

Jurisdiction	Type of Plan	Integration Process for Plan
Frio County	Annual Budget	Integrate mitigation action ideas into annual budget planning process
	Frio County Subdivision Ordinance	Maintain current data on high-risk areas via the mitigation plan and regularly incorporate information on high-risk hazard areas into the subdivision requirements, thereby eliminating or reducing potential impacts on current and future development.
	Flood Damage Prevention Order	Overlay high-risk/flood prone areas with future floodplain regulations, thereby minimizing or reducing the impacts of flooding on current and future development.
	Frio County Basic Emergency Operations Plan	In the process of updating the Frio County Basic Emergency Operations Plan in 2018-2019, integrate the Hazard Mitigation Plan Risk Assessment into the Basic Emergency Operations Plan
	Grant Applications	Training in grant writing for current staff members or hiring a contractor to write grant applications for mitigation projects
City of Dilley	Budget Planning Process	Integrate mitigation action ideas into annual budget planning process

Jurisdiction	Type of Plan	Integration Process for Plan
City of Pearsall	Budget Planning Process	Integrate mitigation action ideas into annual budget planning process
	Flood Damage Prevention Order	Overlay high-risk/flood prone areas from 2014 DFIRMs with future floodplain regulations, thereby minimizing or reducing the impacts of flooding on current and future development

Notes:
DFIRM Digital Flood Insurance Rate Map

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APPENDIX A.
ACRONYMS AND DEFINITIONS

APPENDIX A.
ACRONYMS AND DEFINITIONS

ACRONYMS

Note: Acronyms are defined the first time they are used in each part of this plan.

°F	Degrees Fahrenheit
°C	Degrees Celsius
44 CFR	Title 44 Code of Federal Regulations
AACOG	Alamo Area Council of Governments
CWA	Clean Water Act
CWPP	Community Wildfire Protection Plan
CWSRF	Clean Water State Revolving Fund
CDBG-DR	Community Development Block Grant - Disaster Recovery
DFIRM	Digital Flood Insurance Rate Maps
DMA	Disaster Mitigation Act of 2000
DPS	Department of Public Safety
EAP	Education and Awareness Program
EF	Enhanced Fujita
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Fire Intensity Scale
FPA-FOD	Fire Program Analysis-Fire Occurrence Database
GIS	Geographic Information System
GLF	Geophysical Log Facility
Hazus	Hazards, United States-Multi Hazard
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
IBC	International Building Code
KT	Knot
LAL	Lightning Activity Level
LPR	Local Plans and Regulations
ML	Local Magnitude Scale, or Richter scale

MOU	Memorandum of Understanding
Mph	Miles per Hour
M_W	Moment Magnitude
NASA	National Aeronautics and Space Administration
NCEI	National Centers for Environmental Information
NFIP	National Flood Insurance Program
NID	National Inventory of Dams
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NSP	Natural Systems Protection
NWS	National Weather Service
OEM	Office of Emergency Management
PGA	Peak Ground Acceleration
PHDI	Palmer Hydrological Drought Index
SCIPP	Southern Climate Impacts Planning Program
SHMP	State of Texas Hazard Mitigation Plan
SIP	Structure and Infrastructure Project
SFHA	Special Flood Hazard Area
SPIA Index	Sperry-Piltz Ice Accumulation Index
SWCD	Soil and Water Conservation District
TCEQ	Texas Commission on Environmental Quality
TDEM	Texas Division of Emergency Management
TFS	Texas Forest Service
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TxWRAP	Texas A&M Forest Service Wildfire Risk Assessment Portal
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
UTIG	University of Texas Institute for Geophysics
W/m^2	Watts per Square Meter
WHP	Wildfire Hazard Potential
WMO	World Meteorological Organization

WRCC	Western Regional Climate Center
WUI	Wildland Urban Interface

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1% chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1% annual-chance-flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the NFIP are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water, whether from rainfall, snowmelt, springs, or other sources, flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Breach: An opening through which floodwaters may pass after part of a levee has given way.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Conflagration: A fire that grows beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions, excessive fuel buildup, and explosions are usually the elements behind a wildfire conflagration.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs.

Dam: A barrier, including one for flood detention, designed to impound liquid volumes and which has a height of dam greater than six feet (Texas Administrative Code, Ch. 299, 1986).

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Deposition: Deposition is the placing of eroded material in a new location.

Disaster Mitigation Act of 2000 (DMA): The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage Basin: A basin is the area within which all surface water, whether from rainfall, snowmelt, springs or other sources, flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Emergency Action Plan: A document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize property damage and loss of life. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency. (FEMA 64)

Enhanced Fujita Scale (EF-scale): The EF-scale is a set of wind estimates (not measurements) based on damage. It uses 3-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators. These estimates vary with height and exposure. Standard measurements are taken by weather stations in openly exposed area.

Expansive Soil: Expansive soil and rock are characterized by clayey material that shrinks as it dries or swells as it becomes wet.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Extreme Heat: Summertime weather that is substantially hotter or more humid than average for a location at that time of year.

Fault: A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate.

Flood: The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's FIRM. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A FIRM identifies most, but not necessarily all, of a community's floodplain as the SFHA.

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than one foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Freezing Rain: The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to 6 tons of ice, creating a threat to power and telephone lines and transportation routes.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed

less than 73 miles per hour [mph]) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Ground Subsidence: Ground subsidence is the sinking of land over human-caused or natural underground voids and the settlement of native low density soils.

Groundwater Depletion: Groundwater depletion occurs when groundwater is pumped from pore spaces between grains of sand and gravel. If an aquifer has beds of clay or silt within or next to it, the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure is a loss of support for the clay and silt beds. Because these beds are compressible, they compact (become thinner), and the effects are seen as a lowering of the land surface.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster.

Hazards U.S. Multi-Hazard (Hazus) Loss Estimation Program: Hazus is a GIS-based program used to support the development of risk assessments as required under the DMA. The Hazus software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. Hazus is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. Hazus has also been used to assess vulnerability (exposure) for other hazards.

High Hazard Dam — Dams where failure or operational error will probably cause loss of human life. (FEMA 333)

Hurricane: A tropical cyclone with maximum sustained surface winds (using the U.S. 1-minute average) of 64 knot (kt) (74 miles per hour [mph]) or more.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Hypocenter: The region underground where an earthquake's energy originates.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Interface Area: An area susceptible to wildfires and where wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 people are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under state law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Actions: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

National Flood Insurance Program (NFIP): The NFIP provides federally backed flood insurance in exchange for communities enacting floodplain regulations.

Peak Ground Acceleration: Peak Ground Acceleration is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1,000; or
- Two paid flood losses in excess of $1,000 within any 10-year period since 1978; or
- Three or more paid losses that equal or exceed the current value of the insured property.

Riparian Zone: The area along the banks of a natural watercourse.

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates for the jurisdiction are based on the methodology that the jurisdiction used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation:

Risk Ranking = Probability + Impact (people + property + economy)

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Severe Local Storm: Small-scale atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms, and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Significant Hazard Dam: Dams where failure or operational error will result in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities, or can impact other concerns. Significant hazard dams are often located in rural or agricultural areas but could be located in areas with population and significant infrastructure. (FEMA 333)

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Special Flood Hazard Area: The base floodplain delineated on a FIRM. The SFHA is mapped as a Zone A in riverine situations. The SFHA may or may not encompass all of a community's flood problems.

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion is common along rivers, streams, and drains where banks have been eroded, sloughed, or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Tropical Storm: A tropical cyclone with maximum sustained surface wind speed (using the U.S. 1-minute average) ranges from 34 kt (39 mph) to 63 kt (73 mph).

Tropical Depression: A tropical cyclone with maximum sustained surface wind speed (using the U.S. 1-minute average) ranges from 4 kt (39 mph) to 63 kt (73 mph).

Values Response Index (VRI): The wildfire VRI reflects a rating of the potential impact of a wildfire on values or assets. The VRI is an overall rating that combines the impact ratings for WUI (housing density) and Pine Plantations (pine age) into a single measure. VRI combines the likelihood of a fire occurring (threat) with those areas of most concern that are adversely impacted by fire to derive a single overall measure of wildfire risk.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: Wildfire refers to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Wildfire Hazard Potential (WHP): The wildfire threat or WHP is the likelihood of a wildfire occurring or burning into an area. Threat is calculated by combining multiple landscape characteristics including surface and canopy fuels, fire behavior, historical fire occurrences, weather observations, terrain conditions, and other factors.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly

constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Winter Storm: A storm having significant snowfall, ice, or freezing rain; the quantity of precipitation varies by elevation.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

APPENDIX B.
PLANNING PROCESS DOCUMENTATION

APPENDIX B.
PLANNING PROCESS DOCUMENTATION

This appendix includes the agenda, sign-in sheets, and meeting notes from each of the three Steering Committee Meetings. This appendix also include the results of the Frio County Hazard Mitigation Plan questionnaire, as described in Chapter 2.7.2.

Frio County Hazard Mitigation Plan
Steering Committee Kick-Off Meeting
October 19, 2017
2:00 PM

- Welcome and Introductions
- What is Hazard Mitigation Planning
- Steering Committees Purpose and Responsibilities
- Review/Revise/Update (as needed) Plan Goals
- Review of Past Mitigation Actions
- Critical Facilities
- Next Steps
  - Capabilities Assessment
  - Hazard Analysis
  - Community Participation and Survey Handout (in packet)
- Action Items
- Adjournment

TETRA TECH

Frio County Hazard Mitigation Plan
Steering Committee Kick-Off Meeting
October 19, 2017 2:00 PM
Meeting Notes

- Welcome and Introductions – Laura Johnston (Tetra Tech) welcomed everyone and Meeting attendees stated their name and the jurisdiction/community they were representing. See sign in sheet for a complete list of attendees.
- Each attendee was provided a folder with handouts, a copy of the presentation slides, and contact information for the consultant team.
- Ms. Johnston provided an overview of the planning process and discussed the purpose and goals of the Hazard Mitigation Plan (HMP) for Frio County. Ms. Johnston stated that the plan will only address natural hazards. The HMP is developed to ensure eligibility of the county and participating jurisdictions for disaster recovery grants from the Federal Emergency Management Agency (FEMA) and to develop mitigation actions to help reduce risk and exposure to the hazards. The HMP will help make Frio County a safer and more resilient community.
- Ms. Johnston stated that this an update to the previous expired HMP developed for Frio County was part of a larger plan undertaken by the COG. Neither FEMA nor TDEM accept large scale regional plans like this anymore. It was noted that the COG plan expired in July of 2017.Once adopted, the HMP will need to be reviewed annually or after a significant event and updated at least every 5 years to maintain eligibility for disaster recovery grants.
- Ms. Johnston reviewed the purpose and responsibilities of the Planning and Steering Committee. Planning and Steering Committee members:
  - Are leaders involved in the development of the plan
  - Provide guidance on their specific community
  - Carry information from the meetings to their community
  - Represent all community stakeholders (residents and businesses)
  - Attend and actively participate in all three committee meetings (including this one)
- Ms. Johnston stated that plan participants will sign and adopt the HMP through formal resolutions or other appropriate methods for the jurisdiction. Ms. Johnson discussed the anticipated participants, including Frio County, Pearsall and Dilley. A participating jurisdiction can apply for hazard mitigation grants directly as the applicant of record.

- Ms. Johnston outlined the topics of the second and third steering committee meetings. These meetings are tentatively scheduled for December of 2017 and spring of 2018. A target of early Summer 2018 has been set for TDEM review of the Draft HMP.

- Ms. Johnston explained the difference between overarching goals, the plan goals and objectives, and mitigation actions. Overarching goals state the broad purpose of the HMP. Plan goals are general statements or guidelines that explain the objective of the plan; they are usually broad-based, policy-type statements and represent global visions. Objectives are more short-term aims that, when combined, form a strategy to meet a goal.

- Ms. Johnston referred to the goals located in the expired Frio County HMP and the discussed updates with the Committee. Discussion followed regarding modifications. The Committee drafted and agreed upon a new overarching goal and several specific goals. Ms. Johnston explained that mitigation actions would be developed after the second Steering Committee meeting to identify actions to achieve the goals.

- Ms. Johnston explained that FEMA Region VI requires a minimum of two mitigation actions for each hazard rated medium and high in the plan. Mitigation actions must be supported by at least one goal. However, mitigation actions can fall under multiple goals. Mitigation actions are more likely to be funded if under more than one goal.

- Ms. Johnston reviewed the critical facilities analysis.

  - There was a brief discussion on the definition of "Critical Facilities." Ms. Johnston shared the definition of Critical. Ms. Johnston has a draft list of critical facilities obtained from FEMA's HAZUS defaults but this needs to be updated.

  - Ms. Johnston gave the draft list of the critical facilities to Mr. Kallio, who will distribute the list to the proper departments and jurisdictions. Mr. Kallio will collect, review, and update the lists before returning to Tetra Tech.

  - This updated information is needed to map the critical facilities for the planning area to determine if these facilities are located in high risk areas and how they overlap with hazards. Ms. Johnston emphasized that the list of critical facilities will not be made available to the public nor will the locations of the critical facilities appear in the HMP in sufficient detail for the public to identify their locations.

- Ms. Johnston reviewed the next steps: capabilities assessment, hazard analysis, and community participation and survey.

  - Ms. Johnston provided an overview of capabilities assessment. Tetra Tech initiated online research and completed as much of the document as possible. The draft document was handed out to each community representative to verify the current resources of the jurisdictions. This is used to determine the strengths and opportunities

related to the community's ability to implement the future mitigation actions. Comments are due back to Tt representative Kari Valentine November 15, 2017.

- Tetra Tech will conduct the hazards analysis in the next few months. During the next (second) meeting, the results of the hazards analysis will be presented and the attendees will rank these hazards.
    - When ranking hazards, perception and reality may be different. Perception (especially community perception) can be skewed based on recent event, even if event is not local. When ranking hazards, we need to consider reality on a community-specific basis.
    - Ms. Johnston explained that the hazard assessment will analyze historical information and data, rate of occurrence, and future projected losses, etc. Historic information from Steering Committee members will make the risk assessment more accurate.
    - We will provide hazard-specific information for the members to determine a prioritization ranking of high, medium, or low. Community perception will be uncovered, in part, through the community survey. However, ranking process is still subjective.
- Ms. Johnston discussed how community participation (including the online survey) is an integral part of this HMP update process. Ms. Johnston discussed the benefits of full community participation in order to produce a true community plan.
    - The online surveys consists of 36 questions. The survey was set up for community input; the links to the surveys were provided in the handout packets.
    - Steering Committee members need to get the word out to the communities they serve. Ms. Johnston suggested putting the survey link on local websites and newsletters, mentioning the survey in meetings, posting the announcement, etc. A handout was provided.

- Ms. Johnston reviewed the action items for the Steering Committee members, including:
    - Publicize community survey link to community through website posting and other media
    - Community Representatives will review and make changes to the Capabilities Assessments due back to Tt by November 15, 2017.

