HAZARD MITIGATION PLAN

Bandera County 2024

ROJAS

STATE OF TEXAS
BLANCO COUNTY

LANGFORD
COMMUNITY MANAGEMENT
SERVICES
EST. 1983

SECTION 1: INTRODUCTION

Background

Bandera County is located in South Central Texas just northwest of Bexar County, home to San Antonio which is the 7th most populous city in the United States. While the majority of the County remain rural in nature, the regional population and economic growth is being felt in the area and underscores the need to plan for the mitigation of future hazards to protect people and property. Bandera County is susceptible to a wide range of natural hazards, including but not limited to hurricanes, flooding, hail, extreme heat, drought, and wildfire. The county has a hazard profile similar to many Central Texas communities with hurricanes and tropical storms from the gulf coast in the summer and fall and flash flooding events typically in the spring and summer. With climate change affecting weather patterns and sea level rise on the Texas coast, these and other hazards are forecast to become more frequent and greater in magnitude in the future.

These hazards can be life-threatening, destroy property, disrupt the economy, and lower the overall quality of life for individuals. Hazard mitigation is defined by the Federal Emergency Management Agency (FEMA) as sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. Hazard mitigation planning is an investment in a community's safety and sustainability. It is widely accepted that the most effective hazard mitigation measures are implemented at the local government level, where decisions on the regulation and control of development are ultimately made. This hazard mitigation plan is a vehicle for Bandera County, including participating jurisdictions, to address hazard vulnerabilities by reducing the future impact of many different hazards on people and property that exist today and in the foreseeable future.

Participation and Scope

The Bandera County Hazard Mitigation Plan is a multi-jurisdictional plan covering one (1) County, one (1) city, three (3) independent school districts, and one (2) water districts. The prior hazard mitigation plan for the area was the 2017 AACOG Hazard Mitigation Plan. This plan update includes the Bandera County, Bandera FWSD #1, City of Bandera, Bandera ISD, Flying L PUD, Medina ISD, Medina WSC, and Utopia ISD. Additional entities were invited to participate but chose to do so as stakeholders, rather than jurisdictions. These are listed in Section Two under Public and Stakeholder involvement. Below is an example of outreach efforts to inform the public about the upcoming Hazard Mitigation Action Plan (HMAP) development process.

Notice of mitigation planning efforts on county and city websites and the local newspaper, Spring 2023

> *"The hazard mitigation focus for FEMA is to look at a broad set of threats and how those pair up to community vulnerabilities. We will be considering everything from flood events to hurricanes, tropical*

storms, severe thunderstorms, tornados, hail, lightning, drought, wildfire, extreme heat, and winter storms," Rojas said.

The required plan includes a Core Planning team of Bandera County and its participating jurisdictions along with local teams to develop specific mitigation strategies unique to each community. Once the Core and local teams are both established, Rojas said that they will conduct an on-line community survey to understand residents' top concerns, along with several public hearings. The survey will also be accessible to the public in public facilities such as libraries, city halls, and the county courthouse.

The 2017 AACOG hazard mitigation plan included Bandera County and the City of Bandera. The updated plan will expand upon the 2017 plan with new capabilities, risk assessments, and mitigation actions contained therein, but will also provide a more nuanced view of the county with regard to history, landscape, risk, economy, transportation, local agencies and jurisdictions.

The 2024 hazard mitigation plan update scope is to develop a detailed understanding of the planning area regarding existing capabilities, historical data, and future development patterns. Next, the vulnerability of the area to different hazards will be studied through a detailed hazard risk assessment that will assist the planning team in identifying and ranking mitigation activities based on their likelihood to reduce overall risk.

Purpose

The Mission Statement of the Plan is, ***Protect the people, property, economy, and quality of life in Bandera County from hazards and disasters.***

The Plan was prepared by Bandera County, including participating jurisdictions, and in cooperation with Langford Community Management Services and Rojas Planning. The purpose of the Plan is to minimize or eliminate long-term risks to human life and property from known hazards and to break the cycle of high-cost disaster response and recovery throughout Bandera County. In order to accomplish this, cost-effective hazard mitigation actions within the planning area are identified along with information critical to successful implementation such as estimated cost, responsible departments, funding sources, and timelines. In addition, a FEMA-approved hazard mitigation plan is a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation programs and projects.

A successful Hazard Mitigation Plan will:

1. Align risk reduction with other Federal, State or community objectives;
2. Build or encourage partnerships for risk reduction involving government, organizations, businesses, and the public;
3. Communicate priorities to potential sources of funding;
4. Identify long-term, broadly-supported strategies for risk reduction;
5. Identify implementation approaches that focus resources on the greatest risks and vulnerabilities; and,
6. Increase education and awareness around threats, hazards, and vulnerabilities.

The Core Planning Team has identified twelve natural hazards that need to be addressed in the plan. You can find more information about these hazards in Section 4, while the detailed risk assessments for each hazard are discussed in Sections 5-17. The Plan's specific goals are

identified in Section 18, with mitigation actions outlined in Section 19. Section 20 discusses the ongoing maintenance of the Plan, including how it will be incorporated into existing plans and funding mechanisms, monitoring and evaluation, annual and 5-year updates, and a commitment to involve the public continuously in the Hazard Mitigation Plan.

Authority

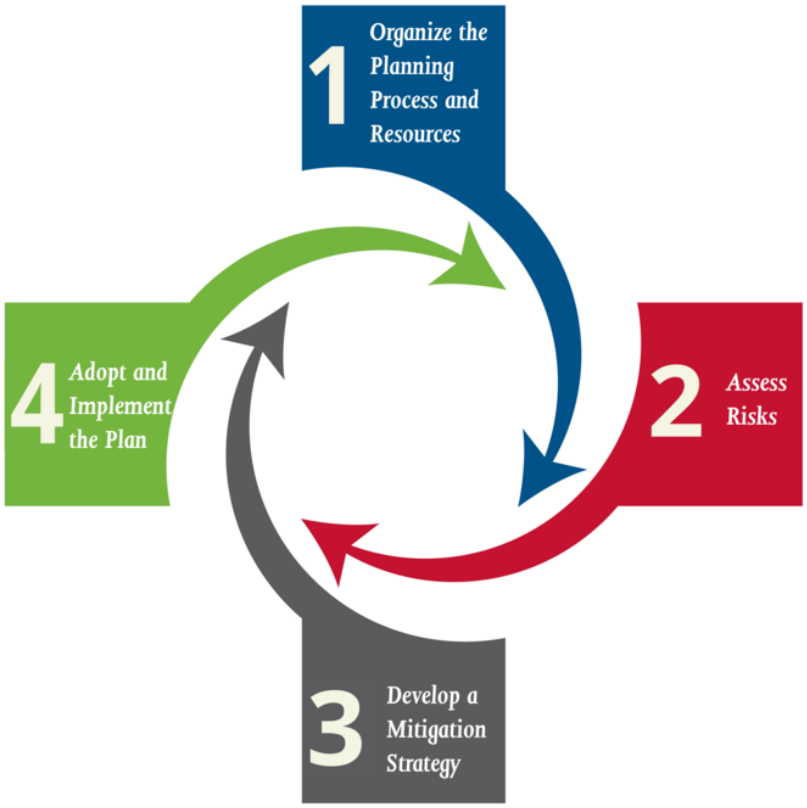
The Texas Division of Emergency Management (TDEM) and FEMA have the authority to review and approve hazard mitigation plans through the Disaster Mitigation Act of 2000, which amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

SECTION 2: PLANNING PROCESS

Plan Preparation and Plan Development

Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of disasters and is most effective when implemented under a comprehensive, long-term mitigation plan. Hazard mitigation planning involves coordination with various constituents and stakeholders to identify risks and vulnerabilities associated with natural disasters and develop long-term strategies for protecting people and property from future hazard events. Mitigation plans are key to breaking the cycle of disaster damage, reconstruction, and repeated damage. This section provides an overview of the planning process including the identification of the key steps of Plan development and a detailed description of how stakeholders and the public were involved.

Figure 1-1: Plan Development Process



1. Organize the Planning Process and Resources – At the start, the participating jurisdictions focus on assembling the resources needed for a successful mitigation planning process. This includes securing technical expertise, defining the planning area, and identifying key individuals, agencies, neighboring jurisdictions, businesses, and/or other stakeholders to participate in the process. The planning process for local and tribal governments must include opportunities for the public to comment on the plan.

2. Assess Risks – Next, the local government needs to identify the characteristics and potential consequences of hazards. It is important to understand what geographic areas each hazard might impact and what people, property, or other assets might be vulnerable.

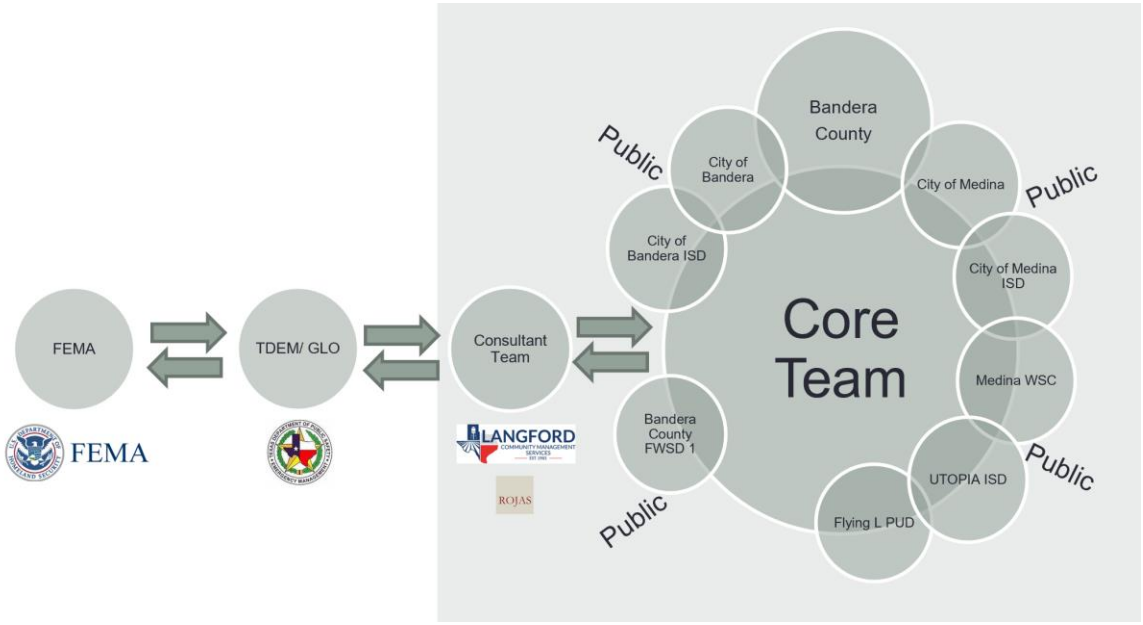
3. Develop a Mitigation Strategy – The local government then sets priorities and develops long-term strategies for avoiding or minimizing the undesired effects of disasters. The mitigation strategy addresses how the mitigation actions will be implemented and administered.

4. Adopt and Implement the Plan – Once FEMA has received the adoption from the governing body and approved the plan, the state, tribe, or local government can bring the mitigation plan to life in a variety of ways, ranging from implementing specific mitigation projects to changing aspects of day-to-day organizational operations. To ensure success, the plan must remain a relevant, living document through routine maintenance. The local government needs to conduct periodic evaluations to assess changing risks and priorities and make revisions as needed.

Planning Team

Bandera County, including participating jurisdictions, hired Langford Community Management Services and Rojas Planning to provide technical support and to oversee development of the plan. The Bandera County Plan update was created using a direct representative model, where each participating jurisdiction chooses and sends a representative to represent their interests. A local planning team was also established at the jurisdictional level, which was responsible for assembling representatives to participate in the meetings and complete relevant tasks. Ultimately, this group was primarily responsible for developing, and eventually implementing the mitigation actions at the local level.

Figure 1-2: Planning Team and Process Diagram



The first Core Planning Team meeting was held on Friday, March 24, 2023, at the Bandera County Justice Center at 3360 State Hwy 173N Bandera, TX 78003. At this meeting an overview of the planning process was discussed as well as what the responsibilities would be of each of the participating jurisdictions and their Core Team representative. Some of the responsibilities of the Core Team that were discussed include Capability Assessment Surveys, identifying critical facilities, providing a survey to the general public, providing input regarding

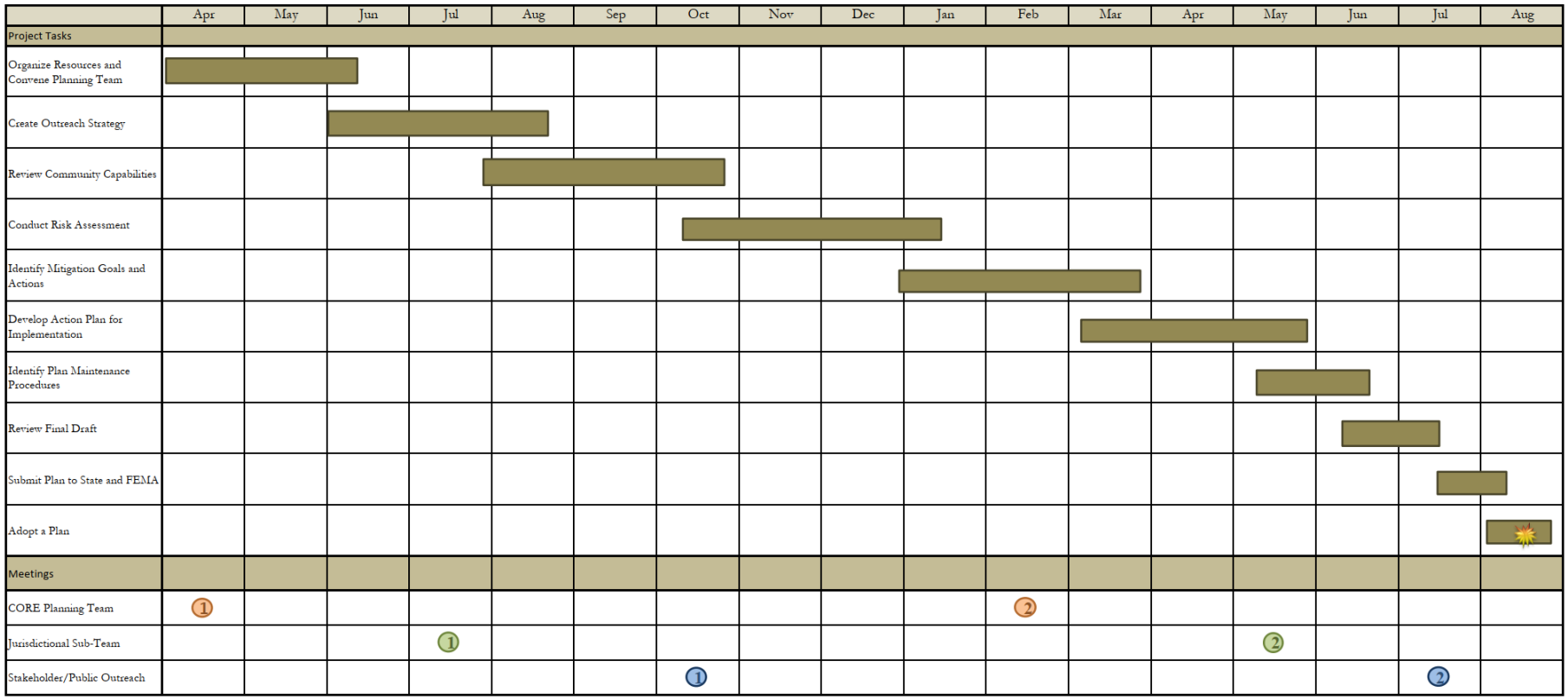
the identification of hazards, identifying mitigation goals, developing new mitigation actions, and ranking mitigation actions.

At least one member from each participating was present at this kickoff Core Team meeting. The meeting included a discussion on Plan stakeholders, options for engaging the public, and developing a schedule for Plan development. Core Team members were asked to attend all workshops; any members that did not attend were given copies of the meeting materials and contacted by phone or e-mail.