  - Appropriate points of contact will review and update as necessary the list of critical facilities and return to Tetra Tech by November 15, 2017

- The date for the next meeting of the Steering Committee has not been determined but is anticipated to be in December of 2017. Meeting details will be forthcoming.
- Adjournment

TETRA TECH

Frio County Hazard Mitigation Plan
Kickoff Steering Committee Meeting

October 19, 2017 @ 2:00 PM
Pearsall, Texas

Committee Member	Signature	Department/Agency	Title	Phone Number	Email Address
Arnulfo C. Luna		Frio County	County Judge	830-334-8154	
Vickie Camacho		Frio County	Commissioner Pct. 1		
Richard Graf		Frio County	Commissioner Pct. 2		
Ruben Maldonado		Frio County	Commissioner Pct. 3		
Jose "Pepe" Flores		Frio County	Commissioner Pct. 4		
Joseph Sindon		Frio County	County Attorney		
Tracy Barerra		Frio County	County Auditor		
Albert DeLeon		Frio County	Sheriff	830-334-3311	
Larry Pearson		Frio County	Chief Deputy	830-334-3311	lpearson@friosheriff.org
Johnny Rodriguez		Frio County	Road & Bridge		
Ray Kallio		Frio County	EMC	830 765 3113	frioemc@friocounty
Mary Moore		City of Pearsall	Mayor		
Charles "Tink" Jackson		City of Pearsall	City Manager		
Xavier Antu		City of Pearsall	Public Works Dir.	830-334-3636	Xantu@cityofpearsall.org
Peter Salinas		City of Pearsall	Police Chief	830-317-7388	psalinas@cityofpearsall.org

Frio County Hazard Mitigation Plan Kickoff Steering Committee Meeting					October 19, 2017 @ 2:00 PM Pearsall, Texas
Committee Member	**Signature**	**Department/Agency**	**Title**	**Phone Number**	**Email Address**
Mary Ann Obregon		City of Dilley	City Council Mayor	830-965-1624	
Jose "Rudy" Alvarez		City of Dilley	City Administrator		
Jerry Reyna		City of Dilley	Police Chief		
Dr. Norbert Rodriguez		Pearsall ISD	Superintendent	830-334-8001	robert.rodriguez@pearsallisd.org
Chris Marquez		Pearsall ISD	ISD Police Chief	830 469 2880	chris.marquez@pearsallisd.org.
Dr. Clint Mclain		Dilley ISD	Superintendent	830 965 1912	clint.mclain@dilleyisd.net
Andy Williams		Frio Regional Hospital	CEO		
Cassandra Onofre		Frio Regional Hospital	Em Dir.	2104875772	conofre@myfrh.com
Mark Leach		Bigfoot VFD	Fire Chief		
Daryl Kallio		Dilley FD	Fire Chief		
J.D. Earls		Moore VFD	Fire Chief		
Placido Aguilar		Pearsall FD	Fire Chief		
Marti Williams		AMR (EMS)	Supervisor		
Nick DeLeon		TxDPS	Sgt.		
Summer Ray		TDEM	DC		

Frio County Hazard Mitigation Plan
Kickoff Steering Committee Meeting

October 19, 2017 @ 2:00 PM
Pearsall, Texas

Committee Member	Signature	Department/Agency	Title	Phone Number	Email Address
Jimmy Smith		TDCJ Briscoe Unit	Warden		
Isis Sutton		Red Cross	Rep.		
Laura Johnston	Laura D. Johnston	Tetra Tech, Inc.	Project Manager	303-312-8800	laura.johnston@tetratech.com
Betsy Wilson	Betsy Wilson	Frio Regional Hosp	Director of Mainh	830-334-7407	bwilson@myfrh.com

Frio County Hazard Mitigation Plan
Steering Committee Meeting #2
December 11, 2017
2:00 PM

- Welcome and Introductions
- Reminder: What is Hazard Mitigation?
- Reminder: Steering Committee Purpose and Responsibilities
- Review of Kickoff Meeting Items
- Hazard Analysis
- Community Participation and Survey Results (in packet)
- Hazard Analysis Review
- Hazard Ranking Exercise (in packet)
- Mitigation Action Worksheet (in packet)
- Next Meeting Date
- Adjournment

TETRA TECH

Frio County Hazard Mitigation Plan
Steering Committee Kick-Off Meeting
December 11, 2017 2:00 PM
Meeting Notes

- Welcome and Introductions – Ms. Laura Johnston (Tetra Tech) welcomed everyone and requested an introduction of each attending committee member and the organization or municipality they represent. Please see the sign in sheet for a full list of meeting attendees.
- Each member of the Committee was provided with handouts and a copy of the presentation slides.
- Ms. Johnston provided an overview of the mitigation plan process, FEMA requirements, and the benefits to Frio County.
  - What is Hazard Mitigation Planning and Why - The county is completing the HMP to create a safer and more resilient community to the effects of natural disasters. The HMP also makes the county and participating communities eligible for FEMA and other grants for mitigation projects. Some grants require a current HMP in order for the community to receive the funds; other grants, such as community development block grants, rank applications higher if the community has a current HMP. The HMP may also help communities and departments secure local funding because the projects were vetted and ranked through a public process.
  - Communities must have participated and adopted the HMP and it should be updated at least every 5 years.
- Ms. Johnston reviewed the purpose and responsibilities of the Steering Committee. Steering Committee members:
  - Provide guidance on their specific community
  - Carry information from the meetings to their community
  - Attend and actively participate in all committee meetings (3)
- Ms. Johnston reviewed the goals developed by the Steering Committee during and since the first kick-off meeting. The goals were given to the Committee members as handouts. Ms. Johnston reminded the Committee that each mitigation action developed must fall under one of the goals and objectives in the plan.
- Ms. Johnston provided an overview of the completed capabilities assessment for the Frio County and reminded the Committee that there are still capabilities assessment for

that are outstanding with the reminder that they need to be completed ASAP and given to either Mr. Ray Kallio, Frio County, or directly sent to Tetra Tech.

- Ms. Johnston presented an overview of the results of the community survey to date, which is still open for new comments. The current results of the survey were provided to the committee members in handouts.
  - To date, only 12 community members participated in the survey online.
  - Ms. Johnston encouraged the Steering Committee to review the survey responses and use that information as appropriate when ranking hazards and preparing mitigation actions.
- Ms. Johnston introduced the hazard identification and risk assessment for Frio County. This process involved the identification of hazards, hazard profiles, an inventory of the assets of each community, and loss estimations. Snapshots of community-specific hazard analysis information was included in the handouts provided to the attendees.
  - Ms. Johnston discussed the hazard ranking form. She explained that after analysis of the hazards was presented, each Steering Committee member will fill out the hazard ranking worksheet (provided in handouts). Members will rank each hazard as “high,” “medium,” or “low” for probability of occurrence and impact on people, property, and the economy.
- Ms. Johnston presented a general overview of the results of the risk assessment and hazard profiles for Frio County and participating communities. Noting that much more detailed countywide information as well as detailed information for at the participating community level will be included in the DRAFT plan which will be provided for review to members.
- Ms. Johnston discussed the following hazards:
  - Dam failure
  - Drought
  - Earthquake
  - Flood
  - Hurricanes and Tropical Storms
  - Severe Storms (Hail/ Wind/ Lightning)
  - Tornado
  - Wildfire
  - Winter Storm

  Discussion followed

- The steering committee was given 10-15 minutes to complete the hazard ranking worksheet, which were then collected from the meeting attendees. Ms. Johnston will score the ranking worksheets and send out the ranking of each hazard.
- Ms. Johnston explained that the county and the two participating jurisdictions need to identify mitigation actions. Ms. Johnston reminded the attendees that two mitigation actions are needed for each hazard. Any mitigation actions carried forward from the current HMP should be included. Ms. Johnston asked the members to use the mitigation action worksheet to develop new mitigation actions and send them to Tetra Tech.
- Ms. Johnston encouraged attendees to use the mitigation action worksheets to support funding efforts for short-, mid-, and long-term projects within their community. She explained that although the HMP is a five-year document, the projects can extend beyond five years. Ms. Johnston stated that mitigation actions cannot be maintenance activities.
- Ms. Johnston encouraged attendees to work with other members of the community to get ideas for mitigation actions. Electronic versions of the mitigation action worksheet will be provided to the department and participating organization in the next few days. Mitigation action worksheets are due back to Tetra Tech by January 12, 2018. During the next meeting the attendees will rank the mitigation actions.
- The 3rd Steering Committee meeting will be scheduled for the spring. Meeting details will be forthcoming.
- Adjournment

TETRA TECH

Frio County Hazard Mitigation Plan
Meeting #2 Steering Committee Meeting

December 11, 2017 @ 2:00 PM
400 S. Pecan
Pearsall, Texas

Committee Member	Signature	Department/Agency	Title	Phone Number	Email Address
Arnulfo C. Luna		Frio County	County Judge	(830) 334-2154	judge.luna@friocounty.org
Vickie Camacho		Frio County	Commissioner Pct. 1		vickie.camacho@friocounty.org
Richard Graf		Frio County	Commissioner Pct. 2	(830) 719-2715	ddpsgraf@yahoo.com
Ruben Maldonado		Frio County	Commissioner Pct. 3	(830) 334-9890	ruben.maldonado@friocounty.org
Jose "Pepe" Flores		Frio County	Commissioner Pct. 4	(830) 461-0563	jose.flores@friocounty.org
Joseph Sindon		Frio County	County Attorney	(830) 334-3687	joseph.sindon@friocounty.org
Tracy Barerra		Frio County	County Auditor	(830) 334-0000	tracy.barrera@friocounty.org
Albert DeLeon		Frio County	Sheriff	(830) 334-3311	adeleon@friosheriff.org
Larry Pearson		Frio County	Chief Deputy		
Johnny Rodriguez		Frio County	Road & Bridge		friorb@sbcglobal.net
Ray Kallio		Frio County	EMC		frioemc@friocounty.org
Mary Moore		City of Pearsall	Mayor	(830) 334-3676	
Charles "Tink" Jackson		City of Pearsall	City Manager	(830) 334-3676	cjackson@cityof pearsall.org
Xavier Antu		City of Pearsall			xantu@cityofpearsall.org

Frio County Hazard Mitigation Plan
Meeting #2 Steering Committee Meeting

December 11, 2017 @ 2:00 PM
400 S. Pecan
Pearsall, Texas

Committee Member	Signature	Department/Agency	Title	Phone Number	Email Address
Peter Salinas		City of Pearsall	Police Chief	(830) 334-4169	
Mary Ann Obregon		City of Dilley	Mayor	(830) 965-1624	
Jose "Rudy" Alvarez	Rudy Alvarez	City of Dilley	City Administrator	(830) 965-1624	
Jerry Revna		City of Dilley	Police Chief	(830) 965-2113	
Dr. Norbert Rodriguez		Pearsall ISD	Superintendent		
Chris Marquez		Pearsall ISD	ISD Police Chief		
Dr. Clint Mclain		Dilley ISD	Superintendent		
Andy Williams		Frio Regional Hospital	CEO		
Cassandra Onofre		Frio Regional Hospital	Em Dir.		
Mark Leach		Bigfoot VFD	Fire Chief		bigfootfirechief@gmail.com
Daryl Kallio		Dilley FD	Fire Chief		dilleyfire@hotmail.com
J.D. Earls		Moore VFD	Fire Chief		moorevfd@aol.com
Placido Aguilar		Pearsall FD	Fire Chief		pvfd@cityofpearsall.org
Marti Williams		AMR (EMS)	Supervisor		Marti.Williams@amr.net
Nick DeLeon		TxDPS	Sgt.		

Frio County Hazard Mitigation Plan Meeting #2 Steering Committee Meeting					December 11, 2017 @ 2:00 PM 400 S. Pecan Pearsall, Texas
Committee Member	**Signature**	**Department/Agency**	**Title**	**Phone Number**	**Email Address**
Summer Ray		TDEM	DC		
Jimmy Smith		TDCJ Briscoe Unit	Warden		
Isis Sutton		Red Cross	Rep.		
Laura Johnston	Laura D. Johnston	Tetra Tech, Inc.	Project Manager	303-312-8800	laura.johnston@tetratech.com
John Morales	Joe Morales	Bigfoot VFD Frio Co. ESD		830-931-5291	moralespropane@AOL.com
Committee Member	**Signature**	**Department/Agency**	**Title**	**Phone Number**	**Email Address**

Hazard Mitigation Plan for Frio County
Steering Committee 3rd Meeting
Tuesday, May 8, 2018
1:30 PM

- Welcome and Introductions
- Review and Reminders
  - What is Hazard Mitigation?
  - Steering Committee Purpose and Responsibilities
  - Mitigation Goals and Objectives
  - Final Hazard Ranking
- Review of Survey Results
  - Question #23 Results
- Mitigation Actions
  - General Guidelines and Requirements
  - Summary Table
  - Presentation / Review of Mitigation Actions
- Ranking of Mitigation Actions (In Packet)
- Plan Maintenance
- Hazard Mitigation Assistance Grants (In Packet)
- Plan submittal to TDEM and FEMA Region VI
- Adjournment

TETRA TECH

Frio County Hazard Mitigation Plan
Steering Committee Kick-Off Meeting
May 8, 2018 2:00 PM
Meeting Notes

- Welcome and Introductions – Mr. Ray Kallio, Frio County Emergency Manager welcomed everyone and introduced Laura Johnston, Project Manager from Tetra Tech. Ms. Johnston greeted the committee and requested an introduction of each attending committee member and the organization or municipality they represent. Ms. Johnston reminded each attendee to please see the sign in sheet for a full list of Steering Committee attendees.
- Each member of the Committee was provided with handouts and a copy of the presentation slides.
- Ms. Johnston went over items covered to date:
  - She reminded each Committee member what hazard mitigation is and why we are going thru this process.
  - She provided a reminder /review of the purpose and responsibilities of the Steering Committee. Steering Committee members:
    - Provide guidance on their specific community
    - Carry information from the meetings to their community
    - Attend and actively participate in all committee meetings (3).
- Ms. Johnston further provided an overview /reviewer of the goals as developed and agreed upon by the Steering Committee previously. The goals were also given to the Committee members in their Powerpoint presentation. The committee was reminded that each of the proposed mitigation actions that the members developed must fall under one of the goals and objectives in the plan.
- The Final Hazard Ranking for the Committee noting that there are separate rankings for each of the participating communities as well as the County. There was a brief discussion on the rankings.
- A review of the survey results advised the committee of total responses. The following questions were some of the questions reported on and discussed:
  - Q3: Which of the following hazard events have you or has anyone in your household experienced in the last 20 years within Frio County. The predominant responses were: Drought, Hail, Extreme Heat, Thunderstorms and Lightning.
  - Q7: How concerned are you about the following natural hazards in Frio County? Top responses were: Severe Storms, Tornado, Drought and Extreme Heat, Wildfire and Flood.

  - Q20: How much money would you (respondents) be willing to spend to retrofit your home to reduce risks from natural hazards? Predominant answers in order: less than $1,000, $1,000 to $4,9999, and "Not sure".
  - Q22 asked: If your property was located in a designated "high hazard" area or had received repetitive damages from a natural hazard event would you consider a buyout offered by a public agency? - 68% responded yes.
  - Q23 asked: Would you support the regulation (restriction) of land uses within high hazard areas? Almost 70% of the respondents said yes.

- Mitigation Actions ranking process:
  - Ms. Johnston reminded the Committee that FEMA requires a minimum of 2 unique actions for each "low", "medium" and "high" ranked hazard. Additionally, she stated that at least one mitigation action for each mitigation goal.
  - A discussion followed on the ranking of the proposed mitigation actions to be included in the plan. Committee members were given time to rank their proposed mitigation actions. Each jurisdiction representative was asked to and submitted a ranking of the proposed actions for their jurisdiction. The rankings will be included in the Plan document.

- Committee members were given the requirements for annual (minimum) Plan Maintenance and the 5-year plan update cycle. A brief question and answer discussion followed. The next steps in the plan development process were overviewed as well. An overview of Hazard Mitigation Assistance Grants was presented and additional information was in the committee member's packets.
- Ms. Johnston also provided the Committee with information regarding funding opportunities for all communities within the State of Texas's from DR 4332 – Hurricane Harvey. She outlined some of the States criteria for ranking projects for funding as provided by Mr. Patrick Kelly at TDEM.

- Adjournment

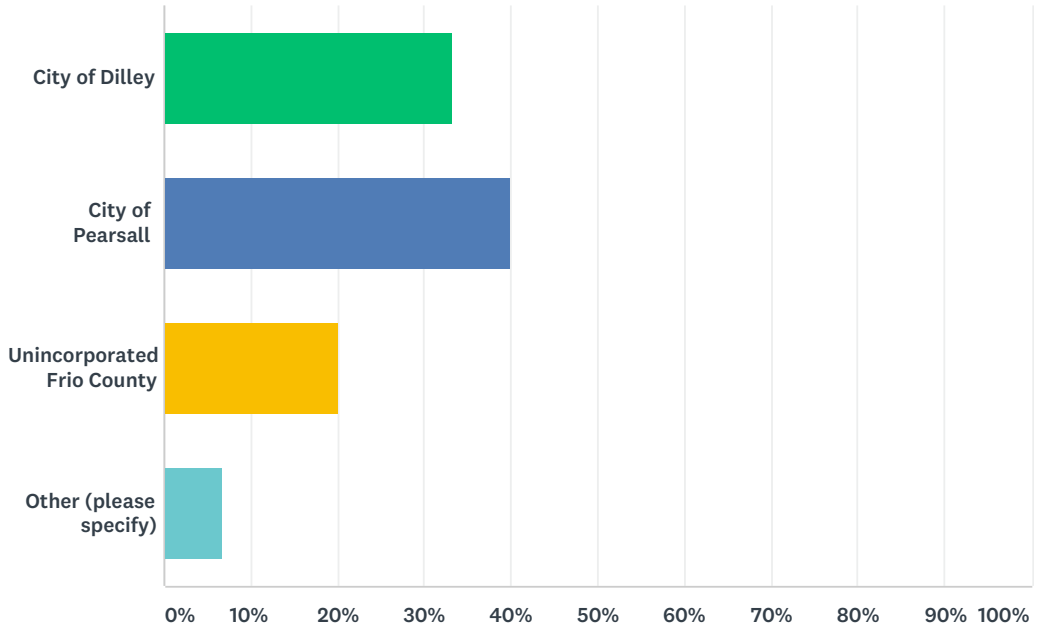
Frio County Hazard Mitigation Plan Meeting #3 Steering Committee Meeting					May 8, 2018 @ 1:30 PM 400 S. Pecan Pearsall, Texas
Committee Member	**Signature**	**Department/Agency**	**Title**	**Phone Number**	**Email Address**
Arnulfo C. Luna		Frio County	County Judge	(830) 334-2154	judge.luna@friocounty.org
Vickie Camacho		Frio County	Commissioner Pct. 1		vickie.camacho@friocounty.org
Richard Graf		Frio County	Commissioner Pct. 2	(830) 719-2715	ddpsgraf@yahoo.com
Ruben Maldonado		Frio County	Commissioner Pct. 3	(830) 334-9890	ruben.maldonado@friocounty.org
Jose "Pepe" Flores		Frio County	Commissioner Pct. 4	(830) 461-0563	jose.flores@friocounty.org
Joseph Sindon		Frio County	County Attorney	(830) 334-3687	joseph.sindon@friocounty.org
Tracy Barerra		Frio County	County Auditor	(830) 334-0000	tracy.barrera@friocounty.org
Albert DeLeon		Frio County	Sheriff	(830) 334-3311	adeleon@friosheriff.org
Larry Pearson		Frio County	Chief Deputy		
Johnny Rodriguez		Frio County	Road & Bridge		friorb@sbcglobal.net
Ray Kallio		Frio County	EMC		frioemc@friocounty.org
Mary Moore		City of Pearsall	Mayor	(830) 334-3676	
Charles "Tink" Jackson		City of Pearsall	City Manager	(830) 334-3676	cjackson@cityof pearsall.org
Xavier Antu		City of Pearsall	Public Works Director	(830) 334-3676 x2107	xantu@cityofpearsall.org
Uche Echeozo		City of Pearsall	Planning Director	830 334 3676	uecheozo@city-of pearsall.org

Frio County Hazard Mitigation Plan Meeting #3 Steering Committee Meeting					May 8, 2018 @ 1:30 PM 400 S. Pecan Pearsall, Texas
Committee Member	**Signature**	**Department/Agency**	**Title**	**Phone Number**	**Email Address**
Peter Salinas		City of Pearsall	Police Chief	(830) 334-4169	
Mary Ann Obregon		City of Dilley	Mayor	(830) 965-1624	
Jose "Rudy" Alvarez		City of Dilley	City Administrator	(830) 965-1624	
Jerry Revna		City of Dilley	Police Chief	(830) 965-2113	
Dr. Norbert Rodriguez		Pearsall ISD	Superintendent		
Chris Marquez		Pearsall ISD	ISD Police Chief		
Dr. Clint Mclain		Dilley ISD	Superintendent		
Andy Williams		Frio Regional Hospital	CEO		
Cassandra Onofre		Frio Regional Hospital	Em Dir.		
Mark Leach		Bigfoot VFD	Fire Chief		bigfootfirechief@gmail.com
Daryl Kallio		Dilley FD	Fire Chief		dilleyfire@hotmail.com
J.D. Earls		Moore VFD	Fire Chief		moorevfd@aol.com
Placido Aguilar		Pearsall FD	Fire Chief		pvfd@cityofpearsall.org
Marti Williams		AMR (EMS)	Supervisor		Marti.Williams@amr.net
Nick DeLeon		TxDPS	Sgt.		

Frio County Hazard Mitigation Plan Meeting #3 Steering Committee Meeting					May 8, 2018 @ 1:30 PM 400 S. Pecan Pearsall, Texas
Committee Member	**Signature**	**Department/Agency**	**Title**	**Phone Number**	**Email Address**
Summer Ray		TDEM	DC		
Jimmy Smith		TDCJ Briscoe Unit	Warden		
Isis Sutton		Red Cross	Rep.		
Laura Johnston		Tetra Tech, Inc.	Project Manager	303-312-8800	laura.johnston@tetratech.com
Tony Gross		TDEM	DC	210 5593496	

Q1 Where in Frio County do you live?

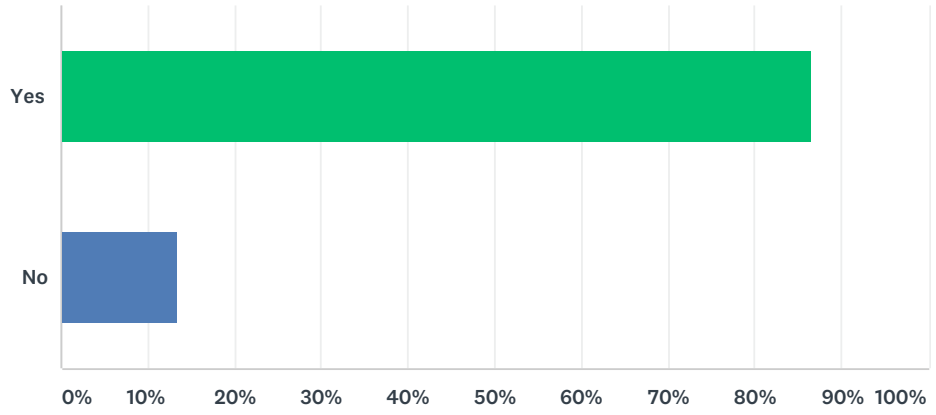
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
City of Dilley	33.33%	5
City of Pearsall	40.00%	6
Unincorporated Frio County	20.00%	3
Other (please specify)	6.67%	1
TOTAL		15

Q2 Do you work in Frio County?

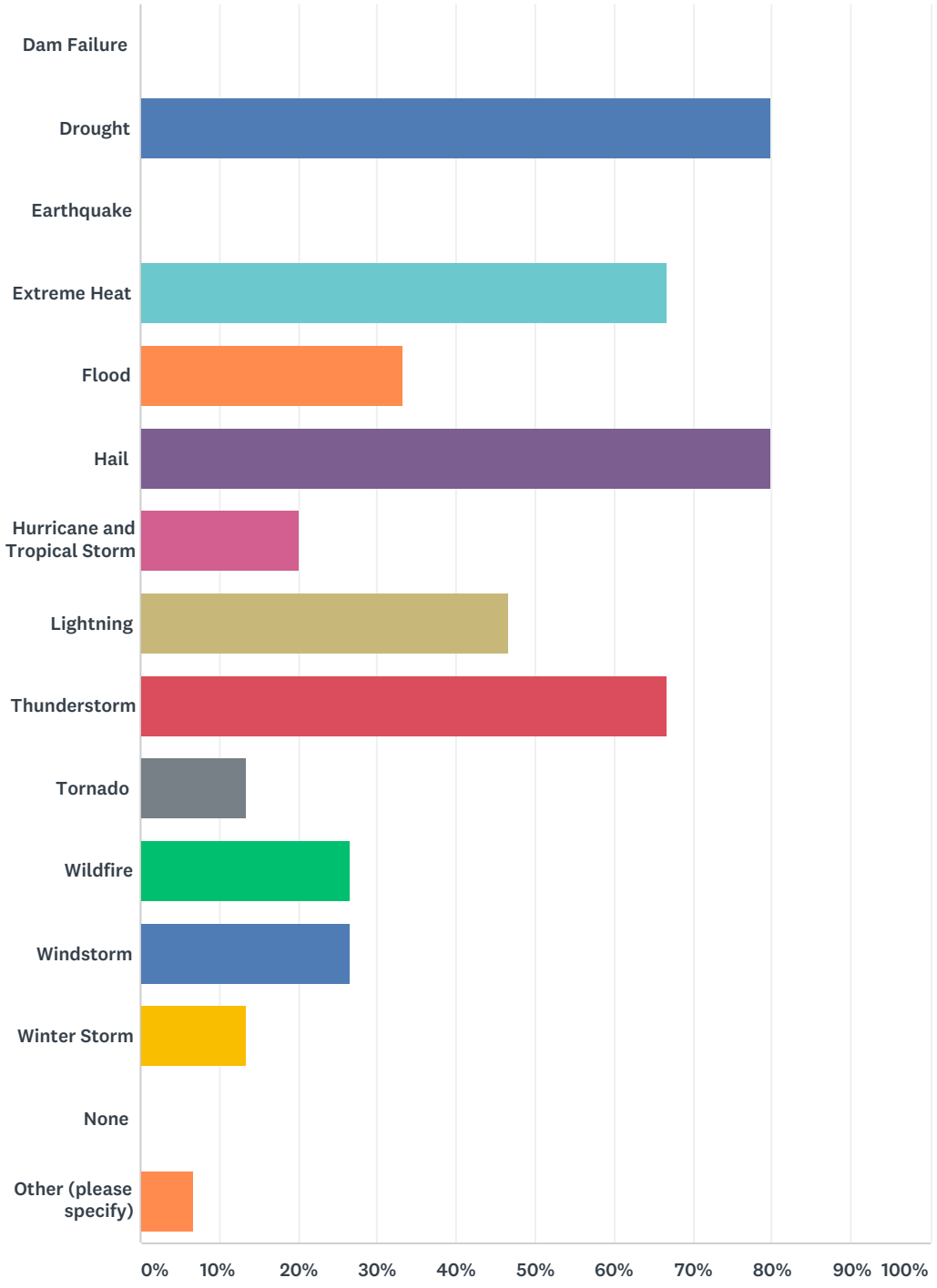
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	86.67%	13
No	13.33%	2
TOTAL		15

Q3 Which of the following hazard events have you or has anyone in your household experienced in the past 20 years within Frio County? (Check all that apply)

Answered: 15 Skipped: 0

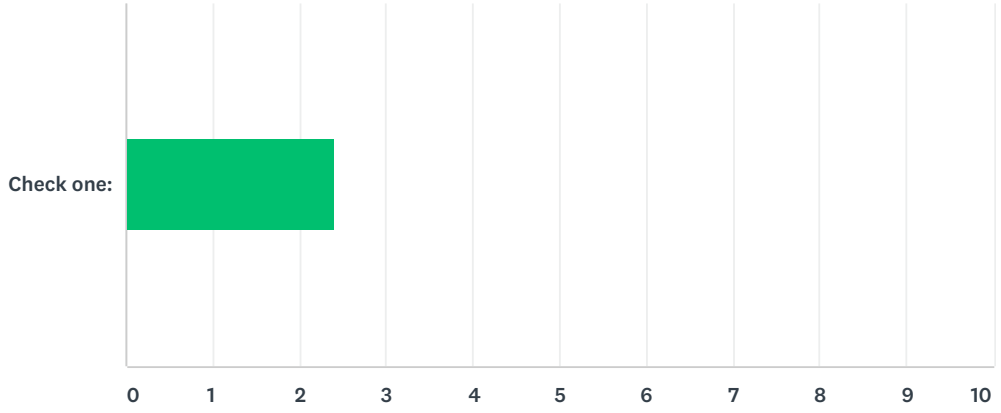


ANSWER CHOICES	RESPONSES	
Dam Failure	0.00%	0

Drought	80.00%	12
Earthquake	0.00%	0
Extreme Heat	66.67%	10
Flood	33.33%	5
Hail	80.00%	12
Hurricane and Tropical Storm	20.00%	3
Lightning	46.67%	7
Thunderstorm	66.67%	10
Tornado	13.33%	2
Wildfire	26.67%	4
Windstorm	26.67%	4
Winter Storm	13.33%	2
None	0.00%	0
Other (please specify)	6.67%	1
Total Respondents: 15		

Q4 How prepared is your household to deal with a natural hazard event?

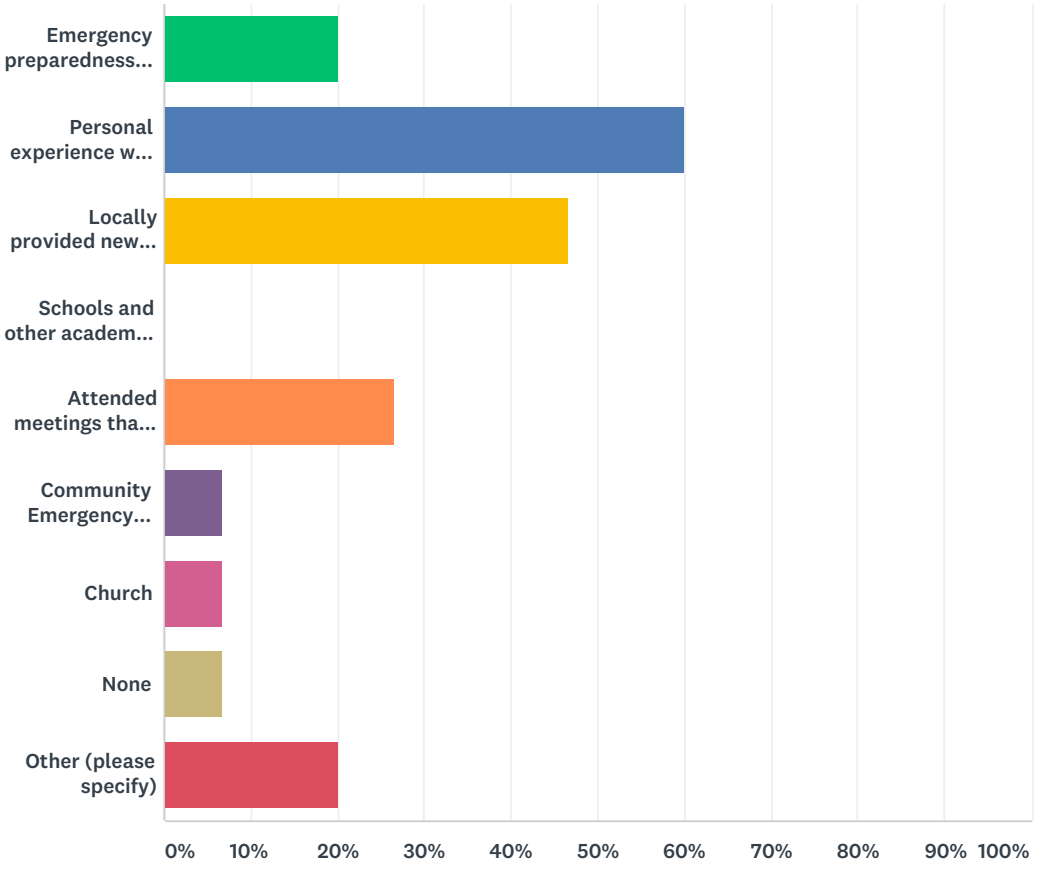
Answered: 15 Skipped: 0



	NOT AT ALL PREPARED	SOMEWHAT PREPARED	ADEQUATELY PREPARED	WELL PREPARED	VERY WELL PREPARED	TOTAL	WEIGHTED AVERAGE
Check one:	20.00% 3	33.33% 5	33.33% 5	13.33% 2	0.00% 0	15	2.40

Q5 Which of the following have provided you with useful information to help you be prepared for a natural hazard event? (Check all that apply)

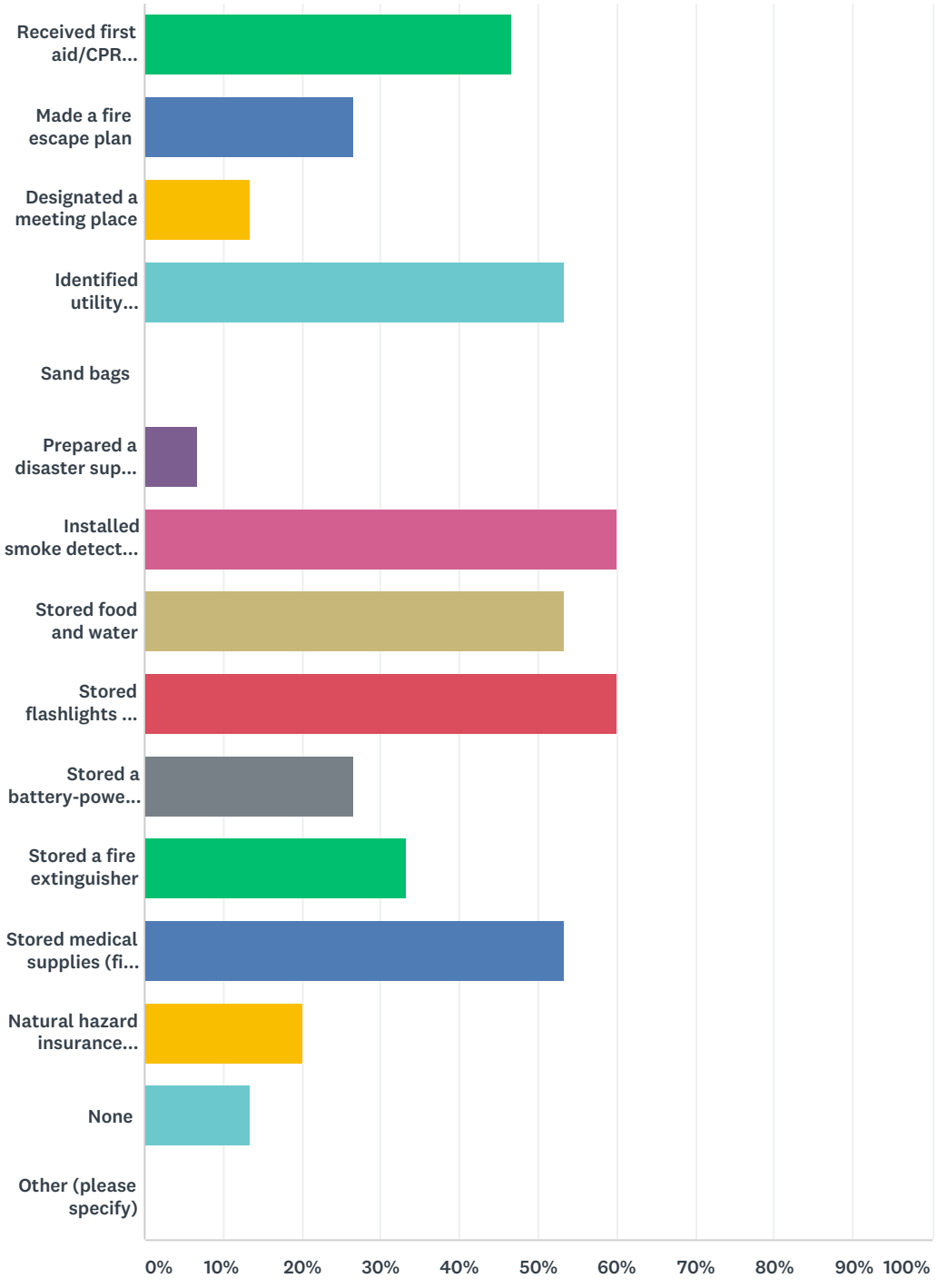
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
Emergency preparedness information from a government source (e.g., federal, state, or local emergency management)	20.00%	3
Personal experience with one or more natural hazards/disasters	60.00%	9
Locally provided news or other media information	46.67%	7
Schools and other academic institutions	0.00%	0
Attended meetings that have dealt with disaster preparedness	26.67%	4
Community Emergency Response Training (CERT)	6.67%	1
Church	6.67%	1
None	6.67%	1
Other (please specify)	20.00%	3
Total Respondents: 15		