Table 2-1. Core Planning Team

Entity	Position or Title	Department
Bandera County	County Judge Emergency Management Coordinator	Commissioners Court Emergency Management
City of Bandera	City Secretary Public Works Supervisor	City Hall Public Works
Bandera ISD	Superintendent	Administration
Bandera FWSD #1	General Manager	Water District Officers
Flying L PUD	Chair	Administration
Medina ISD	Superintendent	Administration
Medina WSC	General Manager	Water District Officers
Utopia ISD	Superintendent	Administration

Project Schedule



CORE Planning Team Meetings

1	Introductions, outreach brainstorming, process review, capabilities assessment and hazards review.
2	Survey, basemaps, outreach strategy,and Jurisdictional Sub-teams.
	Conduct local risk assessments and identify information gaps, identify mitigation goals and actions, and develop implementation plan

Jursidictional Sub-Team

1	Review basemaps, input on risk assessment, create an outreach strategy and complete local capability assessments.
2	Input on mitigation goals and actions, implementation and maintenance procedures, and review and adopt final plan for submission to FEMA

Stakeholder/ Public Outreach Meetings

1	Present basemaps, capability assessments, risk assessment, and draft mitigation actions for feedback and further development.
2	Opportunity to review and comment on final draft.

Resources and Existing Plans

Resources

To conduct hazard risk assessments, various resources were used to gather and analyze data on past hazard events and their impacts on the planning area. The preliminary findings of the hazard risk assessments were presented at Core Meeting 2, and then shared in their entirety with the participants to develop mitigation actions. The information obtained from these assessments facilitated discussions that helped participants develop actions for their respective communities. Resources used for the assessments include the National Oceanic and Atmospheric Administration (NOAA), Texas Geographic Society, U.S. Geographic Society (USGS), U.S. Department of Health and Human Services, US Departments of Agriculture, FEMA, U.S. Army Corp of Engineers (USACE), Texas Water Development Board (TWDB), Texas A & M Forest Service, Texas Division of Emergency Management (TDEM), local reporting, and other sources. This Hazard Mitigation Plan aligns with and supports Bandera Fresh Water Service District #1 and Medina Water Supply Corporation's current and future revisions of their Emergency Response Plan (ERP) and expansion of their existing Vulnerability Assessment to meet the risk and resilience assessment. The EPA has stated that if a CWS serves a population of 3,301 to 49,999, then their risk and resilience assessment certification statement was first due to the EPA by June 30, 2021, and their ERP certification statement was first due to the EPA within six months from that date.

Existing Plans

The following existing plans and regulations were used to develop background information and as a starting point for discussing past and current capabilities, hazards, and mitigation actions.

Texas State Hazard Mitigation plan - The primary role of the plan is to motivate state agencies and local government, as well as the private sector, to prevent catastrophic impact to property and people from natural hazards by addressing their potential for risk, identifying mitigation actions; and establishing priorities to follow through with those actions through collaborative, analytical mitigation planning. An additional role of the plan is to provide the framework for local planning teams to use as a springboard and resource when addressing their local mitigation planning requirements and strategies. The 2018 State Plan is the most recent update.

Bandera County Subdivision and Land Development Regulations (2005, revised 2022) - Rapid population growth and development have caused both economic and environmental problems in other counties and communities in Texas, and – without reasonable regulations to manage development and the subdivision of land – would be likely to do the same in Bandera County, straining County roads and other public infrastructure, devaluing existing property, imposing an unwarranted tax burden on the citizens of the County, threatening water supplies and other natural resources, endangering the natural scenic beauty of the County, and generally imposing an adverse risk on the public health and safety. The purpose of these rules is to provide for the orderly, moral and healthful development of Bandera County, and for the safety, health and well-being of the general public. By establishing procedures for the efficient and orderly subdivision and development of land within its unincorporated areas, Bandera County intends to help maintain the quality of life its citizens have come to expect – and to preserve the natural resources of the County for future generations – without imposing undue burden on current taxpayers and citizens.

Medina River Watershed Master Plan (November 2015) - SARA has worked with partner agencies to complete Watershed Master Plans since 2009 for watersheds within the San Antonio River basin. The master plans have two primary objectives:

1. Identify needs and opportunities related to flood risk, water quality issues, LID, stream restoration, nature-based park planning, mitigation banking, and conservation easements

2. Develop and assess proposed projects to address the identified needs and preserve identified opportunities

Watershed master plans encourage all sectors of the community to work together to create a flood hazard-resilient community. These plans address existing flooding, erosion, and water quality problems and can be useful in preparing for future challenges. Watershed master plans provide recommendations, help educate the public and influence decision makers regarding land use changes, encourage investment in capital projects, and encourage modifications to development regulations within a watershed. The developed watershed master plans within the SAFPR are shown in Table 7-6; these plans are living documents that are updated as needed.

Region 12, San Antonio Regional Flood Planning Group (SARFPG) - Senate Bill 8, 86th Texas Legislature, created a state flood planning process for Texas, through which TWDB will be administering state and regional flood plans. TWDB designated 15 planning area regions, including Region 12. The first regional flood plans are due in January 2023, which will culminate in the first statewide flood plan due September 1, 2024.

Each self-governed regional flood planning group is responsible for identifying and assessing specific flood risks, as well as setting flood risk reduction goals, identifying and recommending flood management evaluations and strategies, and flood mitigation projects to reduce flood risk in their regions. Additionally, the groups will focus on reducing existing flood risks to life and property and on floodplain management in general to avoid increasing flood risk in the future by keeping future populations out of the way of flood flows.

Bandera County River Authority and Ground Water District - In collaboration with the USGS, the Bandera County River Authority and Ground Water District (BCRAGD) developed a tool set in 2018 that provides a flood warning system for Bandera County. The tool consists of a streamflow gage monitoring network, a HEC-RAS that creates a well-calibrated hydraulic model of the Medina River. It has the ability to generate flood inundation maps in the USGS Flood Inundation Mapping Program (FIMP) website46 and a Decision Support System. The hydraulic model of Medina River at and near Bandera was created using high-resolution digital elevation data, aerial photographs, field surveys on structure and channel cross sections, and the stage-discharge rating curve that was established at the Bandera Station. This information was used to develop 29 flood inundation maps showing potential inundation areas and depths for stages ranging from 10 to 38 feet. The river is continuously measured at all gages every 15 minutes and transmitted every hour to a satellite. This information is publicly accessible through the USGS FIMP47[1]

City of Bandera Comprehensive Plan – The Bandera Comprehensive Plan is as much what it is as what it is not. The elements included in the plan and the polices that follow keep Bandera

[1] https://webapps.usgs.gov/infrm/fdst/

true to its roots. This plan meets all requirements of the Texas Local Government Code, Chapter 213. Municipal Comprehensive Plans. It includes provisions on land use, transportation, and public facilities; consists of a single plan organized by subject and geographic area; and will be used to coordinate and guide the establishment of Development Standards. It is a simple, illustrative document that captures the essence of Bandera through a beautifully written vision statement; and creates a future master plan by integrating the natural setting, built environment, and the culture of Bandera to maintain its authenticity. This plan is written to inspire the community to understand its challenges, feel empowered by the possible solutions, and have a sense of urgency to act. Bandera's development codes have been written to ensure an integration with this Comprehensive Plan using the community's DNA as its foundation.

City of Bandera Subdivision Ordinance - The provisions of the Subdivision Ordinance are intended to provide for the orderly development of the City through the creation of neighborhoods that provide for light, air, recreation, transportation, water, drainage, wastewater and other facilities by assuring compliance of land divisions and development, the subdivision requirements and standards contained in this ordinance prior to site preparatory activities on individual lots, tracts, or parcels.

Public and Stakeholder Involvement

The process of hazard mitigation planning presents an opportunity for Bandera County, along with the participating jurisdictions, water utility, stakeholders and the general public, to assess and develop effective actions to mitigate the risk of loss of life and property damage that may result from a disaster occurring within or around the planning area. Public participation and stakeholder involvement in the Plan are critical to ensure that the components of the Plan are accurate and relevant to the needs of the community. The Planning Team develops a greater understanding of local concerns and legacy knowledge with input from individual citizens and the community as a whole. If citizens and stakeholders are involved it also imparts more credibility on the final Plan and increases the likelihood of successfully implemented mitigation actions.

Table 2-2. Plan Stakeholders

FEMA	GLO	TDEM
County Judge	County Commissioners	Mayor
City Council	City of Bandera Chamber of Commerce	County Appraisal District
Alamo Area Council of Governments (AACOG)	Region 12 San Antonio Flood Planning Group	Bandera County River Authority and Groundwater District
Historical Commission	TxDOT – District Representative	TCEQ
City Marshal's Office	City Fire Department	County EMS
Public Works	United Methodist Church	Red Cross
Texas Fire Marshal's Office		

The public input process can be viewed as three tiers of groups based on participation and responsibility for plan development and implementation.

The first tier is the Core Planning Team, which constitutes at least one representative from every participating jurisdiction. Their responsibilities and participation rates are the highest

because they are required to attend every meeting in the project schedule. This includes Core Team Meetings, Jurisdictional Sub-Team Meetings, and Public Meetings. Two Core Planning Team Meetings were held throughout the development of this plan with action items and tasks for each member.

Figure 1-3: First Public Meeting at the Bandera Electric Cooperative, October 18, 2023, from 6 – 8 PM

The second tier was the Jurisdictional Sub-Teams comprised of a greater number of members from each participating jurisdiction with the representative Core Team Member leading the meetings and ensuring that tasks were completed. Jurisdictional Sub-Teams are comprised of a diverse group of local officials that have day to day responsibilities for emergency response and preparedness, development review and regulations, and departmental or legislative decision-making authority. This second tier had responsibilities associated with the specific tasks assigned to each of the two meetings scheduled for this group. The first Jurisdictional Sub-Team meeting was held on July 12, 2023, 2-4pm and consisted of roundtable sessions with participating jurisdictions. The second Jurisdictional Sub-Team meetings were held virtually on May 15, 2024. This meeting included a final review of the mitigation action plan for each community, a priority exercise for the actions in the plan, and development of plan maintenance and implementation strategies.

Table 2-3. Jurisdictional Sub-Teams

Entity	Position or Title	Department
Bandera County	Bandera County EMC	Emergency Management
Bandera County	County Judge	Commissioner's Court

Bandera County	County Engineer	Administration
City of Bandera	City Administrator	Administration
City of Bandera	City Secretary	Administration
Bandera ISD	Superintendent	Administration
Bandera ISD	Executive Assistant	Administration
Flying L PUD	Secretary/ Treasurer	Administration
Flying L PUD	President	Administration
Medina ISD	Superintendent	Administration
Medina ISD	Executive Assistant	Administration
Medina WSC	General Manager	Administration
Medina WSC	Assistant Manager	Administration
Utopia ISD	Superintendent	Administration
Utopia ISD	Executive Assistant	Administration

Figure 1-4: First Public Meeting at the Bandera Electric Cooperative, October 18, 2023, from 6 – 8 PM

Two public workshops were held to gather input from local officials and the public for hazard mitigation. The first workshop was held on October 18, 2023, in Bandera County at the Bandera Electric Cooperative and the second workshop was held on February 27, 2024 in the City of Bandera at the County courthouse. The results of the survey were released in coordination with the first workshop to develop the final list of hazards to be studied. The workshops were designed to enable communities to examine critical facilities and vulnerable populations, as well as to provide feedback on general and specific vulnerabilities, and areas that are prone to natural hazards. Neighboring communities, as well as local and regional stakeholders, were invited via email and phone. They were given an overview of the planning

process and briefed on how they can collaborate with participating jurisdictions to apply for future project funding for implementing mitigation projects that are relevant to their specific hazard risks.

In an effort to reach the widest audience possible, particularly underserved communities and vulnerable populations, Bandera County as well as participating jurisdictions offered paper surveys at public facilities including public libraries and city hall buildings, as well as other locations, in addition to the online forms. The survey announcement as well as all meetings were advertised in English and Spanish on county and city websites as well as social media accounts and published in local newspapers with Spanish translation services available for all meetings. In addition, all in-person meetings were held in handicap accessible locations. No specific feedback was received from attendees self-identifying as a member of an underserved community or vulnerable population.

Figure 1-5: 2nd Core Team Meeting, March 1, 2024, Bandera County Justice Center

The following are a summary of findings from the public survey that was opened on October 18, 2021, and closed on March 18, 2024. The survey was first announced at the first public meeting at the Bandera County Justice Center and was advertised on flyers, QR code leaflets, the county website, city websites, social media, and by word of mouth by Core team members.

Summary of Findings from the Survey:

1. 12 total surveys, 0 manually entered.
2. Unincorporated Bandera County represents nearly 67% of respondents and City of Bandera nearly 17% of respondents.

3. Floods and drought were identified as the highest threat each with over 33% of all responses, followed by wildfire, thunderstorms, and dam failure.
4. Drought, floods, thunderstorms, extreme heat and hailstorms are the more prominent responses in the hazards that had been experienced or hazards expected to be experienced.
5. Just under 83% of respondents are not located in a floodplain, with the same proportion identified as not having flood insurance.
6. Vast majority of respondents are somewhat concerned about being impacted by a disaster at nearly 67%. Just under 17% are extremely concerned and just under 17% are not concerned.
7. Majority have taken steps to make home, business, or community more hazard resistant; just under 67% and more than 83% of respondents would like to know more about how to increase protection.
8. Internet and mail were identified as the most effective way for citizens to receive information regarding how to make their home, business, or community more resistant to hazards.
9. Contact by text or e-mail was identified as the best single way to alert the public to an imminent disaster. All of the above, including TV, internet, text, or social media were identified by the majority of the respondents to alert the public to an imminent disaster.
10. The top mitigation activities identified were retrofit and strengthen essential facilities such as police, fire, emergency medical services, schools, etc., retrofit infrastructure such as elevating roadways and improving drainage systems, work on improving the damage resistance of utilities, provide better information about hazard risk and high-hazard areas, inform property owners of ways they can mitigate damage to their properties, and strengthen codes, ordinances, and plans to require higher risk management standards.
11. Hazard prevention through building regulations, property protection, natural resource protections, structural projects, emergency services, public education and awareness of how to protect from hazards were all identified as overall very important.

SECTION 3: PLANNING AREA PROFILE

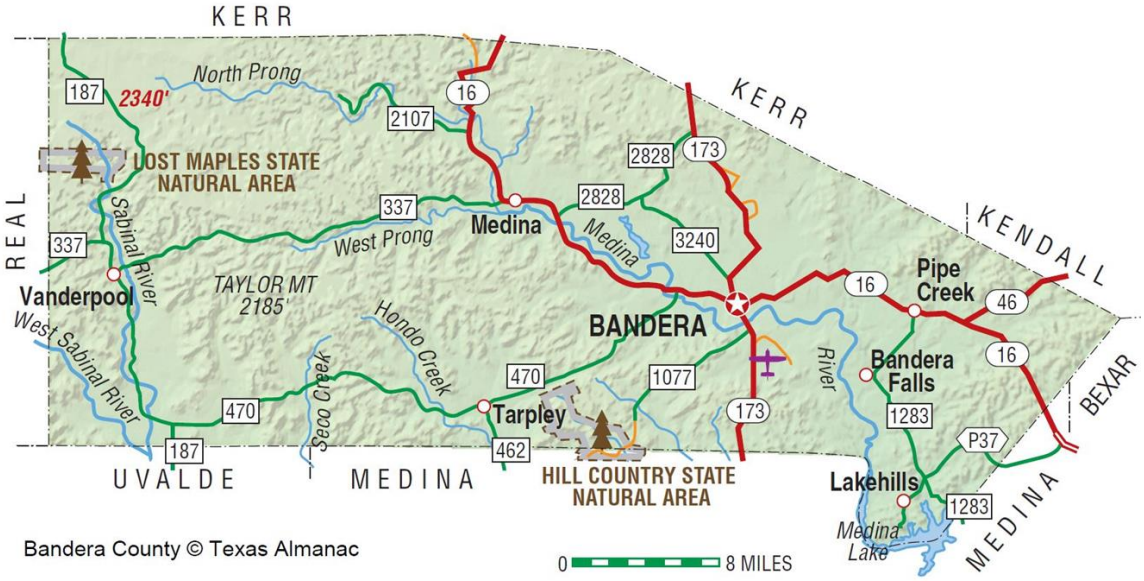
This section provides a profile of the hazard mitigation planning area.