Q6 Which of the following steps has your household taken to prepare for a natural hazard event? (Check all that apply)

Answered: 15 Skipped: 0

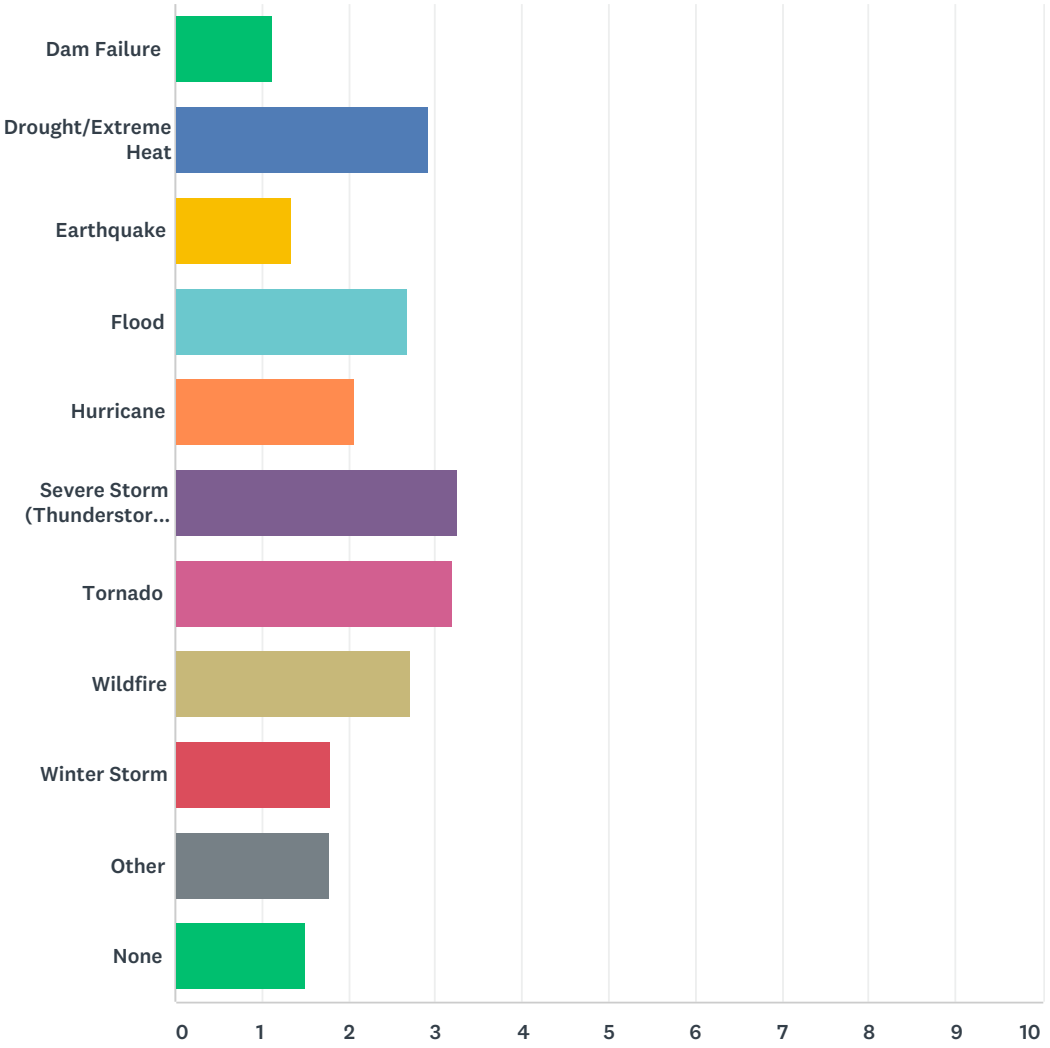


ANSWER CHOICES	RESPONSES	
Received first aid/CPR training	46.67%	7
Made a fire escape plan	26.67%	4

Designated a meeting place	13.33%	2
Identified utility shutoffs	53.33%	8
Sand bags	0.00%	0
Prepared a disaster supply kit	6.67%	1
Installed smoke detectors on each level of the house	60.00%	9
Stored food and water	53.33%	8
Stored flashlights and batteries	60.00%	9
Stored a battery-powered radio	26.67%	4
Stored a fire extinguisher	33.33%	5
Stored medical supplies (first aid kit, medications)	53.33%	8
Natural hazard insurance (Flood, Earthquake, Wildfire)	20.00%	3
None	13.33%	2
Other (please specify)	0.00%	0
Total Respondents: 15		

Q7 How concerned are you about the following natural hazards in Frio County? (Check one response for each hazard)

Answered: 15 Skipped: 0

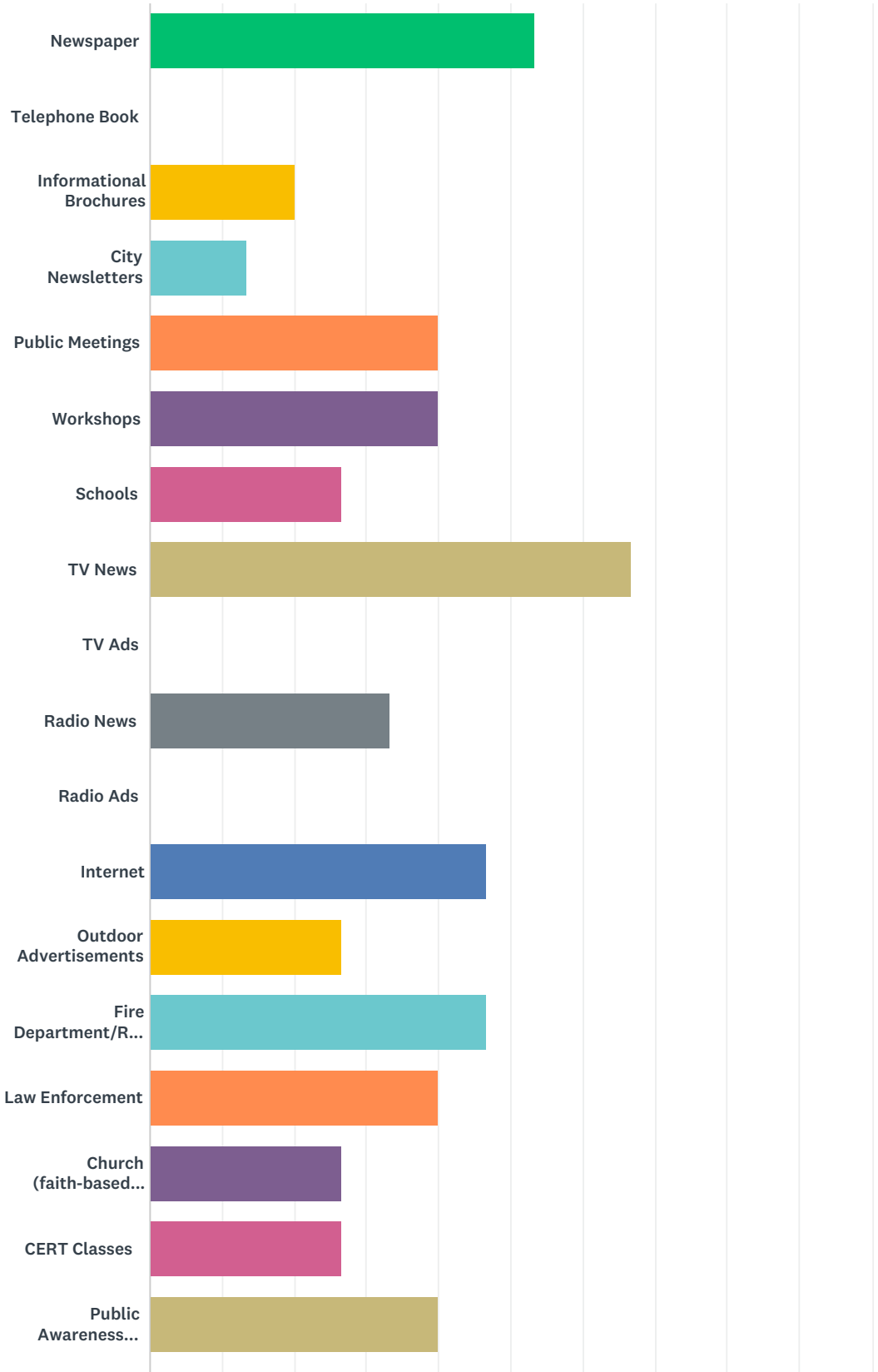


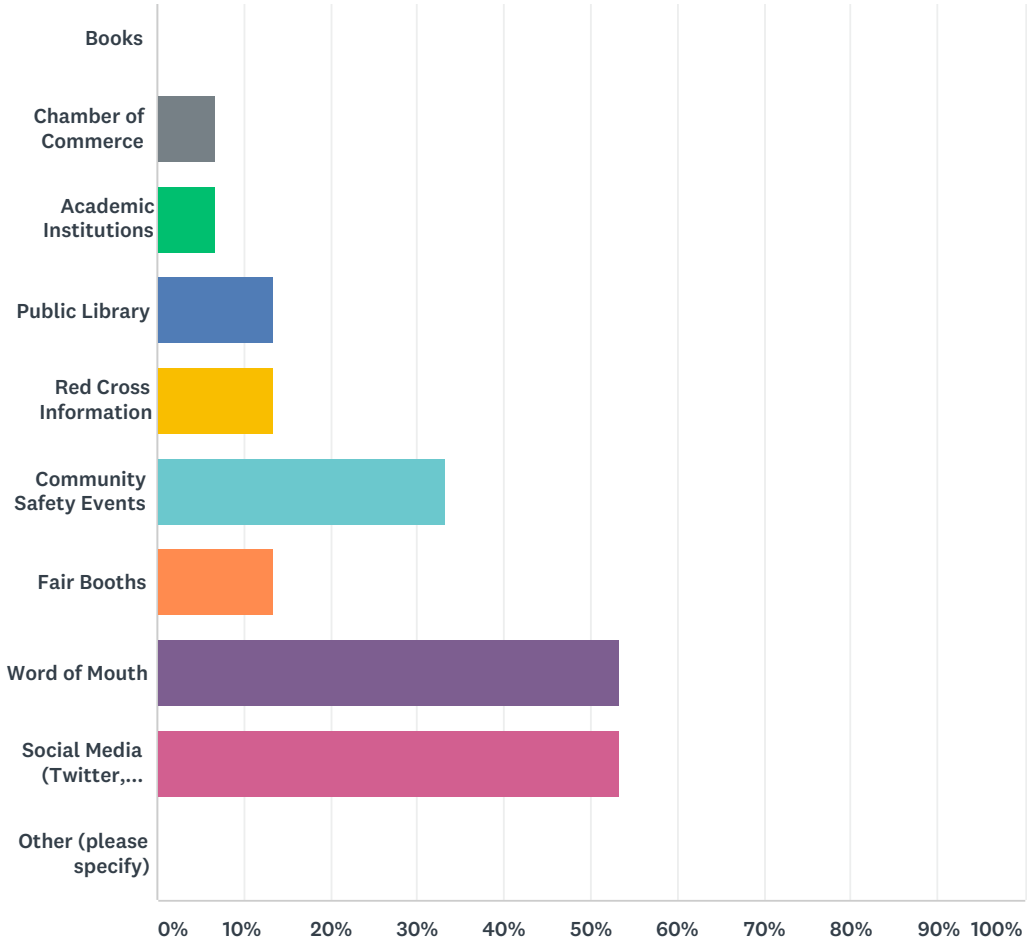
	NOT CONCERNED	SOMEWHAT CONCERNED	CONCERNED	VERY CONCERNED	EXTREMELY CONCERNED	TOTAL	WEIGHTED AVERAGE
Dam Failure	93.33% 14	0.00% 0	6.67% 1	0.00% 0	0.00% 0	15	1.13
Drought/Extreme Heat	13.33% 2	26.67% 4	26.67% 4	20.00% 3	13.33% 2	15	2.93
Earthquake	73.33% 11	20.00% 3	6.67% 1	0.00% 0	0.00% 0	15	1.33
Flood	20.00% 3	26.67% 4	33.33% 5	6.67% 1	13.33% 2	15	2.67
Hurricane	40.00% 6	26.67% 4	20.00% 3	13.33% 2	0.00% 0	15	2.07

Severe Storm (Thunderstorms, Lightning, Hail and/or High Winds)	0.00% 0	33.33% 5	26.67% 4	20.00% 3	20.00% 3	15	3.27
Tornado	13.33% 2	26.67% 4	13.33% 2	20.00% 3	26.67% 4	15	3.20
Wildfire	26.67% 4	20.00% 3	20.00% 3	20.00% 3	13.33% 2	15	2.73
Winter Storm	66.67% 10	0.00% 0	20.00% 3	13.33% 2	0.00% 0	15	1.80
Other	66.67% 6	11.11% 1	11.11% 1	0.00% 0	11.11% 1	9	1.78
None	75.00% 3	0.00% 0	25.00% 1	0.00% 0	0.00% 0	4	1.50

Q8 Which of the following methods do you think are most effective for providing hazard and disaster information? (Check all that apply)

Answered: 15 Skipped: 0



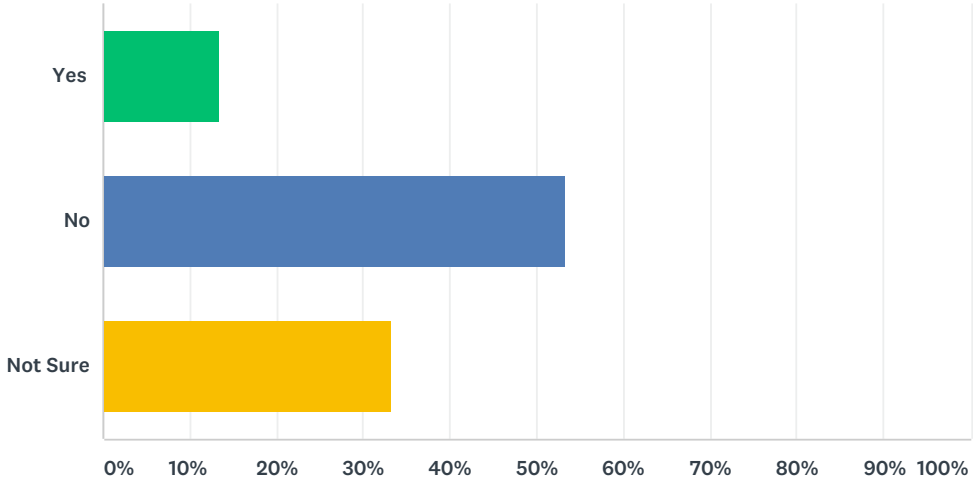


ANSWER CHOICES	RESPONSES	
Newspaper	53.33%	8
Telephone Book	0.00%	0
Informational Brochures	20.00%	3
City Newsletters	13.33%	2
Public Meetings	40.00%	6
Workshops	40.00%	6
Schools	26.67%	4
TV News	66.67%	10
TV Ads	0.00%	0
Radio News	33.33%	5
Radio Ads	0.00%	0
Internet	46.67%	7
Outdoor Advertisements	26.67%	4
Fire Department/Rescue	46.67%	7
Law Enforcement	40.00%	6

Church (faith-based institutions)	26.67%	4
CERT Classes	26.67%	4
Public Awareness Campaign (e.g., Flood Awareness Week, Winter Storm Preparedness Month)	40.00%	6
Books	0.00%	0
Chamber of Commerce	6.67%	1
Academic Institutions	6.67%	1
Public Library	13.33%	2
Red Cross Information	13.33%	2
Community Safety Events	33.33%	5
Fair Booths	13.33%	2
Word of Mouth	53.33%	8
Social Media (Twitter, Facebook, Linkdin)	53.33%	8
Other (please specify)	0.00%	0
Total Respondents: 15		

Q9 Is your property located in or near a FEMA designated floodplain?

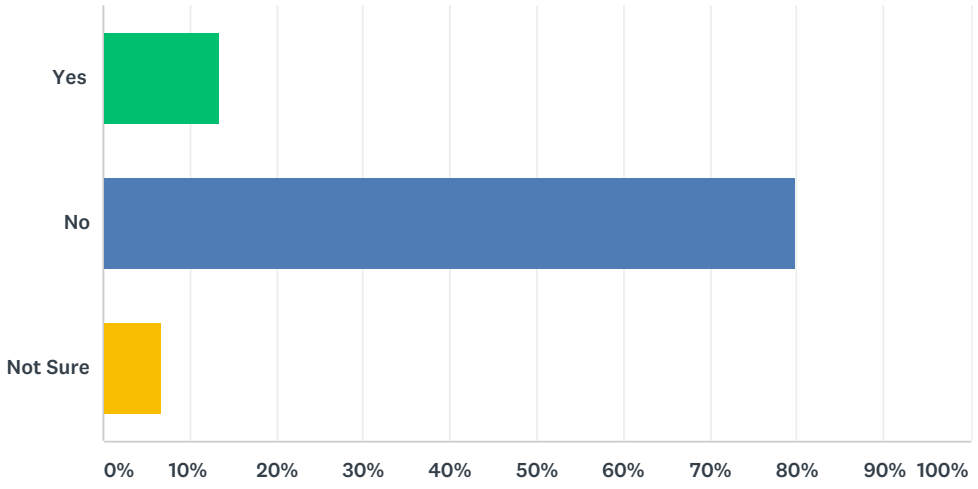
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	13.33%	2
No	53.33%	8
Not Sure	33.33%	5
TOTAL		15

Q10 Do you have flood insurance?