Bandera County

Bandera County is twenty-five miles northwest of San Antonio in the Edwards Plateau region of southwest Texas. It is bordered by Kerr and Kendall counties on the north, Bexar County on the east, Medina and Uvalde counties on the south, and Real County on the west. The county seat and largest town is Bandera and other communities include Bandera Falls, Lakehills, Medina, Pipe Creek, Tarpley, and Vanderpool. The county is crossed by State highways 16, 46, and 173 and Farm roads 187, 337, 470, and 1283.

Bandera County comprises an area of 793 square miles, with elevations that range from 1,200 to 2,300 feet. The western part of the county is drained by the Sabinal River and the eastern part by the Medina River. The alkaline and generally shallow soils overlie limy subsoils. The vegetation consists primarily of grasses such as bluestems, grama, buffalo grass, winter grass, and wild ryes. Along the many streams of the county grow cedar, post oak, Spanish oak, live oak, pecan, and cypress trees. Deer and turkey are plentiful, but there are no large predators.

Figure 3-1: Map of Bandera County



The climate features dry and mild winters and warm summers. Temperatures range in January from an average low of 36° to an average high of 69° F, and in July from 69° to 95° F. The average annual rainfall is twenty-nine inches; the average relative humidity is 76 percent at 6 a.m. and 45 percent at 6 p.m. There is no significant snowfall. The growing season averages 235 days a year, with the last freeze in late March and the first freeze in mid-November.

Figure 3-2: Bandera County Courthouse

Pop. (2020 Census)	20,851[2]
Change from 2010	+1.8%
Area (sq. mi.)	793
Altitude (ft.)	1,200-2,300
Rainfall (in.)	29
Jan. avg. min. (F⁰)	36
July avg. max. (F⁰)	95

Based on the 2022 American Community Survey 5-year estimates, there are currently 8,532 households, a median household income of $70,965, and an employment rate of 50.8%. Based on the 2021 Economic Surveys Business Patterns, there are 404 total employer business establishments.

Economy

In the early twenty-first century tourism, ranching supplies, hunting, fishing, and agriculture were important elements of the county's economy. In 2002 the county had 780 farms and ranches covering 366,827 acres, 76 percent of which were devoted to pasture, 11 percent to crops, and 10 percent to woodlands. That year farmers and ranchers in the area earned $6,961,000; livestock sales accounted for $6,084,000 of the total. Beef cattle, sheep, goats, horses, and apples were the chief agricultural products.

The tourist trade has also become a major source of the county's income. In 1920 Cora and Ed Buck began taking summer boarders at their ranch on Julian Creek. Other families soon advertised for guests, and Bandera, despite its relative isolation, became well known as a resort, with numerous restaurants, dance halls, and dude ranches. Such attractions as the Frontier Times Museum, Bandera Pass, and the site of Camp Montel also bring in thousands of tourists and vacationers annually. Lost Maples State Natural Area, near Vanderpool in the west end of the county, is a birder's paradise known for its fall foliage display; Hill Country State Natural Area is a 4,253-acre primitive camping area with trails for hiking and horseback riding. Numerous hunters are also drawn to the county because of its large deer and turkey population. Such attractions as the Frontier Times Museum, Bandera Pass, and the site of Camp Montel also bring in thousands of tourists and vacationers annually. Lost Maples State Natural Area, near Vanderpool in the west end of the county, is a birder's paradise known for its fall foliage display; Hill Country State Natural Area is a 4,253-acre primitive camping area with trails for hiking and horseback riding. Numerous hunters are also drawn to the county because of its large deer and turkey population.[3]

[2] https://data.census.gov/profile/Bandera_County,_Texas?g=050XX00US48019

[3] https://www.tshaonline.org/handbook/entries/bandera-county

Population and Demographics

The 2020 Census count for Bandera County is 20,851, of which 829 were residents of the City of Bandera.

Table 3-1: Population of Bandera County and participating jurisdictions

Jurisdiction	2020 Census Population	2022 Population Estimate[4]	Estimated Vulnerable or Sensitive Populations[5]		
			Youth (Under 5)	Elderly (Over 65)	Below Poverty Level
Bandera County[6]	20,851	21,182	732	5,919	2,968
City of Bandera	829	565	29	162	83

ISD Population

Bandera ISD

Bandera ISD consists of over 400 square miles encompassing the eastern half of Bandera County which includes a number of rural communities including: Bandera, Pipe Creek, Lakehills and Tarpley. Bandera ISD has grown to a district of over 2,300 students with more than 300 employees and moved from one school building in downtown Bandera that housed all of the students, to four campuses including two elementary schools, a middle school, and a high school. In addition to an administrative central office complex, the district also has a modern support facility which is the home to the transportation, maintenance, and food service departments.

Three of the schools are located in the Bandera area:
Alkek Elementary School – 1798 Highway 173 South
Bandera Middle School - 1005 Cherry Street;
Bandera High School - 474 Old San Antonio Highway

One campus is located in Pipe Creek:
Hill Country Elementary - 6346 FM 1283

Bandera ISD currently has a District Innovation Plan.

Medina ISD

Medina ISD is located in Medina, Texas and is a rural school district which lies in Bandera County. MISD has a population of approximately 249 students in Pre-K through 12th grades. The mission of Medina Independent School District is to create a quality educational system, by providing an excellent learning environment and quality staff, which supports a climate where children and what they learn are important and which allows for meaningful community involvement in ensuring students' success in today's world.

[4] American Community Survey 2022 Estimates
[5] The Estimated Vulnerable or Sensitive Populations are based off of the 2022 American Community Survey
[6] County Totals include jurisdictional totals

High School and Elementary Campus – 1 Bobcat Ln, Medina, TX 78055

Medina ISD currently has a District Improvement Plan and a District Innovation Plan.

Utopia ISD

Utopia Independent School District is a public school district based in the community of Utopia, Texas, US. Located in Uvalde County, the district extends into portions of Bandera, Real, and Medina counties. Utopia ISD has one school - Utopia High School - that serves students in grades pre-kindergarten through twelve. In 2009, the school district was rated "recognized" by the Texas Education Agency.

Utopia High School - 258 School St, Utopia, TX 78884

Utopia ISD has a service area in the western portion of Bandera County but does not have any facilities in the area. Utopia ISD currently has a 5-year strategic plan.

Table 3-2 below provides the population of employees, students, and vulnerable populations for each school district

Table 3-2: ISD Population

ISD	Employees	Students	Children (under5)	Staff with Outdoor Jobs
Bandera ISD	*300	*2,300		
Medina ISD				
Utopia ISD	39	196	16	2

*Includes bus drivers and maintenance workers

Population Growth

The Census 2010 population for Bandera County is 20,485 of which 857 were residents of the City of Bandera. The 2022 population for Bandera County is estimated to be 21,182, of which 565 were residents of the City of Bandera. This estimate is produced by the U.S. Census Bureau using updated housing unit estimates to distribute county household population to the subcounty area based on housing unit change. Bandera County experienced a small increase in population between 2020 and 2022 while the City of Bandera experience a small decrease in population over the same time period. Bandera County had an 1.8% increase over that time period while the City of Bandera had a -3.3% decrease in population suggesting that all of the growth was in the unincorporated county. Table 3-3 provides historic and projected population change rates in Bandera County and the City of Bandera.

Table 3-3: Population Change for Bandera County and Participating Jurisdictions

Jurisdiction	2010 Census	2020 Census	2022 Estimate	Pop Change (2010-2020)	% Change (2010-2020)	Pop Change (2020-2022)	% Change (2020-2022)
Bandera County	20,485	20,851	21,182	366	1.8%	331	1.6%
City of Bandera	857	829	565	-28	-3.3%	-264	-46.7%

Population Projections

Population projections are a useful tool to understand how future growth and development may affect vulnerability to hazards. Planning and growth management efforts will guide city infrastructure investment away from hazard prone areas as both occupied and vacant areas are considered for future development. Population projections from 2030 to 2080 are listed in Table 3-4 and are based on Texas Water Development Board (TWDB) demand projections used for the 2027 State Water Plan. Population projections are based on county-level 1.0 migration scenario projections from the Texas Demographic Center (TDC), which used migration rates between the 2010 and the 2020 decennial Census to project future growth. The population projections show a decrease in population for the Bandera County Planning Area of 274 persons over the 50-year period, or 1.4%. However, with the relatively high rate of growth between 2020-2022, the 50-year projections may tell a different story once 2030 decennial Census is taken into account. As is evident from the last 2-3 years in particular, Bandera and the surrounding counties are growing rapidly with the expansion of Austin and San Antonio.

Table 3-4: TWDB Population Projections

Jurisdiction	P2030	P2040	P2050	P2060	P2070	P2080
Bandera County	19,166	19,303	19,336	19,327	19,196	18,892
City of Bandera	1,591	1,729	1,914	2,097	2,312	2,570
Bandera County FWSD #1	515	669	889	1,162	1,529	2,030

Existing and Future Land Use and Development Trends

It is expected that residential growth will increase along the transportation corridors leading to Bandera County from Bexar and Kendall Counties as they are upgraded, and within the city limits and extra-territorial jurisdiction (ETJ) of the City of Bandera and the communities in the southeastern area of the county.

City of Bandera

The Bandera Comprehensive Plan includes provisions on land use, transportation, and public facilities; consists of a single plan organized by subject and geographic area; and will be used to coordinate and guide the establishment of Development Standards. It is a simple, illustrative document that captures the essence of Bandera through a vision statement; and creates a future master plan by integrating the natural setting, built environment, and the culture of Bandera. The plan is written to inspire the community to understand its challenges, feel empowered by the possible solutions, and have a sense of urgency to act. Bandera's development codes have been written to ensure an integration with this Comprehensive Plan using the community's DNA as its foundation.

The City's wastewater treatment plant is located in the floodway of the Medina River. The Texas Commission on Environmental Quality (TCEQ) has instructed the city to relocate this plant outside of the floodway. Doing so will cost the community in excess of $15 million, which will require grants, loans, and has the potential to max out its debt capacity. Therefore, it is unrealistic to add other projects to an action plan that will not be fiscally or reasonably possible anytime soon.

Critical Facilities and Assets

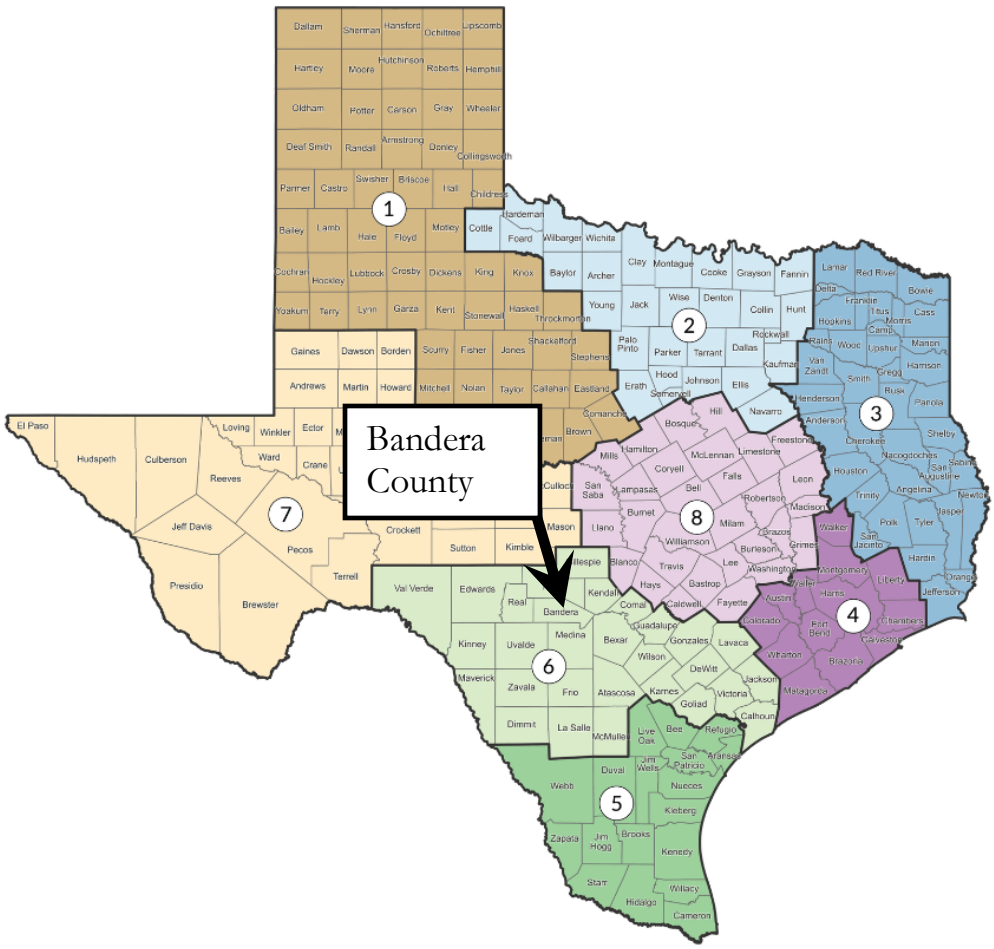
For certain activities and facilities, even a slight risk from a hazard event is too great a threat. FEMA defines these types of places as critical facilities; hospitals, fire stations, police stations, courthouse, communications, public schools, utility infrastructure and similar facilities where essential programs/services are provided. These facilities should be given special consideration when formulating regulatory alternatives, floodplain management plans, and mitigation actions. A critical facility should not be located in a floodplain if at all possible and emergency plans should be developed to continue to provide services during a flood or hazard event. If located in a floodplain it should be provided a higher level of protection so that it can continue to function and provide services during and after a flood. Hazard mitigation actions to mitigate risk to critical facilities are included in this Plan by jurisdiction in Section 19 and a summary of critical facilities is provided in **Appendix D.**

SECTION 4: HAZARDS AND RISK

Based upon a full review of the range of hazards suggested under FEMA planning guidance and input from Bandera County Core Team members, 12 hazards have been identified as important to be addressed in the Bandera County Hazard Mitigation Plan Update. These were chosen based upon a review of the State Hazard Mitigation Plan, a review of the historical record of disaster declarations for the Bandera County planning area, historical incidents contained in the National Centers for Environmental Information (NCEI), and local records and accounts of magnitude and damages from different and distinct hazard events.

According to the State Hazard Mitigation Plan, Bandera County is located within the northern portion of Texas Division of Emergency Management Region 6 where floods, wildfire, and drought can be expected to dominate the hazard profile. This is a rapidly developing area located in the geographic region known as "flash flood alley." It is also one of the areas in Texas that is losing the most working lands such as farms, ranches, and forests. Increasing urbanization in an already flash flood prone area makes this region particularly vulnerable to riverine flooding.

Figure 4-1: Texas State Texas Division of Emergency Management Regions



Source: Texas Division of Emergency Management

The increased risk for these specific hazards in the planning area is confirmed in the table below. Disaster declarations are made at the county level and are not specific to any one city or sub-area, however, it is illustrative for local emergency planners to understand the type and frequency of the hazards impacting the larger region. Keep in mind that the incidents listed are only those that had a level of impact sufficient to necessitate a disaster declaration and that hazards have affected the area more frequently than what the table may initially suggest. Statewide disaster declarations are not included in this list.