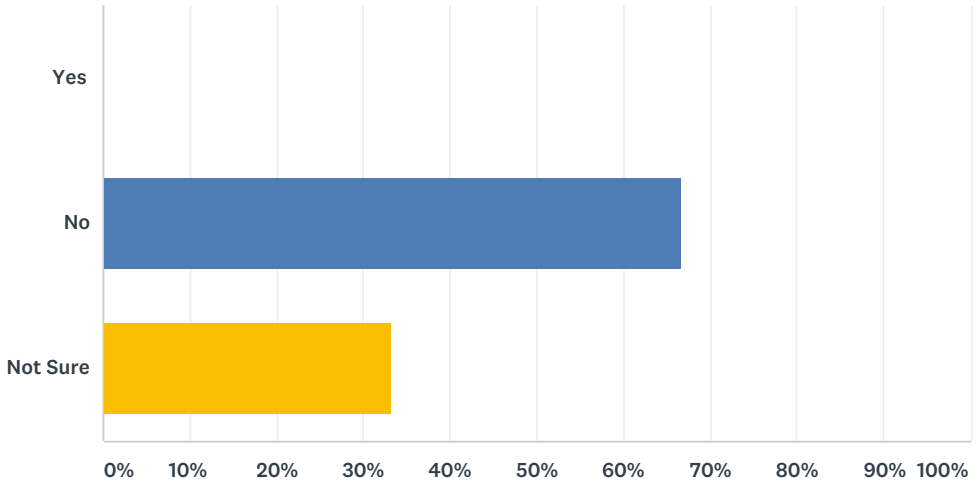
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	13.33%	2
No	80.00%	12
Not Sure	6.67%	1
TOTAL		15

Q11 Is your property located near an earthquake fault?

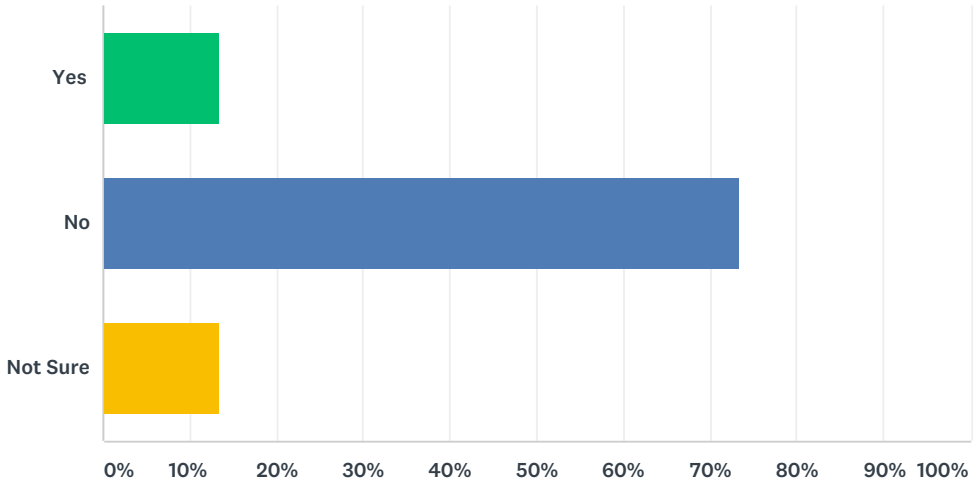
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	0.00%	0
No	66.67%	10
Not Sure	33.33%	5
TOTAL		15

Q12 Do you have earthquake insurance?

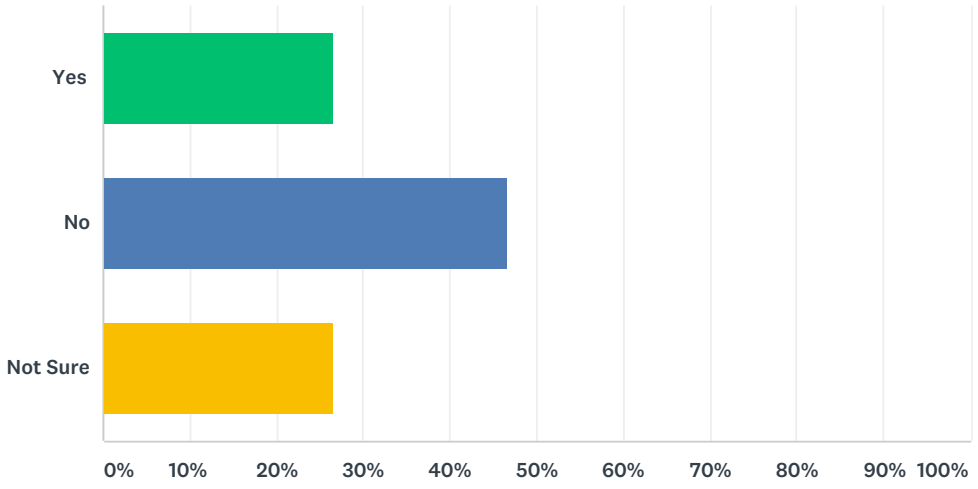
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	13.33%	2
No	73.33%	11
Not Sure	13.33%	2
TOTAL		15

Q13 Is your property located in an area at risk for wildfires?

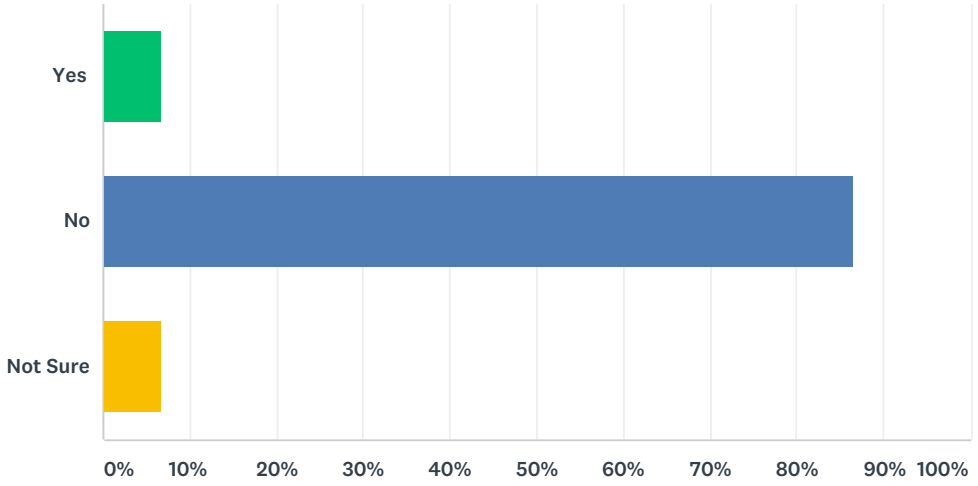
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	26.67%	4
No	46.67%	7
Not Sure	26.67%	4
TOTAL		15

Q14 Have you ever had problems getting homeowners or renters insurance due to risks from natural hazards?

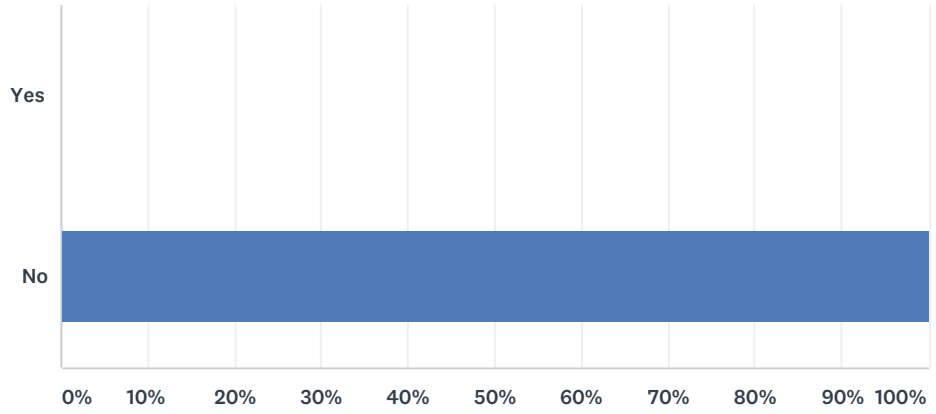
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	6.67%	1
No	86.67%	13
Not Sure	6.67%	1
TOTAL		15

Q15 Do you have any special access or functional needs within your household that would require early warning or specialized response during disasters?

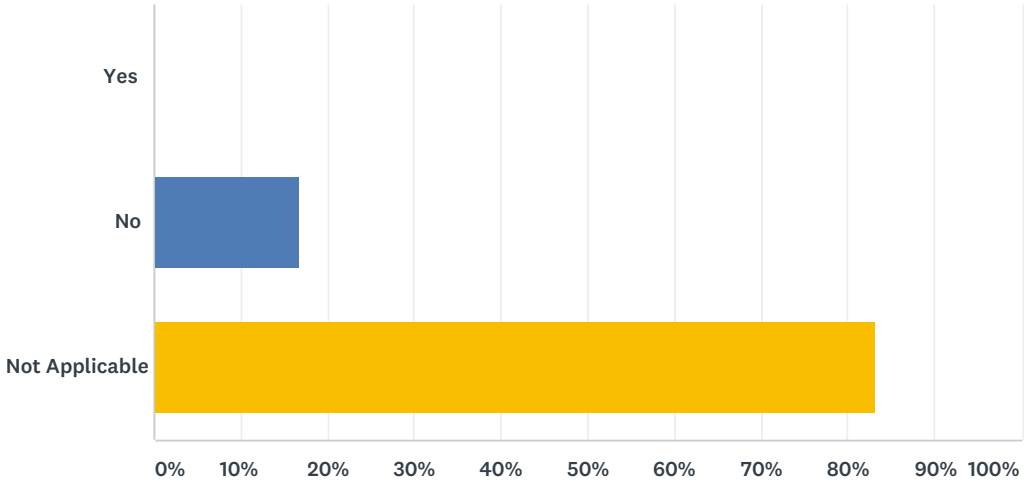
Answered: 15 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	0.00%	0
No	100.00%	15
TOTAL		15

Q16 If the answer to question # 15 was yes, would you like County Emergency Management personnel to contact you regarding your access and functional needs? If yes, please enter your contact information in the following text box.

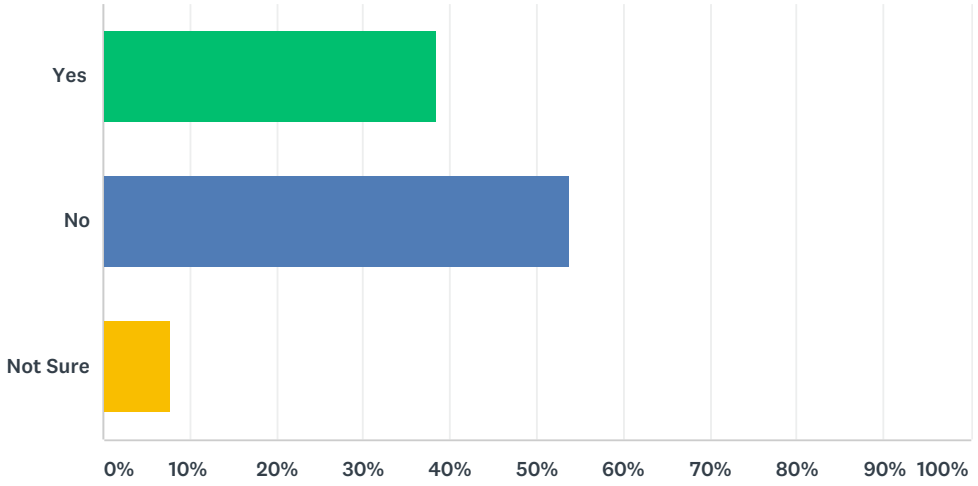
Answered: 12 Skipped: 3



ANSWER CHOICES	RESPONSES	
Yes	0.00%	0
No	16.67%	2
Not Applicable	83.33%	10
TOTAL		12

Q17 When you moved into your home, did you consider the impact a natural disaster could have on your home?

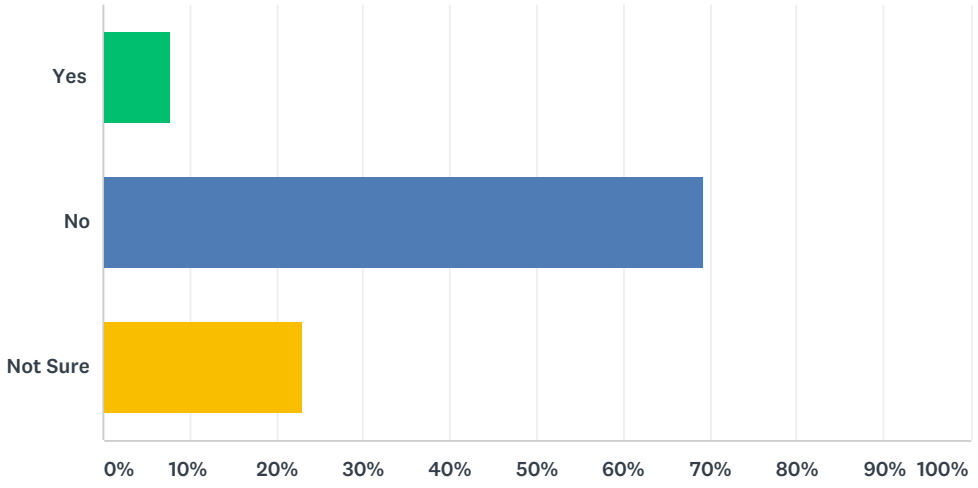
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	38.46%	5
No	53.85%	7
Not Sure	7.69%	1
TOTAL		13

Q18 Was the presence of a natural hazard risk zone (e.g., dam failure zone, flood zone, high fire risk area) disclosed to you by a real estate agent, seller, or landlord before you purchased or moved into your home?

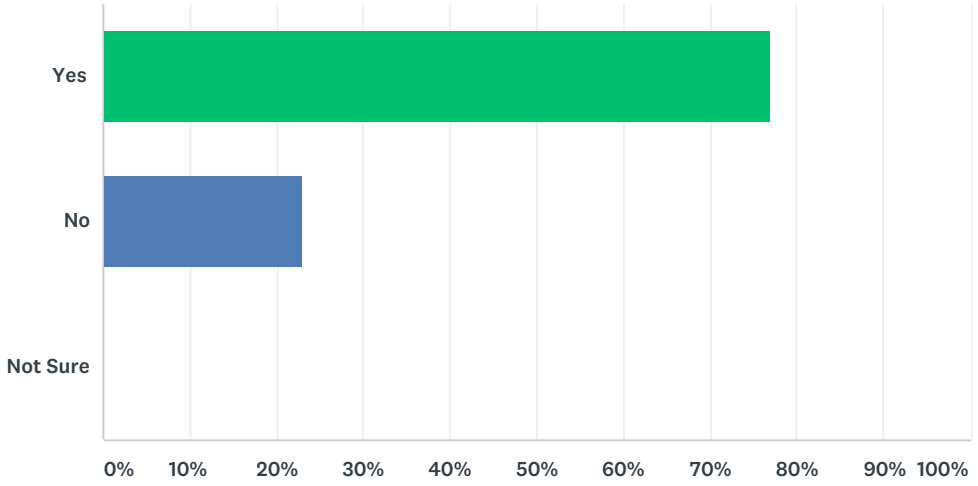
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	7.69%	1
No	69.23%	9
Not Sure	23.08%	3
TOTAL		13

Q19 Would the disclosure of this type of natural hazard risk information influence your decision to buy or rent a home?