Table 4-1: Disaster Declarations in Bandera County

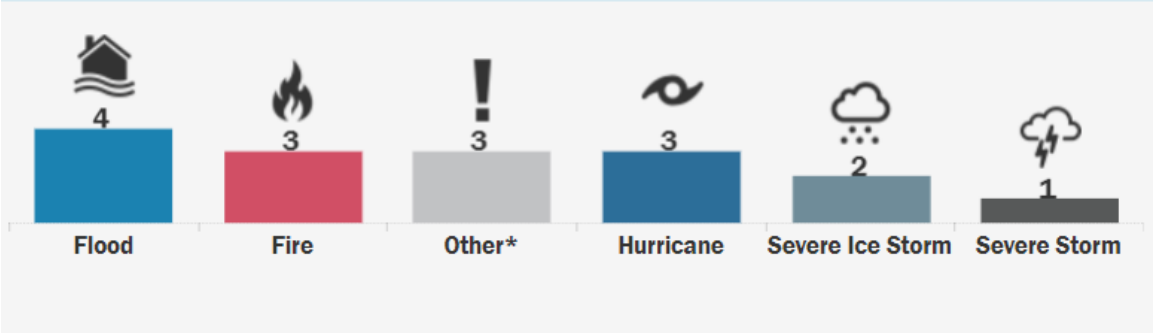
Disaster Number	Year	Incident Category
561	1978	Flood
3113	1993	Drought
1179	1997	Flood
1239	1998	Severe Storm
3142	1999	Fire
1425	2002	Flood
3216	2005	Hurricane
3261	2005	Hurricane
1606	2005	Hurricane
1624	2006	Fire
3284	2008	Fire
4272	2016	Flood
3458	2020	Biological
4485	2020	Biological
3554	2021	Severe Ice Storm
4586	2021	Severe Ice Storm

Source: www.FEMA.gov

Since the US Federal Government began issuing disaster declarations in 1953, Bandera County has had 16 disaster declarations where individual and/or public assistance has been approved. Based on Table 4-1 above, 11 of the 16 disaster declarations have been issued in the past 20 years (since 2002). The infographics below provide a summary of the type of hazard, year, and time of year in which it occurred.

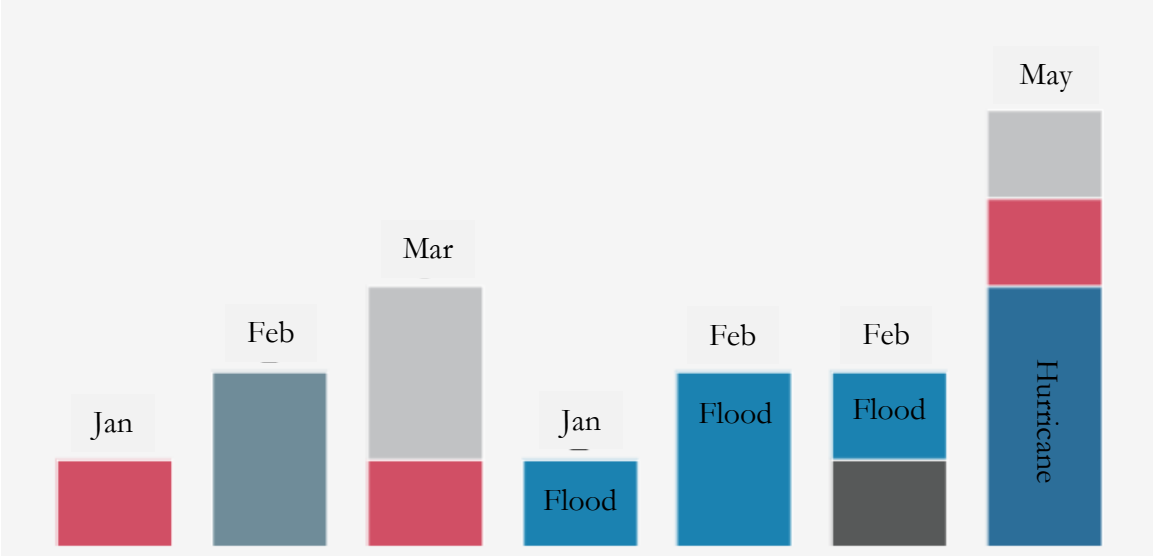
The types of hazards that have had disaster declarations for the Bandera County planning area since 1953 are shown in Figure 4-2 below and color-coded for use in Figure 4-3 on the following page.

Figure 4-2: Bandera County Disaster Declarations Since 1953 by Type



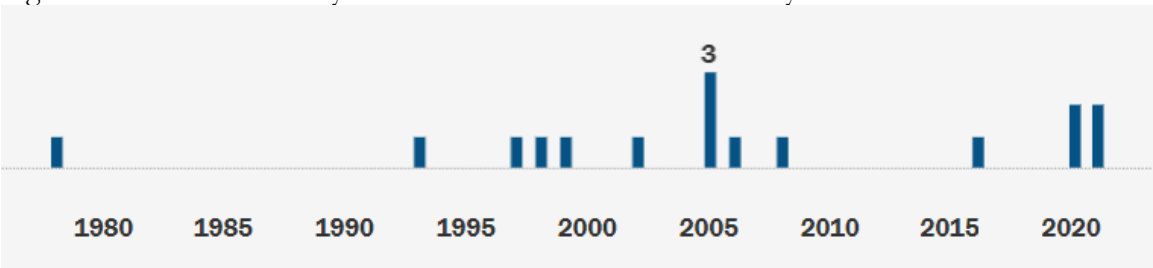
The months during which disasters have been declared in the planning area are shown in Figure 4-3 below. The month of the year in which the disaster occurred is above the color-coded disasters referenced in Figure 4-2.

Figure 4-3: Bandera County Disaster Declarations Since 1953 by Month of Occurrence



The years in which disasters have been declared in the planning area are shown in Figure 4-4 below. Table 4-1 on the previous page can be used as a reference.

Figure 4-4: Bandera County Disaster Declarations Since 1953 by Year of Occurrence



Hazard Descriptions

The 12 hazards and their descriptions on the following page are included in the State of Texas Hazard Mitigation Plan and are determined to be a risk to the planning area. Severe Coastal Flooding and coastal erosion were left off of this list due to the distance of the planning area from the Texas coast and no history of impact.

Table 4-2. Hazard Descriptions

HAZARD	DESCRIPTION
HYDROLOGIC	
Drought	A deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals, and/or people.
Floods	Flooding is a general or temporary condition of partial or complete inundation of water, usually floodplains. The floodplain is an area of land susceptible to being inundated by floodwater from any source.
ATMOSPHERIC	
Extreme Heat	Extreme Heat is a condition when temperatures hover above local excessive heat criteria combined with high humidity levels.
Hailstorm	Hail is showery precipitation in the form of irregular pellets or balls of ice more than 5 mm in diameter.
Hurricanes, Tropical Storms, and Depressions	A hurricane is a large rotating storm with high-speed winds that forms over warm waters in tropical areas. Hurricanes have sustained winds of at least 74 miles per hour and an area of low air pressure in the center called the eye. Hurricanes, tropical storms, and depressions are associated with heavy rainfall and inland flooding, storm surge, and high winds.
Lightning	These are sudden charges of electricity that develop from storms or excessive heat.
Severe Winter Storms	A condition when temperatures hover below freezing and can include ice, snow, and sleet.
Tornado	A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground.
Windstorms	Severe wind storms can occur alone, or when accompanied by severe thunderstorms. Flying debris can cause major damage to utilities, infrastructure, and property.
OTHER	
Earthquake	Any sudden shaking of the ground caused by the passage of seismic waves through Earth's rocks. Seismic waves are produced when some form of energy stored in Earth's crust is suddenly released, usually when masses of rock straining against one another suddenly fracture and "slip."
Wildfire	Wildfires are an unplanned, unwanted fire burning in a natural area, like a forest, grassland, or prairie. Buildings and human development that are susceptible for wildfires are considered the wildland urban interface.
TECHNOLOGICAL	
Dam Failure	Dam Failure can occur with little warning from intense storms, flash flooding, or engineering failures. 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.

Expansive soils and land subsidence were considered by the Core Planning Team but presented such a low risk based on the recorded history of impacts that future impacts are not expected, and therefore they are not necessary to include in the hazard assessment. Based on tabular data from the NID (National Inventory of Dams), 13 dams have a high hazard potential in the Bandera County planning area.

Natural Hazards and Climate Change

Climate change describes the rapid and relatively recent increase in global average temperatures that has helped drive a fivefold increase in the number of weather-related disasters in the last 50 years. Climate change means disasters are happening simultaneously, too.

With increasing global surface temperatures, the possibility of more droughts and increased intensity of storms will likely occur. As more water vapor is evaporated into the atmosphere it becomes fuel for more powerful storms to develop. More heat in the atmosphere and warmer ocean surface temperatures can lead to increased wind speeds in tropical storms. Rising sea levels expose higher locations not usually subjected to the power of the sea and to the erosive forces of waves and currents.

Texas is considered one of the more vulnerable states in the U.S. to abrupt climate changes and to the impact of gradual climate changes to the natural and built environments. Megadroughts can trigger abrupt changes to regional ecosystems and the water cycle, drastically increase extreme summer temperature and fire risk, and reduce availability of water resources, as Texas experienced during 2011-2012. Adapting to climate change through efforts like flood control measures or drought-resistant crops partially reduces climate change risks, although some limits to adaptation have already been reached.

Overview of Hazard Analysis

The hazard risk analysis methodology involves reviewing historical data and conducting statistical analysis on the impact of hazards in the planning area. To gather this information, we retrieved records from the National Centers for Environmental Information (NCEI) and the National Oceanic and Atmospheric Administration (NOAA) that were reported for Bandera County. We also evaluated other local records whenever they were available. Additionally, we used geographic information system (GIS) mapping software to identify and assess the risks for Bandera County and other participating jurisdictions by evaluating community critical facilities and their vulnerability to hazards.

The Risk Assessment includes general parameters for each hazard, such as the location in the planning area, the expected extent or magnitude of the hazard, the frequency of its occurrence based on the number of historical events over the study period, the approximate annualized losses, a description of general vulnerability, and a statement of the hazard's impact. Frequency of return statements are defined in Table 4-3 below.

Table 4-3. Frequency of Return Statements

Frequency of Occurrence	
Highly likely	Event probable in next year.
Likely	Event probable in next 3 years.
Occasional	Event probable in next 5 years.
Unlikely	Event probable in next 10 years.

Impact statements with their associated potential severity are defined in Table 4-4 below.

Table 4-4. Impact Statements

Impact	Severity
High	High classifications and the event is likely/highly likely to occur with severe strength over a significant to extensive portion of the planning area.
Medium	Middle ranges of classifications and the event's impacts on the planning area are noticeable but not devastating.
Low	Two or more of the criteria fall in lower classifications or the event has minimal impacts on the planning area.

Table 4-5 summarizes deaths, injuries, property damage, crop damage, frequency of occurrence, and potential severity of all studied hazard events from 1997-2023 for the Bandera County Planning area.

Table 4-5: Bandera County Hazard Impact Summary (1997-2023)

Hazard	Deaths	Injuries	Property Damage	Crop Damage	Frequency	Potential Severity
Drought	0	0	$0	$0	Likely	Low
Floods	5	26	$5,765,000	$1,010,000	Highly Likely	High
Earthquake	0	0	$0	$0	Unlikely	Low
Extreme Heat	0	0	$0	$0	Highly Likely	Medium
Hailstorm	0	0	$0	$0	Likely	Low
Hurricanes, Tropical Storms, and Depressions	0	0	$1,000,000	$0	Likely	Medium
Lightning	1	2	$0	$0	Highly Likely	Low
Severe Winter Storms	0	0	$0	$0	Likely	Low
Tornado	0	0	$0	$0	Unlikely	Low
Windstorms	0	0	$187,000	$0	Likely	Medium
Wildfire	0	0	$0	$0	Highly Likely	High
Dam Failure	0	0	$0	$0	Unlikely	High

Source: NCEI Storm Events Database 1997 to 2023.

The 25-year hazard profile shows that floods have had an outsized impact on the planning area. Floods are the leading cause of property damage and crop damage and five deaths and 26 injuries, at a minimum, have been attributed to floods. The second highest number of damages and injuries can be attributed to Hurricanes. The third is windstorms with $187,000. Based on the historical impact summary, flooding is the priority hazard from which to protect people and property in the Bandera County planning area. This is followed by hurricanes and then windstorms. All other natural hazards, based on the information in this analysis, currently present a lower priority for mitigation based on the historical severity of impact.

SECTION 5: HURRICANE

Description

A hurricane is an intense tropical weather system of strong thunderstorms with a well-defined surface circulation and maximum sustained winds of 74 mph or higher. Hurricanes, along with Tropical Storms and Depressions, produce a variety of potential hazards including damaging winds, coastal flooding due to storm surge, severe storms with heavy rainfall and high winds, and even tornados.

The information in this chapter covers historical damage to the Bandera County associated with hurricanes, tropical storms, and depressions associated with severe winds. Tornadoes and flooding, other hazards associated with this hazard event, are addressed in Chapters 6 and 11, respectively. Severe winds pose a threat to lives, property, and vital utilities primarily due to the effects of flying debris or downed trees and power lines. Severe winds typically cause the greatest damage to structures of light construction, particularly manufactured homes.

Location

Hurricanes and tropical storms can occur throughout the planning area and are not confined to any geographic area; however, the likelihood of impact decreases the further a location is from the Texas coast. Bandera County is approximately 160 miles away from the Gulf of Mexico at its closest point. The table below lists hurricanes or tropical storm events with a storm track (center of the storm) that crossed the planning area, listed in order of the reported event date. Storm tracks are categorized according to the Saffir-Simpson wind intensity scale with the category assigned as the "peak magnitude" of the storm at some time during its lifespan and not necessarily when the storm track crossed the planning area.

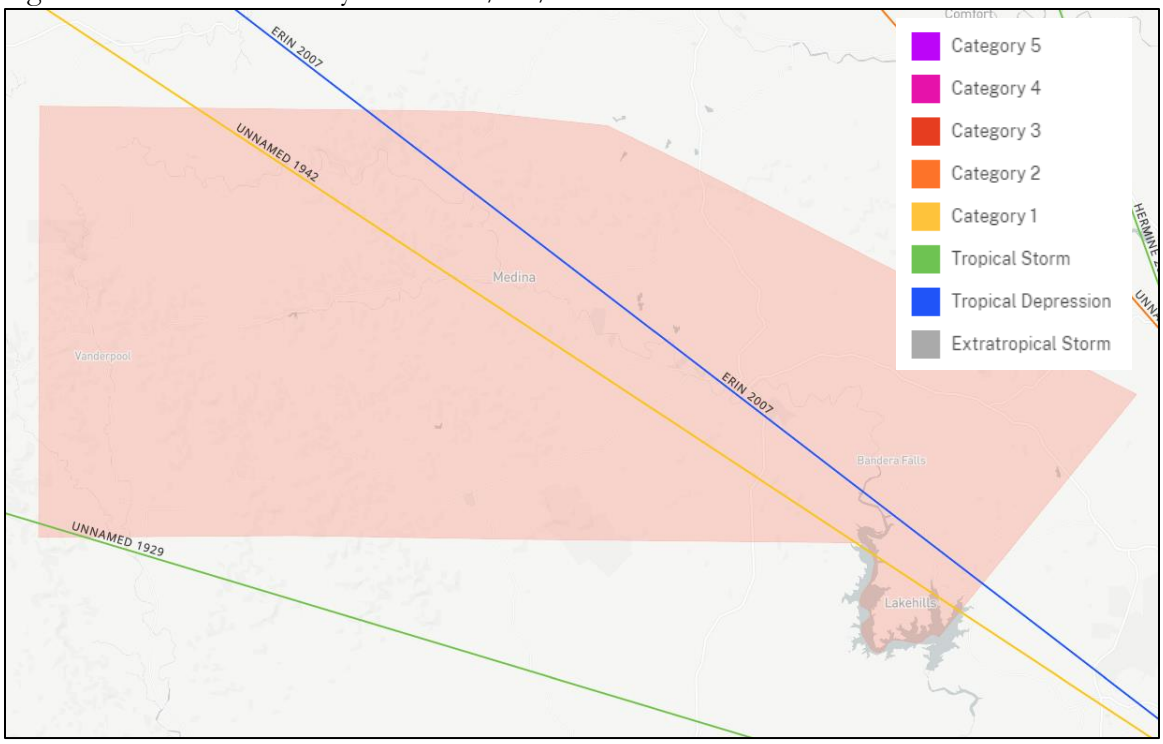
Table 5-1: Hurricane/TS/D Storm Track Events Table

Storm Name	Year	Dates	Category
Unnamed	1929	Jun 29	Tropical Storm (TS)
Unnamed	1942	Aug 30	Hurricane (Cat 1)
Erin	2007	Aug 16	Tropical Depression (TD)

www.noaa.org

The map below shows the historical tracks of hurricanes through the planning area from 1842 to 2023. The category assigned to each storm on the map is its magnitude at the time it crossed into Bandera County. Based on data provided by NOAA's National Climatic Data Center (NCDC) and the FEMA National Risk Index, Bandera County's hurricane risk is very low when compared to areas closer to the Gulf and Atlantic coasts of Texas and the United States.

Figure 5-1: Bandera County Hurricane/TS/D Storm Tracks



Source: *National Climatic Data Center (NCDC), International Best Track Archive for Climate Stewardship (IBTrACS) dataset.*

Extent

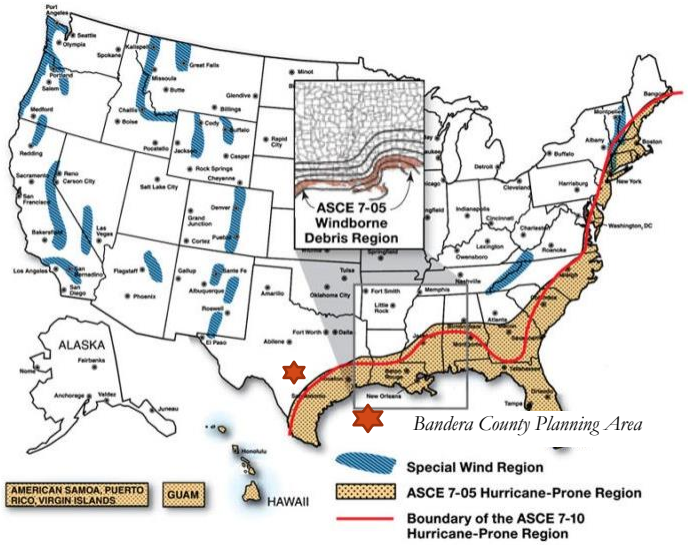
For Hurricanes, extent can be expressed separately for flood, wind, and surge. Flooding will be examined in the next section, but surge is not an issue for Bandera County since it is located so far from the coast. For hurricane wind extent, the Saffir-Simpson Hurricane Wind Scale (SSHWS) scale is the scientific scale most often used to measure hurricane winds. The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating based on a hurricane's sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous, however, and require preventative measures. Wind speeds range from 39-73 mph for Tropical Storms and Tropical Depressions have wind speeds equal to or less than 38 mph.

Table 5-2: Saffir Simpson Scale

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph	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 mph	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 mph	Devastating damage will occur: Well-built framed 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 mph	Catastrophic damage will occur: Well-built framed 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 mph or higher	Catastrophic damage will occur: A high percentage of framed 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.

Figure 5-2: FEMA Wind Zone Map (www.FEMA.gov)



According to the FEMA Wind Zones Map used to determine building standards, Bandera County is not located in a hurricane-prone region. Based on the location and the historical storm tracks for hurricanes and tropical storms in the Bandera County planning area, tropical storms are the key event to be mitigated.

Historical Occurrences

Hurricanes and Tropical Storms that had a direct path through the Bandera County planning area, as well as tracks that went through adjacent counties yet still impacted the Bandera County planning area, are identified in this section. Based on historical storm data provided by NOAA's National Climatic Data Center (NCDC), only six (6) tropical storm events have occurred in the planning area since 1842. Table 5-3 below lists the storms that have impacted the planning area. There have not been any events recorded past the listed dates.

Table 5-3: Historical Hurricane/TS/D Impact Events Table in Bandera County, 1997-2023

Date	Magnitude	Injuries	Fatalities	Property Damage	Crop Damage
8/16/2007	Tropical Depression	0	0	$1,000,000	$0

Source: *NOAA NCEI Storm Events Database*

Significant Events

August 16, 2007

Tropical Storm Erin moved inland near Port Aransas on the morning of August 16 and continued toward the northwest, in the general direction of San Antonio. By noon, the

remnants of Erin were located near Pleasanton in Atascosa County with winds near 30 mph, and moving toward the northwest near 14 mph. What was left of Erin was estimated to be in the Rocksprings area by midnight that night and just south of Ozona on the morning of August 17. The track of highest rain totals associated with Erin over South Central Texas began in Karnes County and streamed northwestward across Wilson, Bexar, Kendall, Bandera, Medina, Gillespie and Kerr Counties.

From Bexar County the extremely heavy rainfall associated with the remains of Tropical Storm Erin spread in Bandera County. Between 3 and 5 inches of rain was reported in general, with up to 7 inches to the northwest of Medina near the Kerr County line. Roads across the north part of county were closed due to high water requiring several high-water rescues. High water also closed bridges north of Medina on SH16 and northwest of Medina on FM2107. Residents were evacuated from over 50 homes in the Lakeshore area. Three cars were washed off bridges and numerous rescues were required. A bystander noted that one truck attempted to cross Privilege Creek and was warned away by everyone nearby, but the truck continued along and was quickly washed into the creek. The driver and his wife were able to leave the truck and were rescued. Their vehicle finally came to rest almost a half-mile down the creek.

Probability of Future Events

The probability of future events relies on measuring the number of previous occurrences of a hurricane or tropical storm event over the 180-year reporting period. Based on three occurrences of a hurricane or tropical storm in the planning area during this time, it is forecast that such a storm event will happen approximately once every 60 years. This frequency provides an unlikely probability that a hurricane or tropical storm will impact some portion of the planning area.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

The proximity of Bandera County to the Texas Coast makes this area slightly vulnerable to flooding from hurricanes and hurricane-force winds that cause damage across large areas. This exposes all building, facilities, and populations in the planning area equally to the impact of a hurricane or tropical storm. Damage to towers, trees, and underground utility lines from uprooted trees and fallen poles can cause damage to utility infrastructure, resulting in considerable disruption. Debris such as small items left outside, signs, roofing materials, and trees can become extremely hazardous in hurricanes and tropical storms and strong winds can easily destroy poorly constructed buildings, barns, and mobile homes. Hurricanes and tropical storms also produce large amounts of rain increasing the risk of flooding. This rain can overwhelm drainage systems as hurricanes and tropical storms that have weakened after making landfall can continue to drop significant quantities of water. The impacts to communities from a Category 5 storm can result in complete destruction of houses, commercial property, and cropland. This would result in large-scale economic impacts and population displacement. Warning time for hurricanes, however, has lengthened due to modern early warning technology allowing the community time to reduce the impact of tropical storms and hurricanes.

Historic Hurricane Impacts

The total property and crop damage to the Bandera County planning area since 1997 is $1,000,000.

The Bandera County planning area features mobile and manufactured home parks which are more vulnerable to hurricane winds than site-built structures. In addition, manufactured and temporary housing is located sporadically throughout rural portions of the planning area which are also vulnerable to the hurricane hazard but more prone to being isolated from essential needs and emergency services in the event of a disaster. Based on 2022 American Community Survey estimates, there are 8,532 housing units in Bandera County of which 28%, or 2,396 units, are mobile or manufactured homes. In addition, 1,833 (21%) of the housing units in the overall planning area were built before 1980. These structures are likely to have been built to lower or less stringent construction standards than newer construction and may be more susceptible to damages during significant events.

Table 5-4. Structures at Greater Risk by Jurisdiction

Jurisdiction	Total Housing Units	Mobile Homes	Housing units built prior to 1980
Bandera County*	8,532	2,396 (28%)	1,833 (21%)
City of Bandera	230	4 (2%)	118 (51%)

*County totals include all jurisdictions in addition to unincorporated areas.
Source: 2022 American Community Survey 5-year estimate, selected housing characteristics

Based on the ACS 2022 data, the City of Bandera is at higher risk of damage from hurricanes when considering age of residential structures and the higher standard of building codes enacted after 1980. Unincorporated Bandera County as a whole is at a higher risk of damage from hurricanes when considering number and ratio of manufactured homes when compared to the City of Bandera.

SECTION 6: FLOOD

Description

Floods are defined as the accumulation of water within a water body and the overflow of excess water into adjacent floodplain lands. When surface water runoff enters into streams, rivers, or dry creek beds, riverine flooding conditions occur whenever the water carrying capacity of the water channel is compromised by excess runoff. Types of flooding include riverine flooding, coastal flooding, and shallow flooding. If the local basin drainage area is relatively flat then slow-moving floodwater can last for days. In drainage areas with substantial slope, or the channel is narrow and confined, rapidly moving and extreme highwater conditions, called a flash flood, can occur.

Common impacts of flooding include damage to personal property, buildings, and infrastructure; bridge and road closures; service disruptions; and injuries and fatalities. In this report, historical damage from flooding is reported here and in Chapter 1 (along with other hurricane related damages).

Location

The Digital Flood Insurance Rate Map (DFIRM) data provided by FEMA for Bandera County delineates the Special Flood Hazard Areas (SFHAs) as those at highest risk of flooding. Flood areas or zones from the most recent DFIRMs from FEMA for Bandera County, and all participating jurisdictions, are illustrated in Figures 6-1 to 6-4.