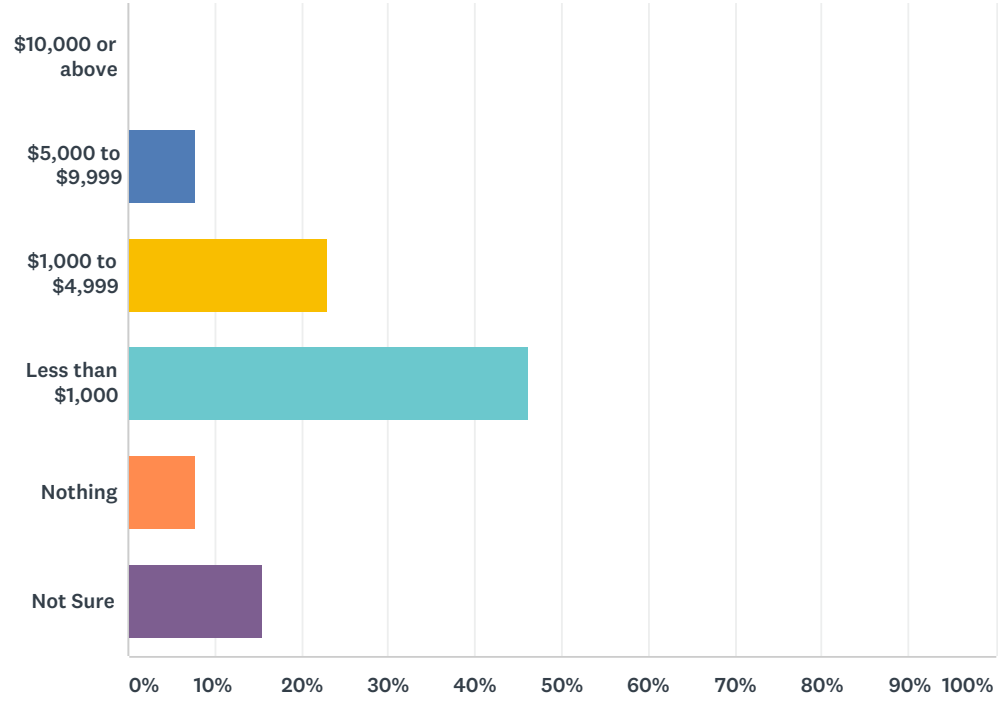
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	76.92%	10
No	23.08%	3
Not Sure	0.00%	0
TOTAL		13

Q20 How much money would you be willing to spend to retrofit your home to reduce risks associated with natural disasters? (for example, by clearing brush and plant materials from around your home to create a "defensible space" for wildfire, performing seismic upgrades, or replacing a combustible roof with non-combustible roofing)

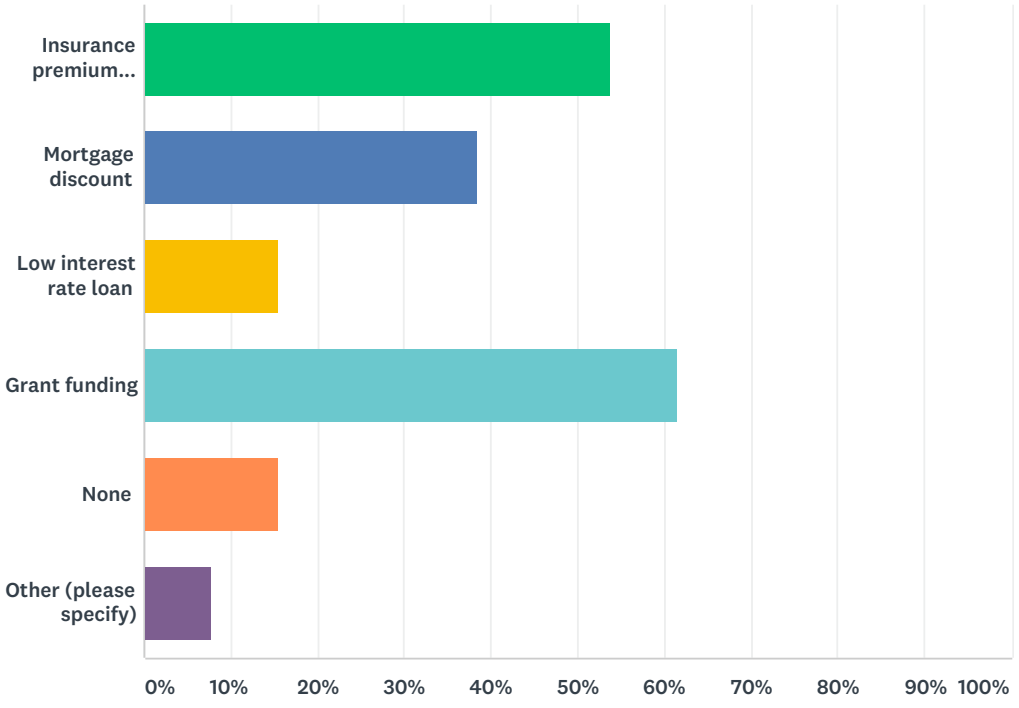
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
$10,000 or above	0.00%	0
$5,000 to $9,999	7.69%	1
$1,000 to $4,999	23.08%	3
Less than $1,000	46.15%	6
Nothing	7.69%	1
Not Sure	15.38%	2
TOTAL		13

Q21 Which of the following incentives would encourage you to spend money to retrofit your home to protect against natural disasters? (Check all that apply)

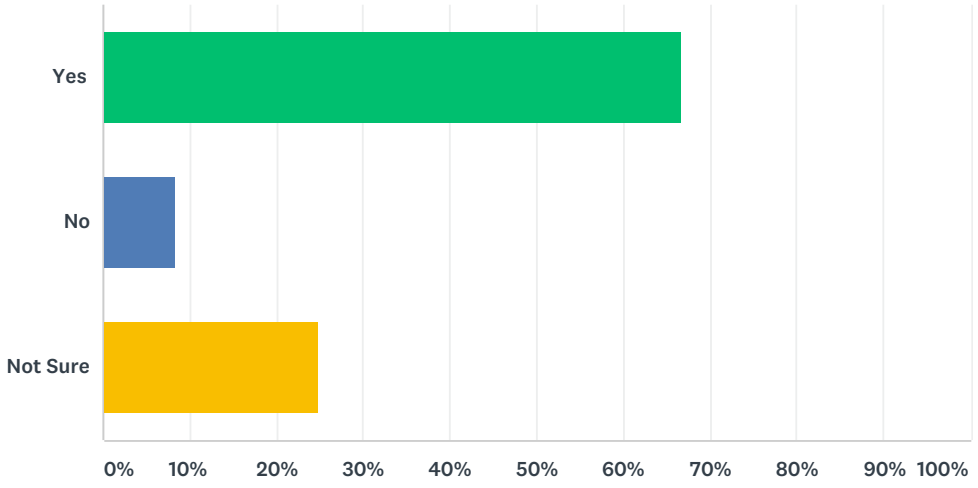
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Insurance premium discount	53.85%	7
Mortgage discount	38.46%	5
Low interest rate loan	15.38%	2
Grant funding	61.54%	8
None	15.38%	2
Other (please specify)	7.69%	1
Total Respondents: 13		

Q22 If your property were located in a designated “high hazard” area or had received repetitive damages from a natural hazard event, would you consider a ”buyout” offered by a public agency?

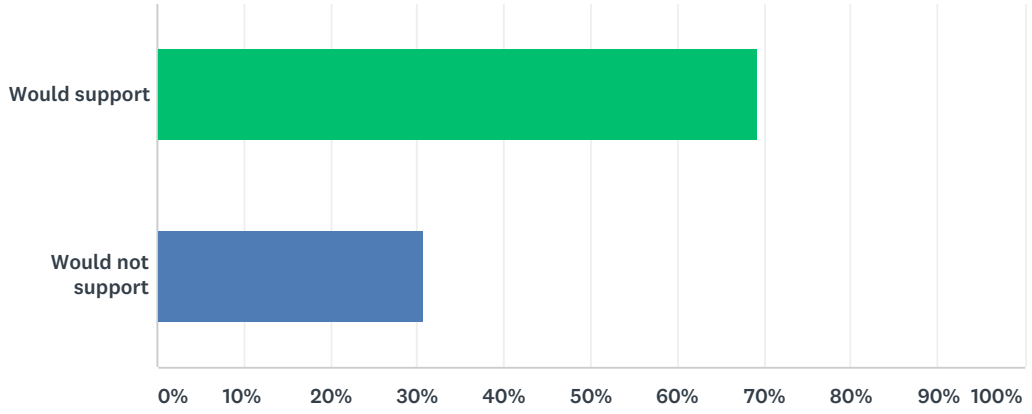
Answered: 12 Skipped: 3



ANSWER CHOICES	RESPONSES	
Yes	66.67%	8
No	8.33%	1
Not Sure	25.00%	3
TOTAL		12

Q23 Would you support the regulation (restriction) of land uses within known high hazard areas?

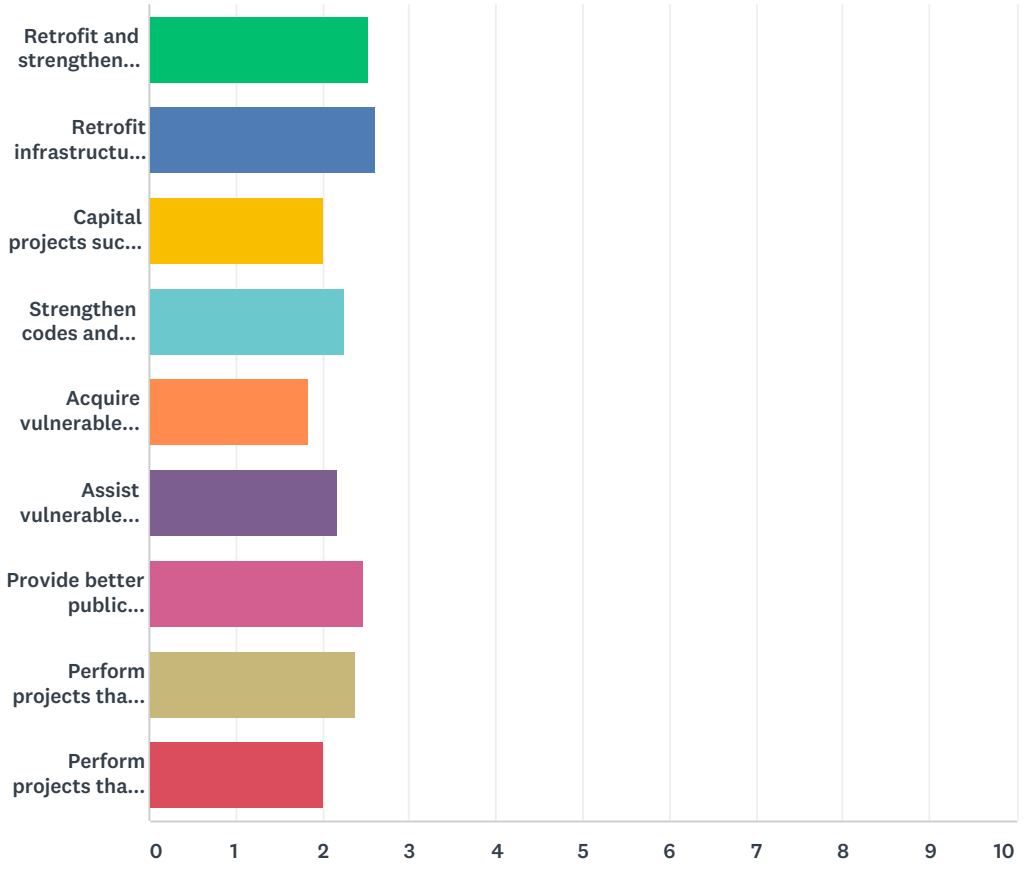
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Would support	69.23%	9
Would not support	30.77%	4
TOTAL		13

Q24 What types of projects do you believe the County, State or Federal government agencies should be doing in order to reduce damage and disruption from hazard events within Frio County? Please rank each option as a high, medium or low priority.

Answered: 13 Skipped: 2

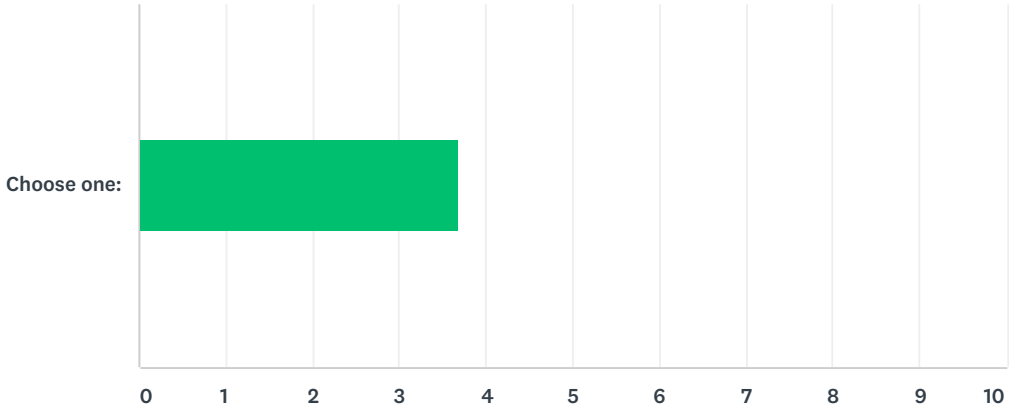


	HIGH	MEDIUM	LOW	TOTAL	WEIGHTED AVERAGE
Retrofit and strengthen essential facilities such as police, fire, schools and hospitals.	69.23% 9	15.38% 2	15.38% 2	13	2.54
Retrofit infrastructure such as roads, bridges, drainage facilities, water supply, waste water and power supply facilities.	69.23% 9	23.08% 3	7.69% 1	13	2.62
Capital projects such as dams, flood walls, drainage improvements and bank stabilization projects.	23.08% 3	53.85% 7	23.08% 3	13	2.00
Strengthen codes and regulations to include higher regulatory standards in hazard areas.	41.67% 5	41.67% 5	16.67% 2	12	2.25
Acquire vulnerable properties and maintain as open space.	15.38% 2	53.85% 7	30.77% 4	13	1.85
Assist vulnerable property owners with securing funding for mitigation.	33.33% 4	50.00% 6	16.67% 2	12	2.17
Provide better public information about risk, and the exposure to hazards within the operational area.	46.15% 6	53.85% 7	0.00% 0	13	2.46

Perform projects that restore the natural environments capacity to absorb the impacts from natural hazards.	46.15% 6	46.15% 6	7.69% 1	13	2.38
Perform projects that mitigate the potential impacts from climate change.	23.08% 3	53.85% 7	23.08% 3	13	2.00

Q25 Please indicate how you feel about the following statement:It is the responsibility of government (local, state and federal) to provide education and programs that promote citizen actions that will reduce exposure to the risks associated with natural hazards.

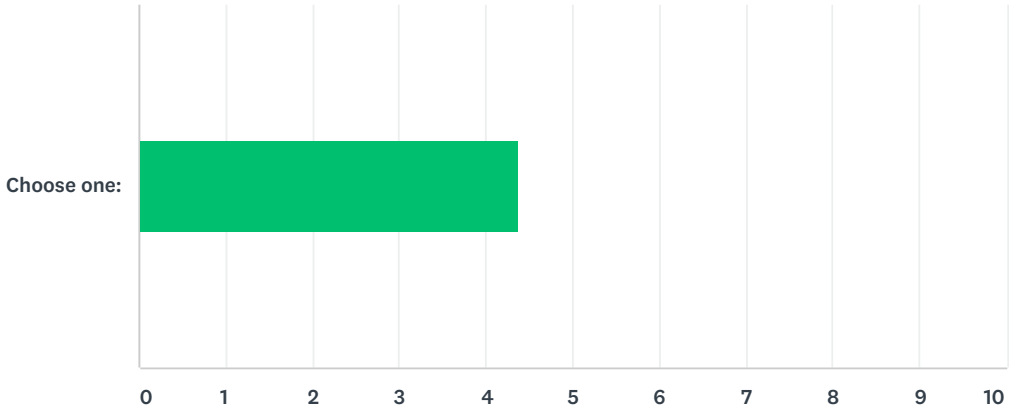
Answered: 13 Skipped: 2



	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
Choose one:	7.69% 1	0.00% 0	30.77% 4	38.46% 5	23.08% 3	13	3.69

Q26 Please indicate how you feel about the following statement:It is my responsibility to educate myself and take actions that will reduce my exposure to the risks associated with natural hazards.

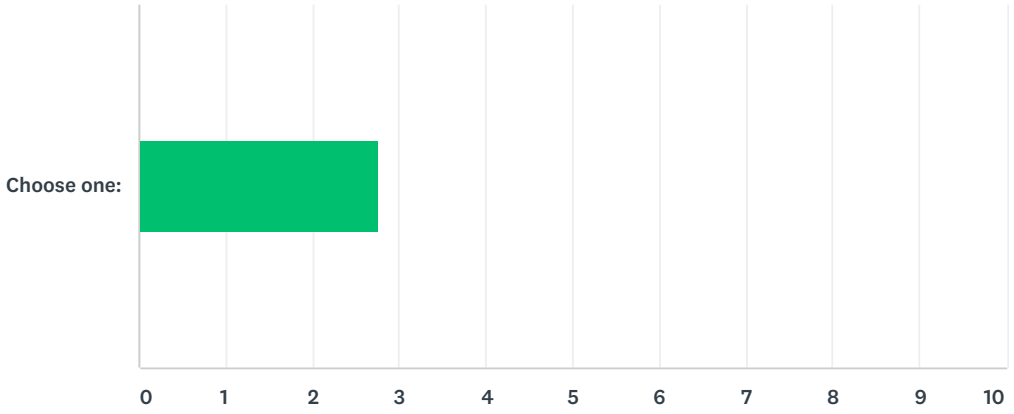
Answered: 13 Skipped: 2



	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
Choose one:	0.00% 0	15.38% 2	0.00% 0	15.38% 2	69.23% 9	13	4.38

Q27 Please indicate how you feel about the following statement:Information about the risks associated with natural hazards is readily available and easy to locate.