Figure 6-1: Bandera County Floodplain Map

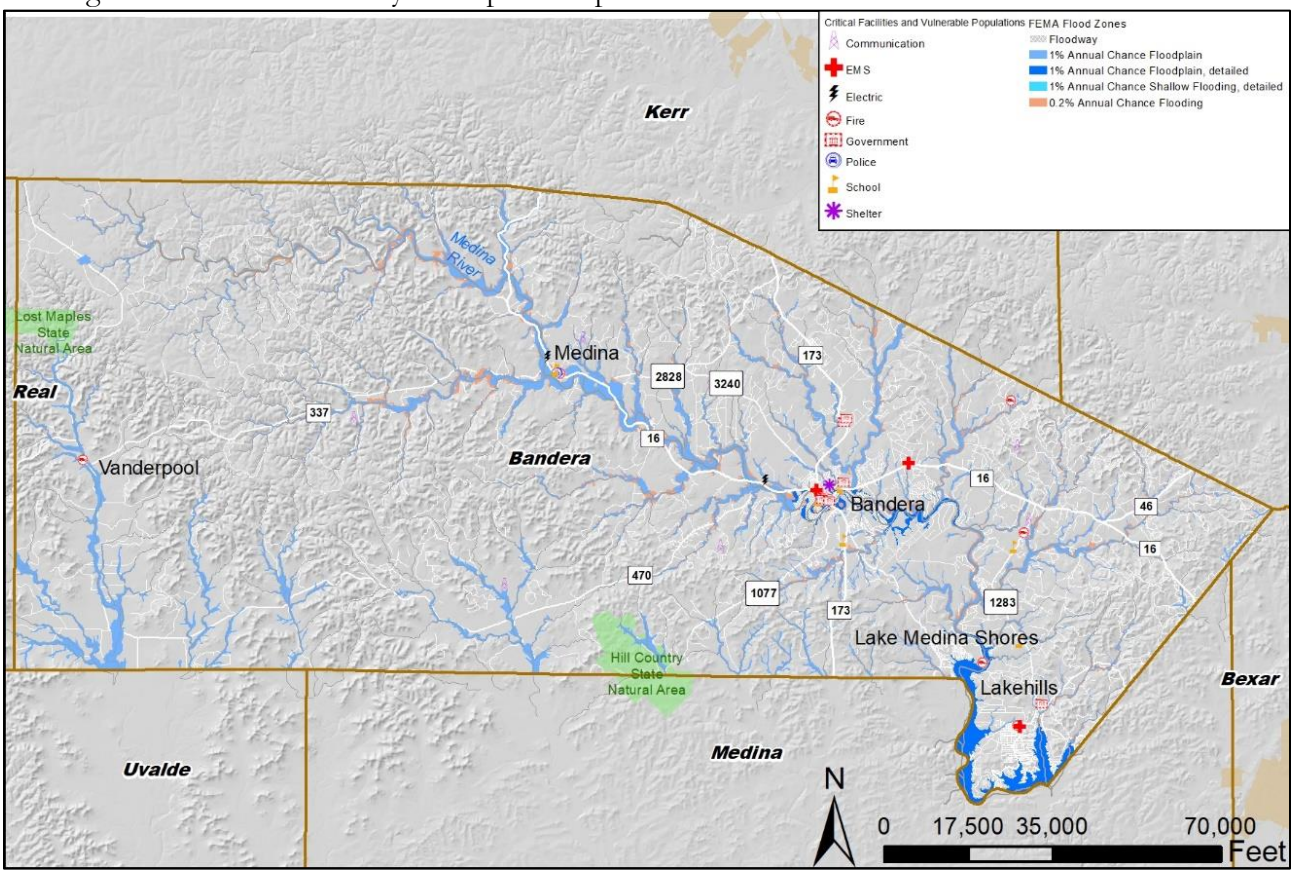


Figure 6-2: City of Bandera Floodplain Map

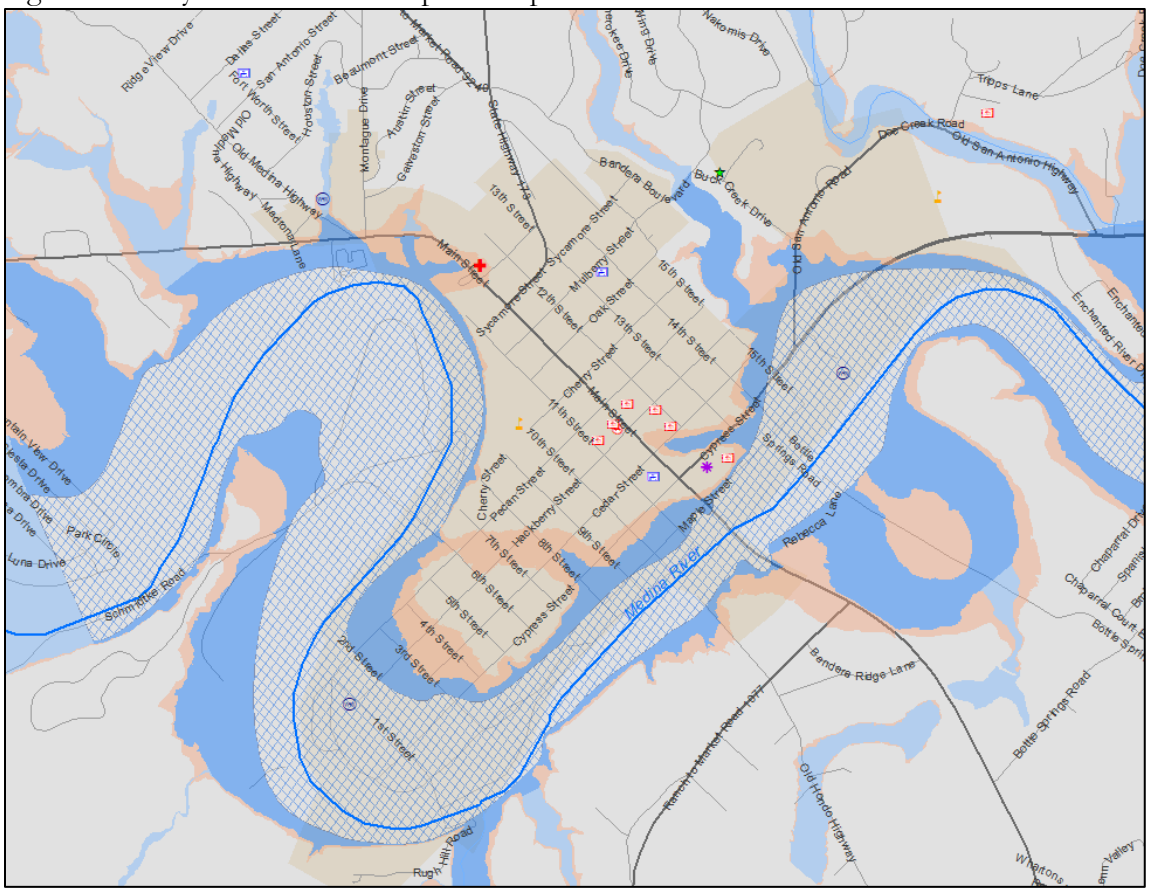


Figure 6-3: Medina Floodplain Map

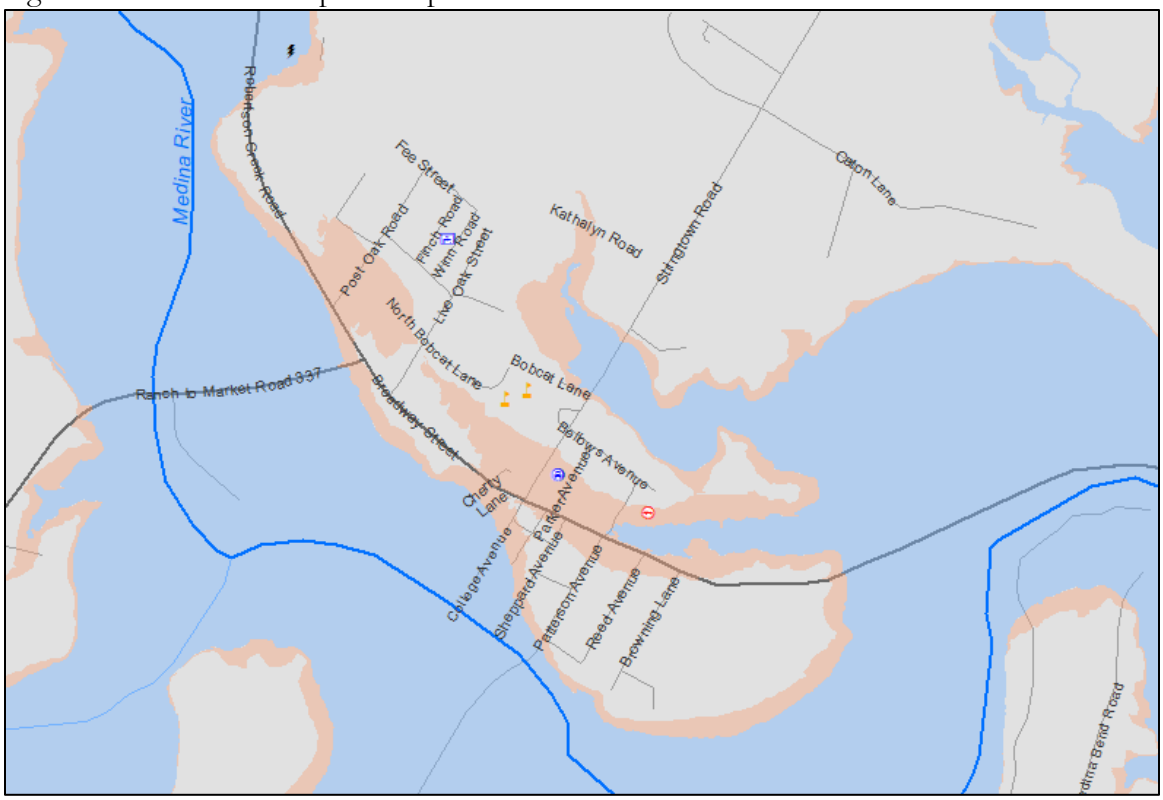


Figure 6-4: Flying L PUD Floodplain Map

Extent

Flood event severity is a complex science studied by hydrologists and engineers. The severity of a flood event is established by a combination of several factors including stream and river basin topography and physiography, precipitation, weather patterns, recent soil moisture conditions, and degree of vegetative clearing and impervious surface. Urbanization, due to its relationship to increased impervious cover, contributes to flood severity. Based on historical occurrences, floods events can last anywhere from a couple of hours to several days.

A Flood Zone provides a measure of a flood's intensity and magnitude. A base flood is defined by FEMA as a flood having a one percent change of being equaled or exceeded in any given year. It is also known as the "100-year flood" or the "1% annual chance event". The base flood is the national standard used by the National Flood Insurance Program. Flood zones are delineated on Flood Insurance Rate Maps, and the depths of flooding can be interpreted from the summary data and profiles in the Flood Insurance Study. Flood depths may range from less than one foot to more than 5 feet in places, and depending on the severity of the event (as measured in annual chance exceedance). Table 6-1 provides a description of FEMA flood zones and the flood impact in terms of severity or potential harm. Flood Zones A, AE, AO, and X are the hazard areas mapped in the planning area and determine the intensity of a potential flood event.

Table 6-1: FEMA Flood Zone Categories

Flood Zone	Description
Floodway	A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. Communities must regulate development in these floodways to ensure that there are no increases in upstream flood elevations. For streams and other watercourses where FEMA has provided Base Flood Elevations (BFEs), but no floodway has been designated, the community must review floodplain development on a case-by-case basis to ensure that increases in water surface elevations do not occur, or identify the need to adopt a floodway if adequate information is available.
Zone A	Areas with a 1% 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.
Zone AE	Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.
Zone AO	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.
0.2 SFHA	These are the areas that have a 0.2 percent chance of being equaled or exceeded on any given year.
Zone X	The areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood, are Zone X.

Historical Occurrence

Historical evidence indicates that areas within the planning area are susceptible to flooding, especially in the form of flash flooding. It is important to note that only reported flood events have been factored into this risk assessment, therefore it is likely that additional flood occurrences have gone unreported before and during the recording period. Table 6-2 identifies historical flood events that resulted in damages, injuries, or fatalities within the planning area. Historical Data is provided by the Storm Prediction Center (NOAA), NCEI database for Bandera County. There have not been any events recorded past the listed dates.

Table 6-2: Historical Flood Events, 1997-2023

Location	Date	Deaths	Injuries	Property Damage	Crop Damage
Countywide	4/3/97	2	0	$0	$0
Countywide	4/4/97	0	0	$0	$0
Countywide	4/26/97	0	0	$5,000	$0
Countywide	5/19/97	0	0	$20,000	$0
Countywide	6/16/97	0	0	$5,000	$0
Countywide	6/21/97	0	0	$10,000	$0
Countywide	6/21/97	2	20	$5,000,000	$1,000,000
Southeast Portion	1/31/98	0	0	$15,000	$0
Countywide	3/16/98	0	0	$10,000	$0
Countywide	8/22/98	0	0	$10,000	$10,000
Countywide	10/1/98	0	0	$10,000	$0
East Portion	10/18/98	0	0	$30,000	$0
Countywide	6/12/99	0	0	$5,000	$0
Countywide	7/11/99	0	0	$15,000	$0
East Portion	7/11/99	0	0	$10,000	$0
South Portion	10/17/00	0	0	$10,000	$0
West Portion	10/23/00	0	0	$25,000	$0
West Portion	11/2/00	0	0	$15,000	$0
West Portion	11/3/00	0	0	$10,000	$0
West Portion	11/3/00	0	0	$10,000	$0
West Portion	11/5/00	0	0	$20,000	$0
Vanderpool	4/23/01	0	0	$80,000	$0
Countywide	5/4/01	0	0	$15,000	$0
Countywide	9/5/01	0	0	$50,000	$0
Countywide	9/6/01	0	0	$5,000	$0
Countywide	11/15/01	0	5	$50,000	$0
Countywide	6/30/02	0	0	$20,000	$0
Countywide	7/2/02	0	0	$0	$0
	7/2/02	0	0	$0	$0
Countywide	7/2/02	0	0	$0	$0
Countywide	7/3/02	0	0	$0	$0
Countywide	7/5/02	0	0	$0	$0
East Portion	7/13/02	0	0	$0	$0
Countywide	9/7/02	0	0	$50,000	$0
West Portion	10/8/02	0	0	$0	$0
Countywide	10/24/02	0	0	$30,000	$0
Countywide	2/21/03	0	0	$10,000	$0
West Portion	6/10/03	0	0	$20,000	$0

South Portion	9/5/03	0	0	$10,000	$0
East Portion	1/16/04	0	0	$10,000	$0
West Portion	3/14/04	1	1	$20,000	$0
West Portion	4/6/04	0	0	$0	$0
Countywide	6/9/04	0	0	$0	$0
	6/9/04	0	0	$0	$0
East Portion	6/27/04	0	0	$0	$0
West Portion	6/28/04	0	0	$0	$0
Countywide	6/29/04	0	0	$0	$0
South Portion	6/30/04	0	0	$0	$0
Tarpley	7/30/04	0	0	$0	$0
East Portion	8/23/04	0	0	$0	$0
West Portion	10/2/04	0	0	$0	$0
Countywide	10/13/04	0	0	$50,000	$0
Countywide	11/16/04	0	0	$0	$0
Countywide	5/8/05	0	0	$0	$0
West Portion	6/1/05	0	0	$0	$0
East Portion	7/16/05	0	0	$0	$0
East Portion	8/10/05	0	0	$0	$0
West Portion	8/10/05	0	0	$0	$0
Tarpley	5/6/06	0	0	$0	$0
Bandera	7/1/06	0	0	$0	$0
Vanderpool	7/2/06	0	0	$0	$0
West Portion	9/17/06	0	0	$0	$0
Tarpley	3/11/07	0	0	$0	$0
Tarpley	3/13/07	0	0	$0	$0
Tarpley	3/26/07	0	0	$0	$0
Tarpley	3/30/07	0	0	$0	$0
Tarpley	4/30/07	0	0	$0	$0
Vanderpool	5/25/07	0	0	$0	$0
Medina Lake	5/27/07	0	0	$0	$0
Medina	6/26/07	0	0	$10,000	$0
Medina Lake	6/28/07	0	0	$0	$0
Vanderpool	7/3/07	0	0	$0	$0
Medina	7/8/07	0	0	$0	$0
Medina	7/21/07	0	0	$100,000	$0
Tarpley	7/21/07	0	0	$0	$0
Bandera	7/21/07	0	0	$0	$0
Vanderpool	7/28/07	0	0	$0	$0
Medina Lake	11/20/09	0	0	$0	$0

Vanderpool	4/15/10	0	0	$0	$0
Vanderpool	4/15/10	0	0	$0	$0
Medina Lake	5/14/10	0	0	$0	$0
Medina Lake	9/8/10	0	0	$0	$0
Medina Circle R Arpt	3/19/12	0	0	$0	$0
Bandera	3/20/12	0	0	$0	$0
Tarpley	3/20/12	0	0	$0	$0
Medina Circle R Arpt	3/20/12	0	0	$0	$0
Vanderpool	3/20/12	0	0	$0	$0
Vanderpool	5/10/12	0	0	$0	$0
Bluff	5/10/12	0	0	$0	$0
Vanderpool	5/10/12	0	0	$0	$0
Bandera Flying L Arp	5/25/14	0	0	$0	$0
Medina	5/25/14	0	0	$0	$0
Vanderpool	5/26/14	0	0	$0	$0
Medina Circle R Arpt	4/17/15	0	0	$0	$0
Bandera Flying L Arp	6/21/15	0	0	$0	$0
Medina Lake	6/22/15	0	0	$0	$0
Bandera	4/18/16	0	0	$0	$0
Pipecreek	4/18/16	0	0	$0	$0
Bandera Flying L Arp	5/17/16	0	0	$0	$0
Medina Circle R Arpt	5/19/16	0	0	$0	$0
Bandera Flying L Arp	5/29/16	0	0	$0	$0
Bandera Flying L Arp	5/29/16	0	0	$0	$0
Bandera	5/29/16	0	0	$0	$0
Bandera Flying L Arp	5/30/16	0	0	$0	$0
Medina	5/30/16	0	0	$0	$0
Bandera Flying L Arp	5/31/16	0	0	$0	$0
Bandera	8/17/16	0	0	$0	$0
Medina Lake	9/9/18	0	0	$0	$0
Tarpley	9/9/18	0	0	$0	$0
Pipecreek	9/9/18	0	0	$0	$0
Bandera	9/22/18	0	0	$0	$0
Medina Lake	9/22/18	0	0	$0	$0
Tarpley	8/30/22	0	0	$0	$0
Medina Lake	6/4/23	0	0	$0	$0

* 117total events from 1997-2023, values are in 2023 dollars.

Significant Events

July 21, 2007

Thunderstorms associated with a persistent upper-level low produced heavy rain and flash flooding thro ugh the morning on July 21. Extremely heavy rainfall was reported from eastern Bandera County into northern Medina County. Most parts of eastern Bandera County reported 3 to 4 inches of rain, but the highest amount was in Bandera where up to 8 inches fell. Flash flooding was both widespread and severe, closing SH16, SH173, FM1283 and FM470. Thunderstorms produced heavy rain and isolated severe weather which led to a historic flash flood on the Blanco River late Saturday night and into Sunday. Hundreds of homes were destroyed along the river from the City of Blanco down into Wimberley and San Marcos. The flood crest continued downstream for days affecting residents and homes along the San Marcos and Guadalupe Rivers and several people lost their lives due to flash flooding. A large tornado outbreak occurred on Saturday night producing numerous small brief tornadoes.

June 21, 1997

The heavy rain Friday night into Saturday afternoon had left South Central Texas soils saturated. The situation worsened Saturday evening into Sunday as heavy rain associated with the upper low-pressure system redeveloped over the western Texas Hill Country. Very heavy rains over the Texas Hill Country Saturday night and Sunday morning caused widespread flooding as well as flash flooding across numerous counties. The heavy rains moved into San Antonio Sunday morning and into the Austin area later in the morning. By Sunday afternoon and evening, areas of showers and thunderstorms had diminished over South Central Texas as the upper low moved into North Texas. Late Sunday evening, they again developed over the Texas Hill Country, producing additional severe flooding and flash flooding late Sunday night into Monday morning.

Rainfall amounts for the three rain events, including the period from Friday through Monday, averaged between 4 and 6 inches, with over 15 inches across many locations in the Texas Hill Country. The least amount of rain fell in the Del Rio area, west of the low, while the most rain fell over parts of the Texas Hill Country. The heaviest rain amounts fell in Bandera County, where over 20 inches was reported. Bandera measured 19.47 inches of rain in 2 days, while 21 inches of rain was measured 4 miles west of Tarpley in Bandera County.

Probability of Future Events

FEMA states that flooding is the most common natural disaster in the United States, affecting every region and every state. Based on recorded historical occurrences and extent within the Bandera planning area, 117 recorded flooding events in the 25-year reporting period provides a probability of occurrence of at least 1 event per year. This frequency supports a **highly likely** probability of future events, meaning that an event is probable in the next year.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

The flood hazard areas throughout Bandera County are subject to periodic inundation, which may result in loss of life and property, reduction in health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect public safety. Riverine Flooding has killed and injured more people than any other weather-related hazard and the greatest number of deaths is due to people driving into water going over roads. For this study, the location and proximity to the floodplain or SFHA determines a property's vulnerability to a flood. Structures that lie along banks of a waterway are the most vulnerable and are often repetitive loss structures. Future development is encouraged to be outside of the floodplain, although there are some critical facilities, homes, and businesses already located in the floodplain due to their development before current floodplain regulations.

Table 6-3: Critical Facilities in the 1% or 0.2% Annual Chance Floodplain by Jurisdiction

Jurisdiction	Critical Facilities
Bandera County	1 Police Headquarters (Medina), 2 Fire Stations (Medina and Vanderpool), 2 Electric Substations
City of Bandera	1 Wastewater Treatment Plant, 2 Lift Stations
Bandera FWSD #1	None
Bandera ISD	None
Flying L PUD	None
Medina ISD	None
Medina WSC	None
Utopia ISD	None

Flood losses are exacerbated by the cumulative effect of obstructions in floodplains. Occupancy of flood hazard areas is especially hazardous when development is inadequately elevated, flood-proofed, or otherwise protected from flood damage. Moreover, increased development in floodplain can increase flood heights and velocities making flooding more intense and widespread then predicted. Mitigation actions are included to address flood maintenance issues as well (Section 15), such as routinely clearing debris from roadside ditches and bridges. Expanding drainage culverts and storm water structures to more adequately convey flood waters is critical to flood mitigation as well. Table 6-4 below shows Bandera County dollar losses from January 1998 through December 2023.

Table 6-4: Bandera County Impact from Flooding

Time Period	Deaths	Injuries	Property Damage	Crop Damage
Loss Summary, Bandera County				
25-year Total	5	26	$5,765,000	$1,010,000
Per Year	<1	1	$240,208	$42,083
Per Capita Dollar Losses (2020 Pop: 20,851)				
25-year Total	<1	<1	$276	$48
Per Year	<1	<1	$11	$2

Source: NCEI Storm Events Database 1998 to 2023 subset for Texas

Table 6-5 below distributes the countywide impacts presented previously in tables 6-4 amongst the various participating jurisdictions based on ratios of population and total area.

Table 6-5: Flood Losses by Jurisdiction 1997-2023

Jurisdiction	Est. Prop. Losses	Est. Crop Losses	Total Est. Losses
Bandera County, 20,851	$5,535,553	$969,802	$6,505,355
City of Bandera, 829	$229,447	$40,198	$269,645
Bandera FWSD #1	$0	$0	$0
Bandera ISD	$0	$0	$0
Medina ISD	$0	$0	$0
Flying L PUD	$0	$0	$0
Utopia ISD	$0	$0	$0
Medina WSC	$0	$0	$0
Total Losses	$5,765,000	$1,010,000	$6,775,000

National Flood Insurance Program (NFIP) Participation

Bandera County, in addition to all eligible participating jurisdictions, participate in the National Flood Insurance Program (NFIP). Bandera FWSD #1, Bandera ISD, Medina ISD, and Flying L PUD, Utopia ISD, and Medina WSC do not participate in the NFIP since they are not eligible to do so. The NFIP protects businesses and homeowners from devastating losses in the event of a flood hazard. As an additional indicator of floodplain management responsibility, communities may choose to participate in FEMA's Community Rating System (CRS). This is an incentive-based program that allows communities to undertake flood mitigation activities that go beyond NFIP requirements. Currently, none of the communities in Bandera County participate in CRS. It is the purpose of all NFIP jurisdictions participating in the Hazard Mitigation plan to continue to promote the public health, safety, and general welfare by minimizing public and private losses due to flood conditions in specific areas. These communities are guided by their local Floodplain Management Ordinance and will continue to comply with NFIP requirements through their local permitting, inspection, and record-keeping requirements for new and substantially developed construction. The NFIP participating jurisdictions each have a floodplain manager; the city manager serves this role for the cities and the emergency management coordinator serves this role for the counties.

Table 6-6: Repetitive Loss and Severe Repetitive Loss Properties

Jurisdiction	Number of RL Structures	Number of Losses
Bandera County	14	38
City of Bandera	0	0
Total	14	38

There are 14 repetitive loss Properties and 0 severe repetitive loss properties as defined by the NFIP within the Bandera County planning area. All of these are residential single-family properties with slab on grad foundations.

SECTION 7: DROUGHT

Description

Drought is deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals, and/or people. Droughts are defined as a moisture deficit at a magnitude high enough to have social, environmental or economic effects and can become very prolonged and persist from one year to the next. Common effects of drought include crop failure, water supply shortages, and fish and wildlife mortality. The Texas Hazard Mitigation Plan describes the climate of 2/3rds of Texas Counties as arid or semi-arid with these Counties almost always in varying stages of drought.

Location

Droughts vary greatly in their intensity and duration and can occur regularly throughout Bandera County, including all participating jurisdictions, equally. Drought is monitored nationwide by the National Drought Mitigation Center (NDMC) which provides the Drought Monitor map in Figure 7.1 showing the entirety of the planning area currently experiencing extreme drought (D3) conditions or exceptional drought (D4). The planning area has experienced exceptional drought conditions within the last fifteen years, particularly during the drought of summer 2011 where the entire state of Texas was in some level of drought (Figure 7.2).

Figure 7.1: US Drought Monitor, March 12, 2024

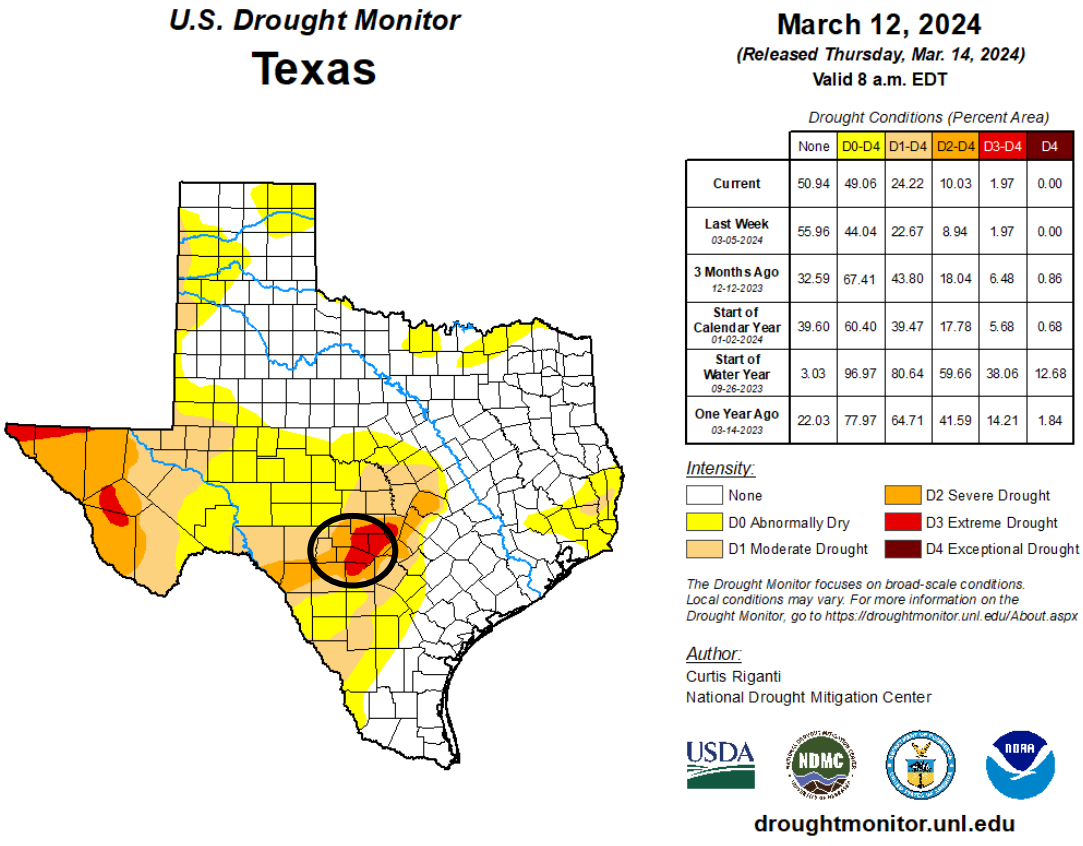
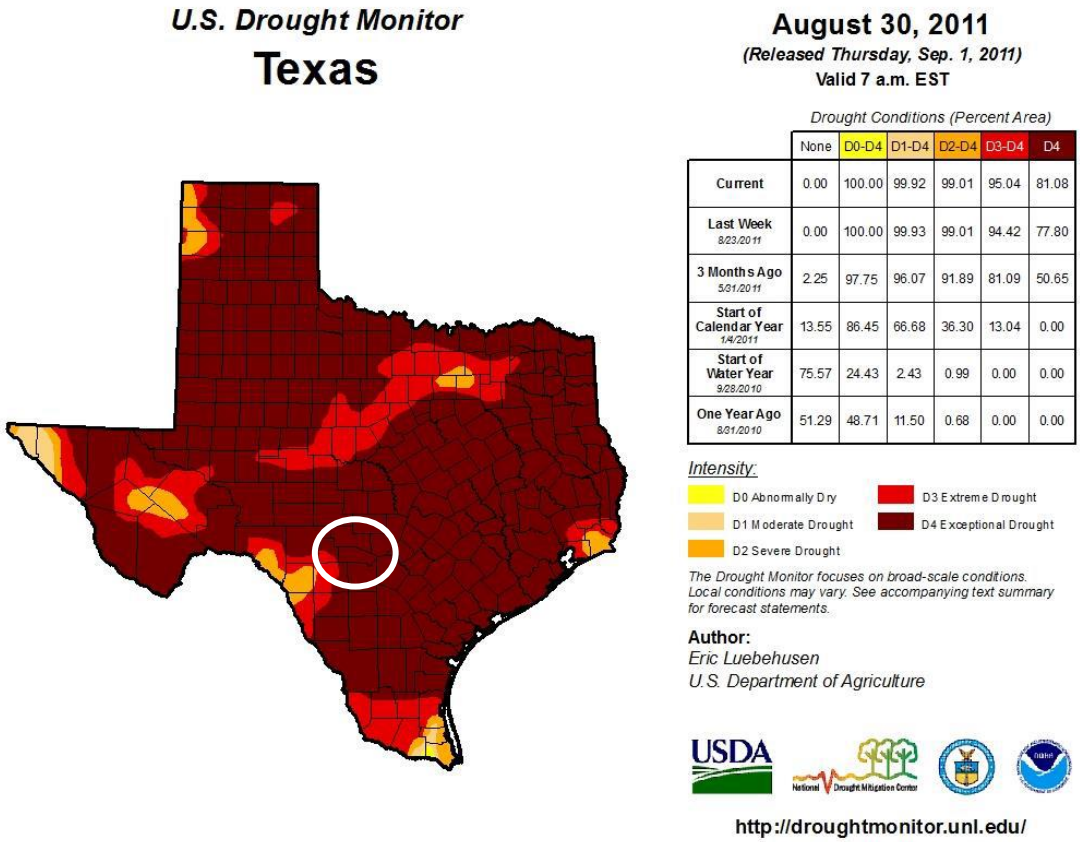


Figure 7.2: US Drought Monitor, August 30, 2011



Extent

The Palmer Drought Severity Index (PDSI) is based on precipitation and temperature and is used to measure the extent of drought. The index measures the moisture supply of the environment. The PDSI classifications vary roughly between -4.0 and +4.0 ranging from extremely dry to extremely wet periods. NOAA's United States Drought Monitor (USDM) Categories range from D0 to D4 according to the intensity of drought and are based on a number of indicators, including the PDSI, and used to describe broad scale drought conditions across the United State. Table 7.1 describes the basic PDSI classification descriptions and Table 7.2 depicts the magnitude of drought with descriptions of possible impacts.

Table 7-1: PDSI Classifications for Dry and Wet Periods	
4.00 or more	Extremely Wet
3.00 to 3.99	Very Wet
2.00 to 2.99	Moderately Wet
1.00 to 1.99	Slightly Wet
0.50 to 0.99	Incipient Wet Spell
0.49 to -0.49	Near Normal
-0.50 to -0.99	Incipient Dry Spell
-1.00 to -1.99	Mild Drought
-2.00 to -2.99	Moderate Drought
-3.00 to -3.99	Severe Drought
-4.00 or less	Extreme Drought

http://drought.unl.edu/whatis/indices.htm

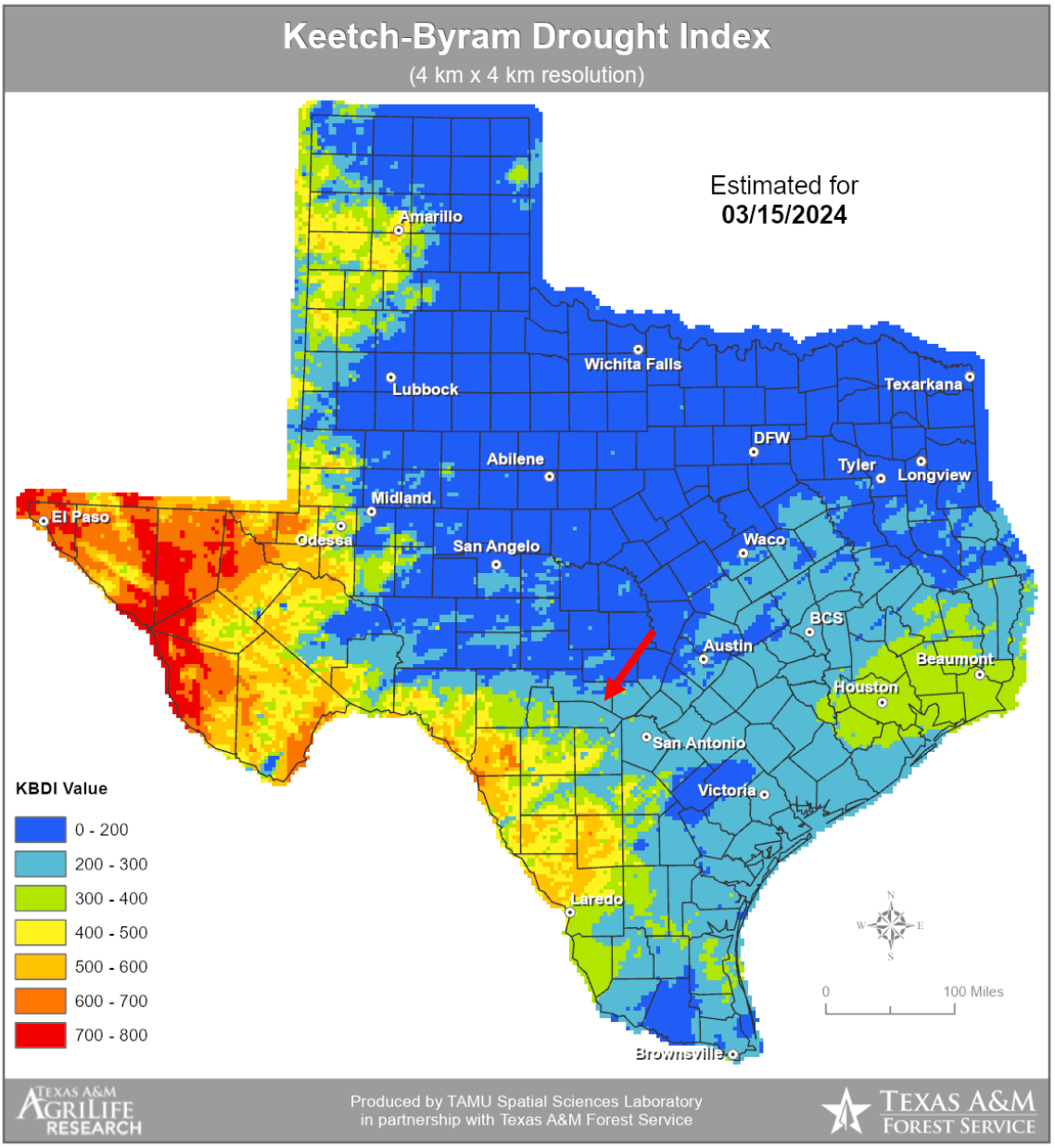
Table 7-2: Drought Severity Classification

			Ranges				
Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures Coming out of drought: some lingering water deficits pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	Some damage to crops, pastures Streams, reservoirs, or wells low, some water shortages developing or imminent Voluntary water-use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	Crop or pasture losses likely Water shortages common Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	Major crop/pasture losses Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

Based on the extent and location for historic and current drought conditions, the Bandera County planning area can anticipate a range of drought from abnormally dry to exceptional, or D0 to D4 based on the USDM Drought Intensity Category.