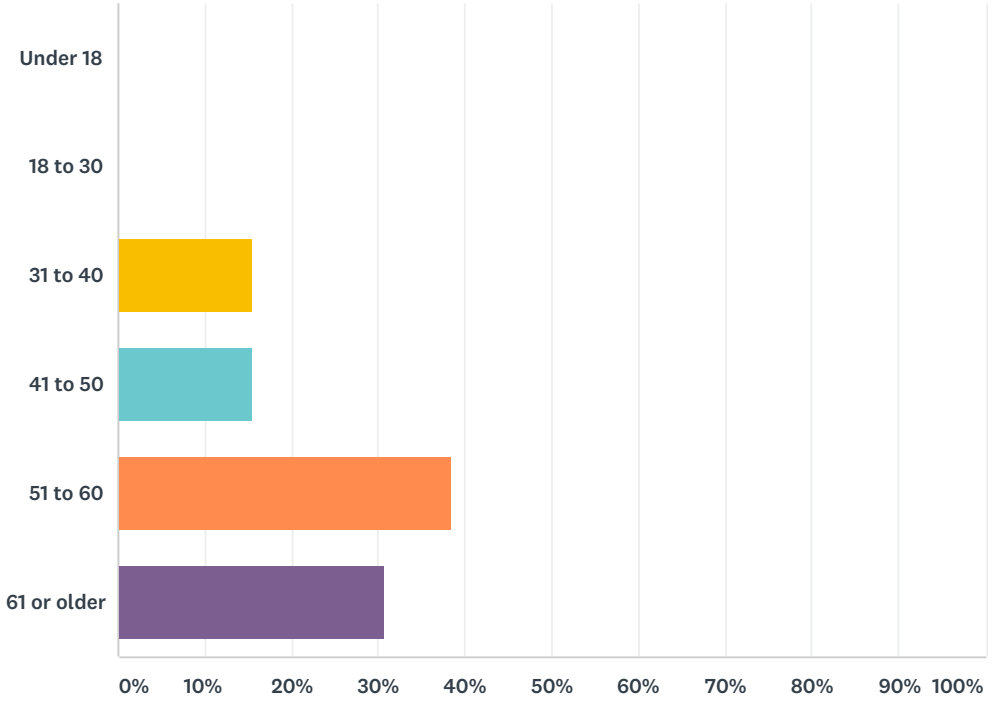
Answered: 13 Skipped: 2



	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
Choose one:	7.69% 1	38.46% 5	30.77% 4	15.38% 2	7.69% 1	13	2.77

Q28 Please indicate your age range:

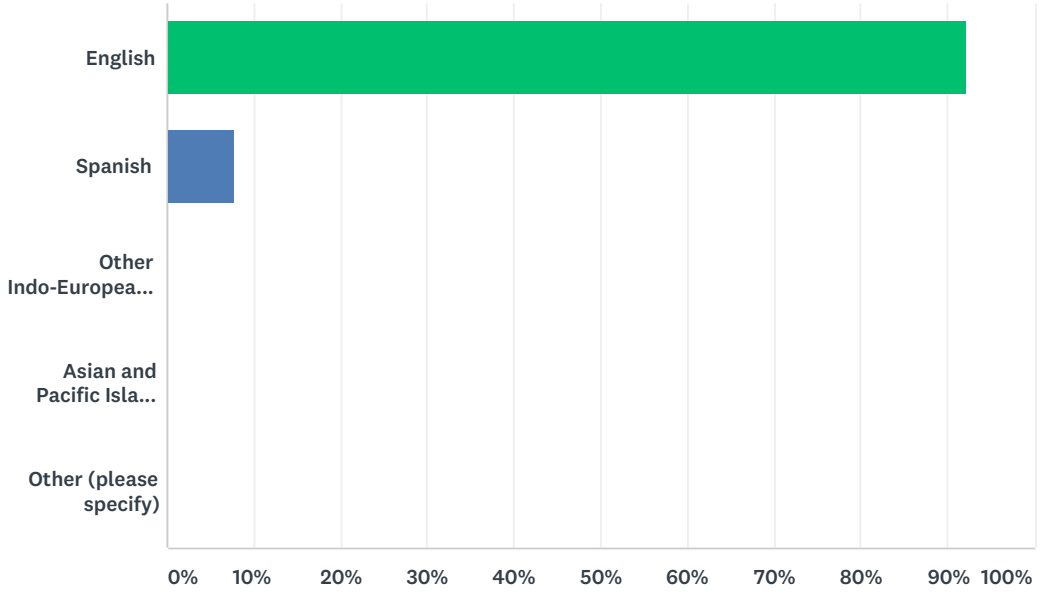
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Under 18	0.00%	0
18 to 30	0.00%	0
31 to 40	15.38%	2
41 to 50	15.38%	2
51 to 60	38.46%	5
61 or older	30.77%	4
TOTAL		13

Q29 Please indicate the primary language spoken in your household.

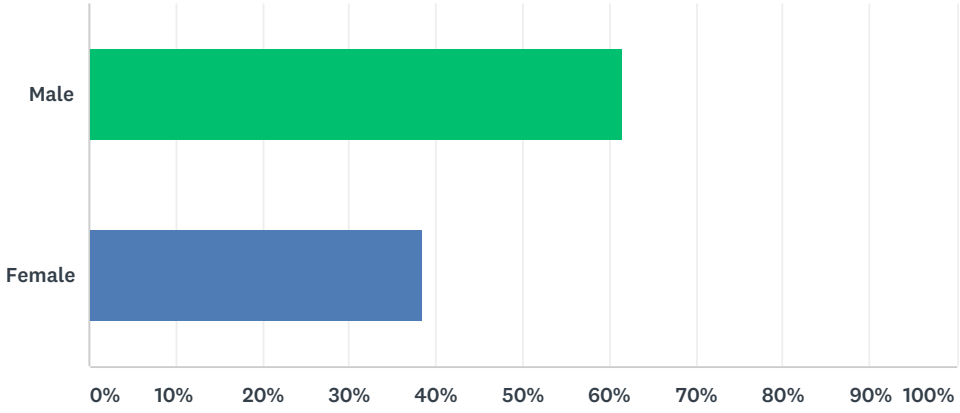
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
English	92.31%	12
Spanish	7.69%	1
Other Indo-European Languages	0.00%	0
Asian and Pacific Island Languages	0.00%	0
Other (please specify)	0.00%	0
TOTAL		13

Q30 Please indicate your gender:

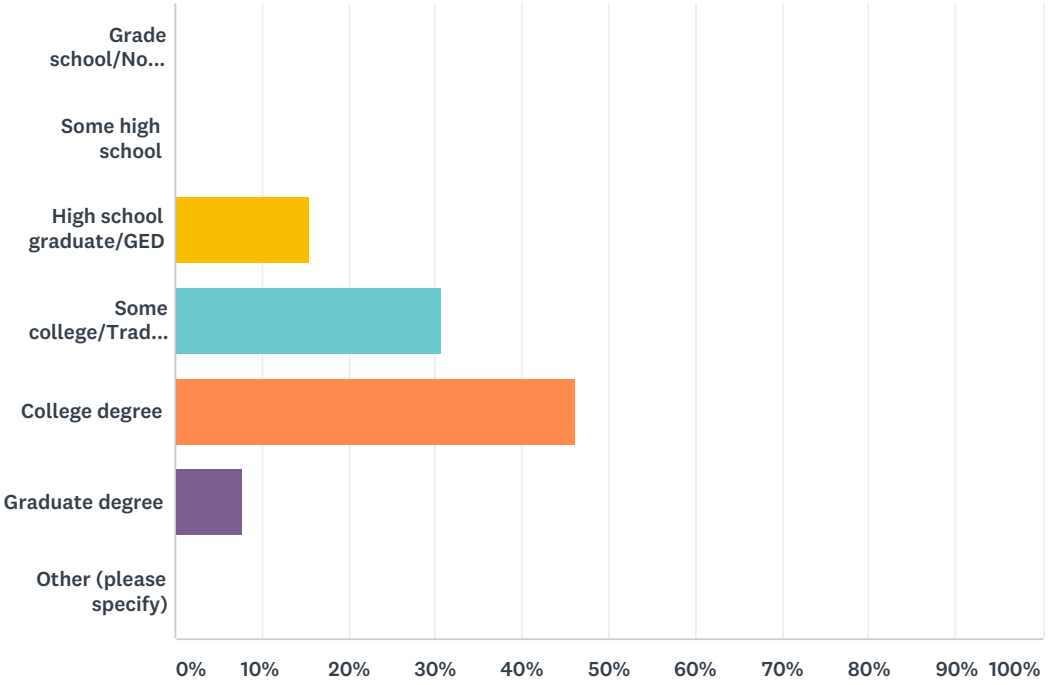
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Male	61.54%	8
Female	38.46%	5
TOTAL		13

Q31 Please indicate your highest level of education.

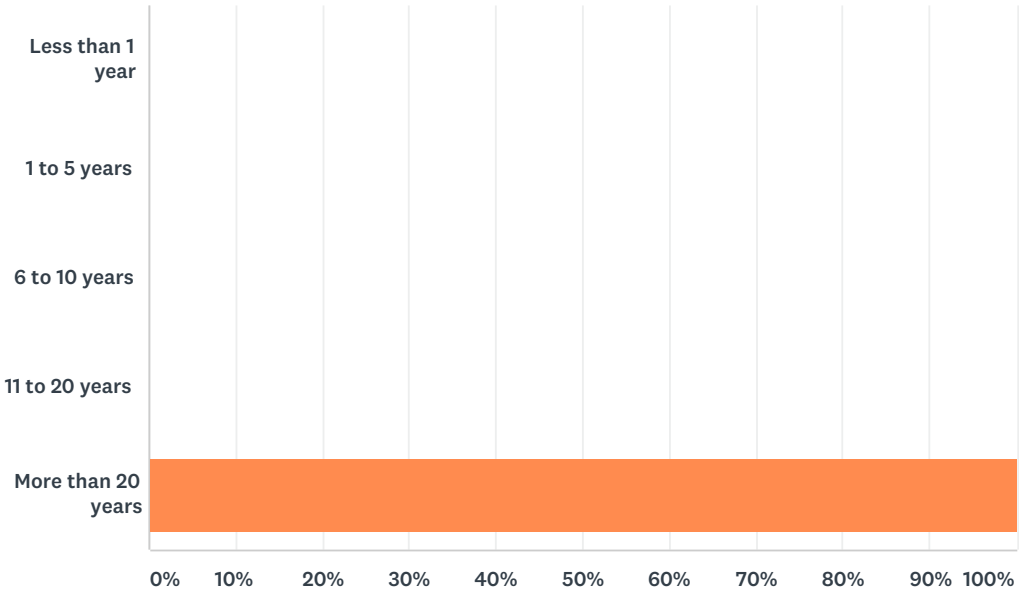
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Grade school/No schooling	0.00%	0
Some high school	0.00%	0
High school graduate/GED	15.38%	2
Some college/Trade school	30.77%	4
College degree	46.15%	6
Graduate degree	7.69%	1
Other (please specify)	0.00%	0
TOTAL		13

Q32 How long have you lived in Frio County?

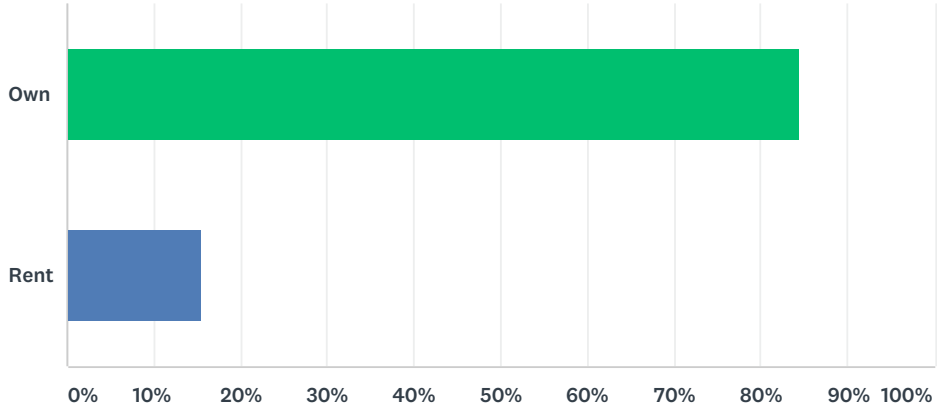
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Less than 1 year	0.00%	0
1 to 5 years	0.00%	0
6 to 10 years	0.00%	0
11 to 20 years	0.00%	0
More than 20 years	100.00%	13
TOTAL		13

Q33 Do you own or rent your place of residence?

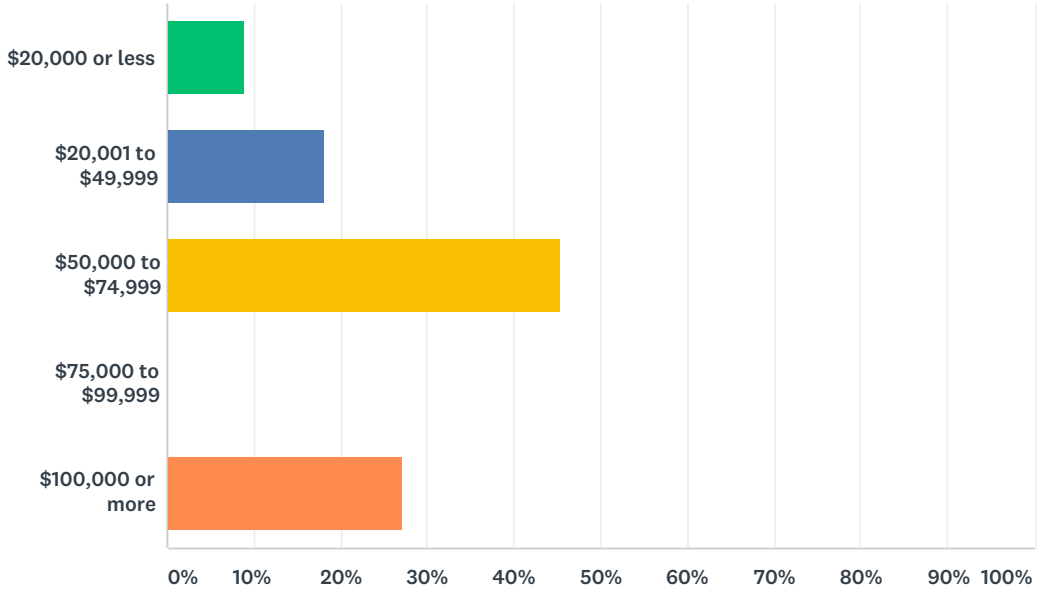
Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Own	84.62%	11
Rent	15.38%	2
TOTAL		13

Q34 How much is your gross household income?

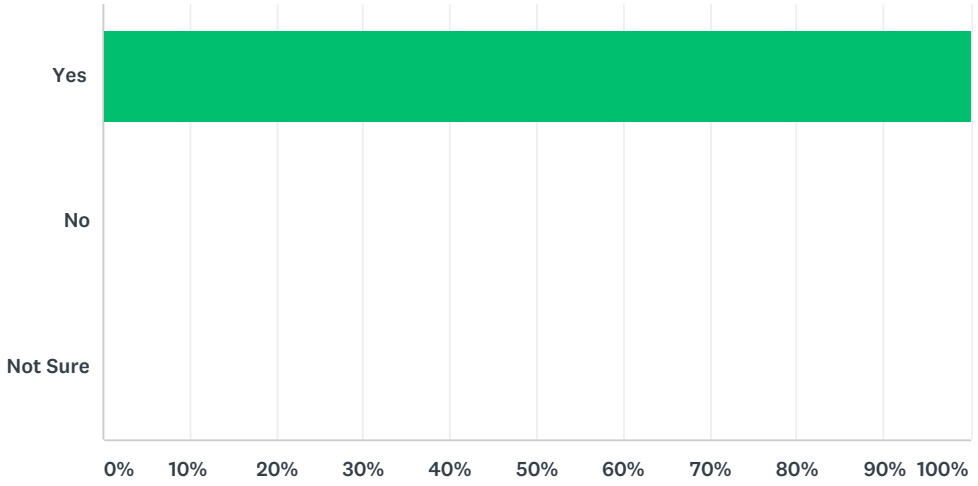
Answered: 11 Skipped: 4



ANSWER CHOICES	RESPONSES	
$20,000 or less	9.09%	1
$20,001 to $49,999	18.18%	2
$50,000 to $74,999	45.45%	5
$75,000 to $99,999	0.00%	0
$100,000 or more	27.27%	3
TOTAL		11

Q35 Do you have regular access to the Internet either in your home, work or elsewhere?

Answered: 13 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	100.00%	13
No	0.00%	0
Not Sure	0.00%	0
TOTAL		13

Q36 Comments

Answered: 3 Skipped: 12

APPENDIX C.
LOCAL MITIGATION PLAN REVIEW TOOL

APPENDIX C.

LOCAL MITIGATION PLAN REVIEW TOOL

This appendix presents the local mitigation action review tool for the Frio County Hazard Mitigation Plan. The review tool demonstrates how the plan meets federal regulations and offers state and FEMA planners an opportunity to provide feedback on the plan to the community.

Enclosure A

Attached is the list of approved participating governments included in the March 25, 2019 review of the referenced Hazard Mitigation plan.

	Community Name
1)	Dilley
2)	Frio County
3)	Pearsall

LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool.*

Jurisdiction: Frio County, Texas	**Title of Plan:** Frio County Hazard Mitigation Plan	**Date of Plan:** August 2018
Local Point of Contact: Mr. Ray Kallio	**Address:** 101 N. Commerce St. Dilley, Texas 78017	
Title: Emergency Management Coordinator		
Agency: Frio County Office of Emergency Management		
Phone Number: (830) 334-0088	**E-Mail:** frioemc@friocounty.org	

State Reviewer: Betty Rogers	**Title:** Mitigation Planner	**Date:** Aug. 31, 2018

FEMA Reviewer: David Reiff	**Title:** Mitigation Planner	**Date:** March 25, 2019
Date Received in FEMA Region VI	March 20, 2019	
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved	**March 25, 2019**	

LOCAL MITIGATION PLAN REVIEW TOOL

SECTION 1:
REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST **Regulation (44 CFR 201.6 Local Mitigation Plans)**	**Location in Plan (section and/or page number)**	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Pages 2-1 to 2-2 (Section 2.2) and 2-3 (Section 2.4); Appendix B	X	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Pages 2-3 to 2-7 (Sections 2.5, 2.6, and 2.7)	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Pages 2-4 to 2-9 (Section 2.7)	X	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Page 2-4 (Section 2.6); Pages 3-17 to 3-23 (Section 3.10); Pages 4-1 to 4-5 (Chapter 4);	X	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Pages 17-1 to 17-3 (Sections 17.2)	X	
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Pages 17-1 to 17-3 (Section 17.2, and Pages E-1 through E-4 (Appendix E)	X	
ELEMENT A: REQUIRED REVISIONS			

LOCAL MITIGATION PLAN REVIEW TOOL

1. REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Chapters 5 through 15, including: • Section 1 of each chapter (Hazard Profile) describes the type of hazard • Section 1.1 of each chapter (Location); and • Sections 1.2 (Extent); which describe the extent of the hazard	X	
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Chapters 6 through 15, Section 1.3 (Past Events) of each chapter Vulnerability and Impact Section 2 of each chapter Probability of future events: Chapters 6 through 15, Section 3 of each chapter	X	
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Chapters 6 through 15; specifically, Section 1.2 (Extent), Section 2.1 (Exposure) and Section 2 (Vulnerability) of each chapter	X	
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Page 9-13 to 9-14 (Section 9.1.2)	X	
ELEMENT B: REQUIRED REVISIONS			

1. REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and	Pages 3-17 to 3-23 (Section 3.10); Pages 4-	X	

improve these existing policies and programs? (Requirement §201.6(c)(3))	1 through 4-5 (Chapter 4)		
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Pages 3-19; Pages 3-21 through 3-23 (description of laws, ordinances, and programs for each jurisdiction); Pages 4-1 through 4-5 (floodplain ordinances); Pages 9-14 to 9-15;	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Pages 16-1 through 16-2 (Chapter 16)	X	
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Pages 16-1 through 16-10; specifically, Tables 16-1	X	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Pages 16-4 and 16-5 (Section 16.2.2)	X	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Pages 17-3 through 17-5 (Section 17.3)	X	
ELEMENT C: REQUIRED REVISIONS			

1. REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))		N/A	N/A
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))		N/A	N/A
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))		N/A	N/A
ELEMENT D: REQUIRED REVISIONS New Plan			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Page 17-1 (Section 17.1)	X	
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	Page 17-1 (Section 17.1)	X	

1. REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT E: REQUIRED REVISIONS **E1 & E2:** Once all Requirements have been met, the jurisdiction(s) must provide documentation demonstrating that the plan has been adopted.			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (optional for State reviewers only; not to be completed by FEMA)			
F1.			
F2.			
ELEMENT F: REQUIRED REVISION			

LOCAL MITIGATION PLAN REVIEW TOOL

SECTION 2:
PLAN ASSESSMENT

INSTRUCTIONS: The purpose of the Plan Assessment is to offer the local community more comprehensive feedback to the community on the quality and utility of the plan in a narrative format. The audience for the Plan Assessment is not only the plan developer/local community planner, but also elected officials, local departments and agencies, and others involved in implementing the Local Mitigation Plan. The Plan Assessment must be completed by FEMA. The Assessment is an opportunity for FEMA to provide feedback and information to the community on: 1) suggested improvements to the Plan; 2) specific sections in the Plan where the community has gone above and beyond minimum requirements; 3) recommendations for plan implementation; and 4) ongoing partnership(s) and information on other FEMA programs, specifically RiskMAP and Hazard Mitigation Assistance programs. The Plan Assessment is divided into two sections:

1. Plan Strengths and Opportunities for Improvement
2. Resources for Implementing Your Approved Plan

Plan Strengths and Opportunities for Improvement is organized according to the plan Elements listed in the Regulation Checklist. Each Element includes a series of italicized bulleted items that are suggested topics for consideration while evaluating plans, but it is not intended to be a comprehensive list. FEMA Mitigation Planners are not required to answer each bullet item, and should use them as a guide to paraphrase their own written assessment (2-3 sentences) of each Element.

The Plan Assessment must not reiterate the required revisions from the Regulation Checklist or be regulatory in nature, and should be open-ended and to provide the community with suggestions for improvements or recommended revisions. The recommended revisions are suggestions for improvement and are not required to be made for the Plan to meet Federal regulatory requirements. The italicized text should be deleted once FEMA has added comments regarding strengths of the plan and potential improvements for future plan revisions. It is recommended that the Plan Assessment be a short synopsis of the overall strengths and weaknesses of the Plan (no longer than two pages), rather than a complete recap section by section.

Resources for Implementing Your Approved Plan provides a place for FEMA to offer information, data sources and general suggestions on the overall plan implementation and maintenance process. Information on other possible sources of assistance including, but not limited to, existing publications, grant funding or training opportunities, can be provided. States may add state and local resources, if available.

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

Element B: Hazard Identification and Risk Assessment

- The plan combines Drought and Extreme Heat. These hazards may exacerbate each other but are not mutually dependent. The hazards should be profiled separately.

Element C: Mitigation Strategy

Element D: Plan Update, Evaluation, and Implementation (Plan Updates Only)

B. Resources for Implementing Your Approved Plan

This section provides examples of possible resources plan implementation.

Ideas may be offered on moving the mitigation plan forward and continuing the relationship with key mitigation stakeholders such as the following:

- What FEMA assistance (funding) programs are available (for example, Hazard Mitigation Assistance (HMA)) to the jurisdiction(s) to assist with implementing the mitigation actions?
- What other Federal programs (National Flood Insurance Program (NFIP), Community Rating System (CRS), Risk MAP, etc.) may provide assistance for mitigation activities?
- What publications, technical guidance or other resources are available to the jurisdiction(s) relevant to the identified mitigation actions?
- Are there upcoming trainings/workshops (Benefit-Cost Analysis (BCA), HMA, etc.) to assist the jurisdictions(s)?
- What mitigation actions can be funded by other Federal agencies (for example, U.S. Forest Service, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA) Smart Growth, Housing and Urban Development (HUD) Sustainable Communities, etc.) and/or state and local agencies?

FEMA Mitigation grants are available to eligible applicants. Search grants.gov for additional resources for implementing mitigation actions.

LOCAL MITIGATION PLAN REVIEW TOOL

SECTION 3:
MULTI-JURISDICTION SUMMARY SHEET (OPTIONAL)

INSTRUCTIONS: For multi-jurisdictional plans, a Multi-jurisdiction Summary Spreadsheet may be completed by listing each participating jurisdiction, which required Elements for each jurisdiction were 'Met' or 'Not Met,' and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it should be used as an optional worksheet to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET												
#	Jurisdiction Name	Jurisdiction Type (city/borough / township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
1	Frio County	County	Ray Kallio		frioemc@friocounty.org		Y	Y	Y	Y	Y	N/A
2	City of Dilley	City	Jose "Rudy" Alvarez		cityadministrator@cityofdilleytx.com		Y	Y	Y	Y	Y	N/A
3	City of Pearsall	City	Uche Echeozo		uecheozo@cityofpearsall.org		Y	Y	Y	Y	Y	N/A

APPENDIX D.
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

APPENDIX D.
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

This appendix presents the signed resolutions from the planning partners.

STATE OF TEXAS §

§ **IN THE COMMISSIONERS COURT**

COUNTY OF FRIO §

FRIO COUNTY HAZARD MITIGATION PLAN RESOLUTION

At a special called meeting of the Frio County Commissioners Court held at the Frio County Courthouse, Pearsall, Texas, at which a quorum was present, the following Resolution was adopted:

WHEREAS, Section 322 of the Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5165) requires local governments to develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects; and,

WHEREAS, the Code of Federal Regulations (CFR) at Title 44, Chapter 1, part 201, requires the County to prepare and adopt a local mitigation plan every five years; and,

WHEREAS, a steering committee comprised of m embers of the County, and participating incorporated areas within, selected and deemed appropriate by the Commissioners Court in its authority to do so as granted by the people, as well as the local participating governments' leadership was convened in order to assess the risks of hazards facing the County and the Communities, and to make recommendations on actions to be taken to mitigate these hazards; and,

WHEREAS, a request for proposals was issued through the Frio County Purchasing Department to hire an experienced consulting firm to work with the County to update a comprehensive hazard mitigation plan for the County and the participating jurisdictions; and,

WHEREAS, on September 25, 2017 the Frio County Commissioners Court awarded a contract for the drafting of the plan to Tetra Tech, Inc. to update the Frio County Hazard Mitigation Plan; and,

WHEREAS, the plan has been completed and incorporates the comments, ideas and concerns of the community and of the public in general, which this plan is designed to protect, ascertained through a series of public meetings, publication of the draft plan, press releases, and other outreach activities; and

NOW, THEREFORE, BE IT RESOLVED by the Commissioners Court of Frio County, Texas at this its regular called meeting on the 27th day of February 2019, duly noticed, with a quorum present, that the Commissioners Court of Frio County, Texas the 2018 Frio County, Texas Hazard Mitigation Plan, which is hereby approved and adopted by the Commissioners Court of Frio County, who resolves to execute the actions of this plan. A copy of this plan is attached as exhibit A, and will be available upon request from the Frio County Office of Emergency Management.

This resolution is approved by a vote of: 5 AYES, 0 NAYS, 0
ABSTENTION
ABSENT 0

HON. ARNULFO C. LUNA
County Judge

HON. VICKIE CAMACHO
Commissioner, Precinct No. 1

HON. RICHARD GRAF
Commissioner, Precinct No. 2

HON. RUBEN MALDONADO
Commissioner, Precinct No. 3

HON. JOSE ASUNCION
Commissioner, Precinct No. 4

ATTEST:

HON. ANGIE TULLIS
Frio County Clerk
Ex officio Clerk of the
Frio County Commissioners Court

COMMISSIONERS COURT
FRIO COUNTY, TEXAS

By: _____
(Chief) Deputy Clerk

STATE OF TEXAS §

§ **CITY OF DILLEY**

COUNTY OF FRIO §

CITY OF DILLEY HAZARD MITIGATION PLAN RESOLUTION

At a special called meeting of the City of Dilley held at 116 E. Miller St., Dilley, Texas at which a quorum was present, the following Resolution was adopted:

WHEREAS, Section 322 of the Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5165) requires local governments to develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects; and,

WHEREAS, the Code of Federal Regulation (CFR) at Title 44, Chapter 1, part 201, requires the City to prepare and adopt a local mitigation plan every five years; and,

WHEREAS, a steering committee comprised of members of the City Council and participating incorporated areas within, selected and deemed appropriate by the City Council in its authority to do so as granted by the people, as well as the local participating governments' leadership was convened in order to assess the risks of hazards facing the City and the Communities, and to make recommendations on actions to be taken to mitigate the hazards; and,

WHEREAS, a request for proposals was issued through the City of Dilley Purchasing Department to hire and experiences consulting firm to work with the City to update a comprehensive hazard mitigation plan for the City, and the participating jurisdictions; and,

WHEREAS, on March 12, 2019 the City Council awarded a contract for the drafting of the plan to update the City of Dilley Hazard Mitigation Plan; and,

WHEREAS, the plan has been completed and incorporates the comments, ideas and concerns of the community and of the public in general, which this plan is designed to protect, ascertained through a series of public meetings, publication of the draft plan, press releases, and other outreach activities; and

NOW,THEREFORE, BE IT RESOLVED by the City Council of the City of Dilley, Texas at this its regular called meeting on the 12th day of March 2019, duly noticed, with a quorum present, that the City Council of Dilley, Texas the 2018 City of Dilley, Texas Hazard Mitigation Plan, which is hereby approved and adopted by the City Council of Dilley, Texas, who resolves to execute the actions of this plan, A copy of this plan is attached as exhibit A, and will be available upon request from the City of Dilley Emergency Management.

PASSED AND **APPROVED** this 12th day March, 2019.

Mary Ann Obregon, Mayor
City of Dilley, Texas

ATTEST:

Juanita G. Fonseca, City Secretary
City of Dilley, Texas

RESOLUTION
No. 2019-03-01

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF PEARSALL, TEXAS ADOPTING THE FRIO COUNTY 2018 HAZARD MITIGATION PLAN.

WHEREAS, the Disaster Mitigation Act of 2000 (DMA) is federal legislation that requires proactive, pre-disaster planning as a prerequisite for funding available under the Robert T. Stafford Act;

WHEREAS, the DMA encourages state and local authorities to work together on pre-disaster planning calling for the DMA to help local governments articulate accurate needs for mitigation resulting in faster allocation of funding and more cost-effective risk reduction projects;

WHEREAS, hazard mitigation is the use of long-and short-term strategies to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster;

WHEREAS, hazard mitigation involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards;

WHEREAS, the responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state, and federal government;

WHEREAS, Frio County and the participating municipalities (the Cities of Dilley and Pearsall) have developed a hazard mitigation plan to reduce risks from natural disasters and to comply with the DMA;

WHEREAS, the City Council of the City of Pearsall, Texas desires to adopt the Frio County 2018 Hazard Mitigation Plan that has been FEMA approved pending adoption by participating jurisdictions; and

WHEREAS, the Frio County 2018 Hazard Mitigation Plan is described and attached as Exhibit "A"; and

WHEREAS, there will be no fiscal impact on the City of Pearsall in adopting the Frio County 2018 Hazard Mitigation Plan; and

WHEREAS, failure to adopt the Frio County 2018 Hazard Mitigation Plan may result in the City of Pearsall being ineligible to receive certain FEMA Mitigation Grants; and

WHEREAS, the City Council of the City of Pearsall, Texas finds that this Resolution was adopted at a meeting of the Pearsall City Council that was held in strict compliance with the Texas Open Meetings Act at which a quorum of the City Council Members were present and voting;

NOW, THEREFORE, IT **IS HEREBY RESOLVED** by the City Council of the City of Pearsall, Texas that:

Section 1. The City Council of the City of Pearsall, Texas adopts the foregoing recitations as true and correct.

Section 2. The City Council of the City of Pearsall, Texas adopts the the Frio County 2018 Hazard Mitigation Plan described and attached as Exhibit "A".

DULY PASSED and APPROVED on the __12th__ day of March, 2019.

CITY OF PEARSALL, TEXAS

Mary Moore, Mayor

ATTEST:

Krystal Garcia, City Secretary

APPENDIX E.
EXAMPLE PROGRESS REPORT

APPENDIX E.
EXAMPLE PROGRESS REPORT

Frio County
Hazard Mitigation Plan
Annual Progress Report

Reporting Period: 2018-2022

Background: Frio County and the Cities of Dilley and Pearsall developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the participating partners organized resources, assessed risks from natural hazards within the planning area, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, these jurisdictions maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under FEMA's Hazard Mitigation Assistance grants.

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ____, 2018, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before _____, 2022. As of this reporting period, the performance period for this plan is considered to be __% complete. The Hazard Mitigation Plan has targeted 16 hazard mitigation actions to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

__ out of __ actions (__%) reported ongoing action toward completion

__ out of __ actions (__%) were reported as being complete

__ out of __ actions (___%) reported no action taken

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Frio County Hazard Mitigation Plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the Hazard Mitigation Plan dynamic and responsive to the needs and capabilities of the partner jurisdictions. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area (all of Frio County)
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement
- Monitor the incorporation of the Mitigation Plan into planning mechanisms.

The Hazard Mitigation Plan Steering Committee: The Hazard Mitigation Plan Steering Committee, made up of planning partners and stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on _____, 201_. It was determined through the plan's development process that a Steering Committee would remain in service to oversee maintenance of the

plan. At a minimum, the Steering Committee will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Steering Committee membership (sign-in sheet attached).

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

_____

_____

_____

_____

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: The following sample table reviews the recommended mitigation actions for Frio County. When reporting, the status will need to include all the planning partners' mitigation actions. Reviewers of this report should refer to the Hazard Mitigation Plan for more detailed descriptions of each action and the prioritization process.

Address the following in the "status" column of the following table:

Was any element of the action carried out during the reporting period?

If no action was completed, why?

Is the timeline for implementation for the action still appropriate?

If the action was completed, does it need to be changed or removed from the action plan?

Table E-1. Mitigation Action Plan Matrix

Action No.	Title	Action Taken? (Yes or No)	Timeline	Priority	Status	Status (√, O, X)
FRIO COUNTY						

Changes That May Impact Implementation of the Plan: (*Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Steering Committee, the following recommendations will be noted for future updates or revisions to the plan:

_____

_____

_____

_____

_____

Public Review Notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the governing boards of all planning partners and to local media outlets and the report is posted on the Frio County Hazard Mitigation Plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here

http://www.co.frio.tx.us/