The Keetch-Byram Drought Index is used by the Texas Forest Service to determine the fire potential based on daily water balance, precipitation, and soil moisture. Figure 7-3 shows the Keetch-Byram Drought Index rating classification for all of Texas and color coded by County with a scale of 0 to 800 (low risk to high risk). Bandera County is in the 200-300 risk category at the time this report is written. The Keetch-Byram Drought Index is also discussed in relation to wildfires in section 13.

Figure 7-3: Keetch-Byram Drought Index



Source: https://twc.tamu.edu/kbdi

Historical Occurrences

Bandera County has often experienced moderate to significant drought in the past. It is difficult to identify the start of prolonged drought since they develop over an extended period of time. The hydrological impacts of drought such as depleted reservoir and groundwater levels take longer still to develop.

Significant Events

1950-1957, Statewide

Driest period in state history. By 1956, 244 of 254 counties are declared federal disaster areas with an annual estimated economic loss of $3.5 billion.

1995-1996, Statewide

Agricultural losses of more than $5 billion statewide exceed previous record.

2005, South, East, Central, and Northeast Texas

The state records only 4.93 inches average rainfall as the third driest period in 110 years.

May 2011 – March 2012, Statewide

The drought of 2011 in South Central Texas was the most severe one-year drought ever for Texas. Agricultural losses in the state due to the 2011 drought reached a record $7.62 billion, making it the costliest drought in history, according to totals by Texas AgriLife Extension Service economists. "2011 was the driest year on record and certainly an infamous year of distinction for the state's farmers and ranchers," said Dr. David Anderson, AgriLife Extension livestock economist. "The $7.62 billion mark for 2011 is more than $3.5 billion higher than the 2006 drought loss estimates, which previously was the costliest drought on record."[7] Drought conditions began in May and were exacerbated by a La Niña event causing below normal rainfall. Conditions began to improve in the spring of 2012 when the La Niña event weakened and most of South-Central Texas saw above normal rainfall.

The data used to assess the historical experience with drought for the planning area came from the NOAA's NCEI National Storms Database. This database contains extensive and authoritative information for weather related event in the country from 1998 thru 2023 (a 25-year period). Agricultural producers such as farmers and ranchers purchase crop insurance to protect their yield in the event of a natural disaster such as drought, hail, or flood. Historical crop damages are typically not found in the public record and likely much higher than quantified by NCEI data due to agricultural losses being a transaction between the agricultural land owner and insurance policy holder. Furthermore, the extent of crop loss due to drought is difficult to quantify because a drought during a growing season can impact the next two years of crop production. Table 7-3 lists historical events that have occurred in Bandera County as reported in the NCEI. There have not been any events recorded past the listed dates.

Table 7-3: Historical Occurrences of Drought in Bandera County

Date Range	Direct Injuries	Direct Fatalities	Property Damage	Crop Damage
May - October, 2000	0	0	0	0
May - December, 2011	0	0	0	0
January - April, 2012	0	0	0	0

[7] https://today.agrilife.org/2012/03/21/updated-2011-texas-agricultural-drought-losses-total-7-62-billion/

June, 2012	0	0	0	0
November - December, 2012	0	0	0	0
March, 2013 – May, 2015	0	0	0	0
April - July, 2018	0	0	0	0
October, 2019 - January, 2020	0	0	0	0
October, 2020 – May, 2021	0	0	0	0
January, 2022 - October, 2023	0	0	0	0

Data provided the by NOAA drought monitor also provides a perspective of historical occurrences of drought in the planning area by summarizing the percent of area in each drought category by county on a weekly basis. The table below provides a summary of the number of weeks in each drought category or the magnitude of the drought that describes the drought condition for the majority of the county for each weekly period from 1/4/2000 to 3/12/2024. This 24-year window of drought data provides a clear picture as to how often the occurrence of different drought categories can be expected in the future.

Table 7-4: Historical Drought Magnitude

Drought Category	Description	Bandera County	
None	Normal to Wet Conditions	431	34%
D0	Abnormally Dry	134	11%
D1	Moderate Drought	150	12%
D2	Severe Drought	249	20%
D3	Extreme Drought	173	14%
D4	Exceptional Drought	125	10%
	Total	1,262	100%

Source: https://droughtmonitor.unl.edu/Data/DataDownload/ComprehensiveStatistics.aspx

Probability of Future Events

Based on available records of historic events from NCEI, there have been thirteen (13) time periods of drought within a 25-year reporting period. This provides a probability of occurrence of one event every one to two years. Based on the drought monitor data for a 25-year reporting period, the planning area is in severe to exceptional drought approximately 44% of the time. This frequency supports a **likely** probability of future events occurring within the Bandera County planning area which means that an event is probable in the next 3 years.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

Drought affects large areas creating vulnerability for people, animals, property, agriculture, and the environment. Over the entirety of the planning area the biggest impacts of drought are dead crops and grazing land, edible plants for animals, and even trees. This primarily affects farming and wildlife, but people can be directly impacted as well due to shortages of potable water supply. Communities will also ration the use of water during prolonged drought,

particularly for lawn care, swimming pools, and irrigation. Drought is related to, and can exacerbate, the natural hazards of wildfires and extreme heat. Drought can contribute to the cause of wildfires due to dying vegetation serving as ignition fuel and can be intensified by extreme heat. The impacts of drought mostly affect water shortages and crop/livestock losses and do not typically extend to buildings and critical facilities.

The entire population of Bandera County is vulnerable to water supply shortages which present widespread health risks since people can only survive a few days without water. Potable water is used for many essential functions such as drinking, bathing, heating and cooling systems, and some electricity production. This affects vulnerable populations more acutely such as children, older adults, and people with illnesses or fragile health conditions. Also, vulnerable populations that do not have adequate air conditioning units in their homes are more at risk for injury or fatalities.

The planning area has a total population of 21,182 according to the 2022 ACS population estimate. Those over the age of 65 represent 27.9% (5,919) of the total population and children under the age of 5 represent 3.5% (732) of the total population. The total population of the county that is estimated to be below the poverty level is 14.3% (2,968). Table 7-5 presents the 2022 American Community Survey population and age cohort estimates below.

Table 7-5: Populations at Greater Risk by Jurisdiction

Jurisdiction	Population 65 and Older	Population Under 5	Population Below Poverty Level
Bandera County	5,919/27.9%	732/ 3.5%	2,968/14.3%
City of Bandera	565	29/5.1%	83/16.3%

Source: 2022 American Community Survey (Note: County totals include both incorporated and unincorporated areas)

The environment of the Bandera County planning area is also vulnerable to damage during drought. Through lack of food and water and habitat degradation, aquatic and terrestrial species both can experience significant reductions due to death and lower reproduction rates. Land can experience damage as well due to shrinking, subsidence, and erosion in some areas during extreme or prolonged drought.

Water is central to the ability of people to inhabit and transact commerce in a region and the economic impacts of drought can be significant, especially during prolonged drought. The ability to produce goods and provide services is dependent on direct and indirect access to clean water. Due to the interconnected nature of supply and production chains, the negative effects of droughts can have ripple effects on many industries and sectors of the economy. The overall impact of damages caused by periods of drought is dependent on its extent and duration. It is rare that drought alone leads to a direct risk to the health and safety of people in the Bandera County planning area, however severe water shortages could lead to a direct risk to the health and safety of the population. The severity of the impact of a drought event can be mitigated by preparedness and planning by the community comprised of government, businesses, and citizens.

The National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln developed the drought impact reporter to provide a national database of drought impacts by county. The number of impacts in ten distinct impact categories from 2005-Present are provided below. Table 7-6 lists the drought impacts in Bandera County based on reports received by the Drought Impact Reporter. These reports are predominantly provided by the

media, but can also come from NWS, other agencies, CoCoRaHS, legacy reports, and user reports.

Table 7-6: Drought Impacts, 2005-Present

Bandera County	
Agriculture	76
Business & Industry	0
Energy	0
Fire	24
Plants & Wildlife	67
Relief, Response & Restrictions	21
Society & Public Health	10
Tourism & Recreation	4
Water Supply & Quality	21
County Impact Reports*	104

Source: https://unldroughtcenter.maps.arcgis.com/apps/dashboards/46afe627bb60422f85944d70069c09cf
*Each county impact report may have more than one drought impact category associated with it

Based on 18 years of data from the NCEI, the direct impacts of droughts in the Bandera County planning area have resulted in no known property or crop losses and no known injuries and fatalities. The impact to the planning area from drought has been limited and negligible based on data reported to the NCEI from 2005-Present. Drought impact reports like those presented above, however, come from a number of different sources and provide a different perspective of the impact that drought can have on communities beyond direct monetary property or crop damages that typically aren't reported publicly. It is important to consider that crop damage information is rarely publicly reported and water availability issues are not easily quantified so the impact is likely much more pronounced than the direct losses attributed to this hazard. Below is a recent example of a drought impact report.

County: Bandera County
State: TX
Duration: 3/5/2024 - 4/4/2024
Title: Southwest Texas pastures needed more moisture
Description: Cool and windy conditions in Southwest Texas posed little threat to agricultural production, although dry conditions hindered further green up of cool-season forage. No precipitation was reported. Deciduous wild trees and pecans began budding and were expected to bloom in the coming weeks. Producers were starting to till their land in preparation for the planting season. Row crop production continued, and planting was expected to begin in late March. Corn planting continued. Irrigated winter wheat was in good condition. Dryland oats were a total loss, while irrigated oats were starting to head out. Pastures were green but needed more moisture to stimulate good spring growth. Coastal sandbur remained a problem, but lack of rainfall prevented most land managers from being able to apply pre-emergent herbicides. Producers were still heavily supplementing livestock and wildlife. Hay supplies were dwindling, and the body conditions of livestock and wildlife were deteriorating due to the lack of rain.
AgriLife Today (College Station, Texas), March 5, 2024
Impact ID: 59159
Impact
Source:https://moderator.droughtreporter.unl.edu/RSSfeed/ImpactView/59159

Historic Drought Impacts

No injuries, fatalities, property or crop damages were reported in the 25-year period of analysis. Based on historical records, annual loss impacts and estimates are considered to be negligible.

Drought Impacts Forecast

No injuries, fatalities, property or crop damages were reported in the 25-year period of analysis. Based on historical records, forecast impact estimates are considered to be negligible.

SECTION 8: WINDSTORMS

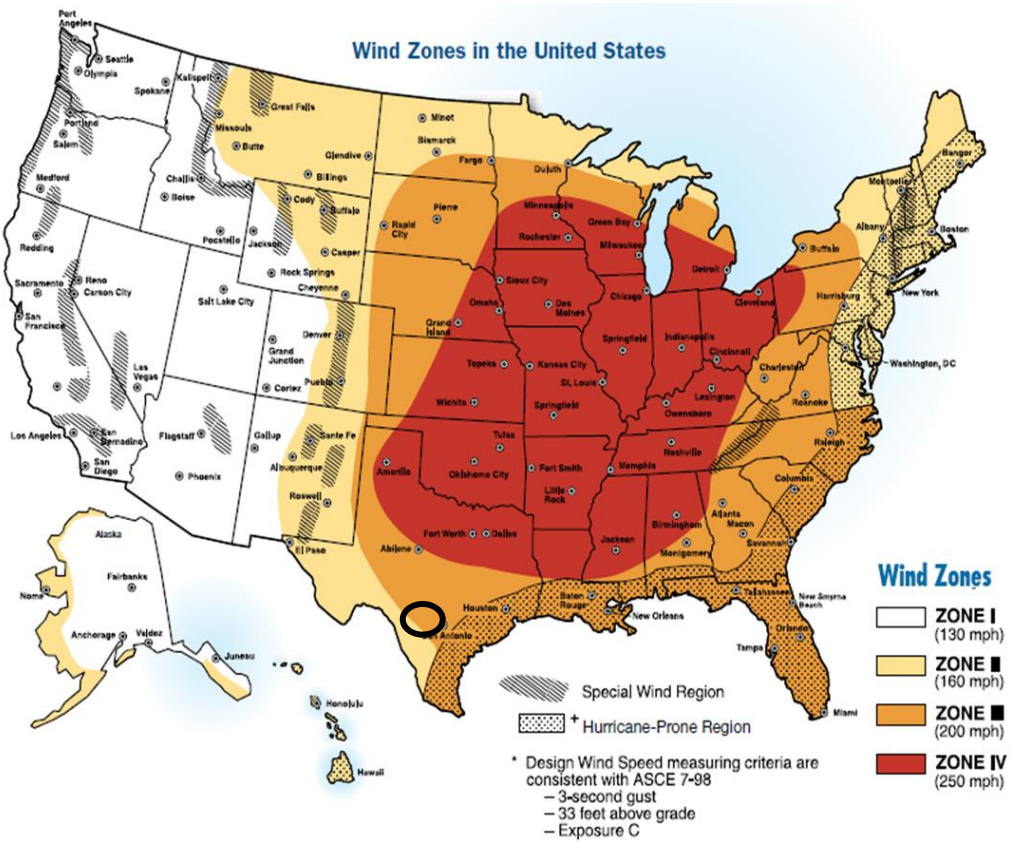
Description

Severe Wind can occur as straight-line events (derechos), or with other natural hazards including hurricanes and severe thunderstorms. According to the National Weather Service (NWS), a thunderstorm occurs when thunder accompanies rainfall. Thunderstorms create extreme wind events and are created when heat and moisture near the Earth's surface is transported to the upper levels of the atmosphere. The clouds, precipitation, and severe wind that become the thunderstorm are the result of this process. Straight line winds can have gusts of 87 knots (100 mph) or more and are responsible for most thunderstorm wind damages. One type of straight-line wind, the downburst, is a small area of rapidly descending air beneath a thunderstorm. A downburst can cause damage equivalent to a strong tornado and make air travel extremely hazardous.

Location

Thunderstorms are unpredictable and can occur anywhere in the planning area. Bandera County, along with all participating jurisdictions, is equally at risk of thunderstorm winds. According to FEMA's Wind Zones map of the United States (Figure 8-1), the planning area falls under Wind Zone II, which is associated with winds that can reach up to 160 mph. This area is also situated near the coast, making it vulnerable to hurricanes.

Figure 8-1: FEMA wind zones in the United States



Source: FEMA and the American Society of Civil Engineers (ASCE)

Extent

The extent or magnitude of a specific thunderstorm wind event is measured by the Beaufort Wind Scale, developed in 1805. Table 8-1 describes the Beaufort Wind Scale, with different intensities of wind events in terms of speed and effect, from calm to violent and destructive. Based on historical occurrences, the planning area is expected to experience a windstorm with a maximum magnitude of 78 Knots.

Table 8-1: 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 13-19 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (18-25 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	High waves (23-32 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 (29-41 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 (37-52 ft) waves, 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: www.spc.noaa.gov/faq/tornado/beaufort.html

Historical Occurrences

Historical occurrences of thunderstorm wind events with resulting damages that have impacted the Bandera County planning area are shown below in Table 8-2. Only high wind

events associated with thunderstorm wind are considered in this section. Wind damage associated with other hazards, such as tornados or hurricanes, are accounted for in other sections. From 1998-2023, there have been 17 thunderstorm wind events recorded in the NCEI storm events database that have impacted the Bandera County planning area. The NCEI, organized under the National Oceanic and Atmospheric Administration, is the largest archive available for climate data, however, it is important to note that only incidents and damages reported to the NCEI have been factored into this risk assessment. Some occurrences seem to appear multiple times which is due to reports from various locations throughout the planning area. There have not been any events recorded past the listed dates.

Table 8-2: Historical Thunderstorm-Wind Events in Bandera County, 1997-2023

Jurisdiction	Date	Magnitude	Injuries	Fatalities	Property Damage	Crop Damage
Bandera	5/25/98	53	0	0	$0	$0
Bandera	3/27/99		0	0	$15,000	$0
Bandera	6/12/99		0	0	$15,000	$0
Bandera	11/15/01		0	0	$15,000	$0
Medina Lake	7/23/03	60	0	0	$80,000	$0
Vanderpool	5/28/05	70	0	0	$0	$0
Bandera	4/30/07	60	0	0	$0	$0
Tarpley	6/3/07	60	0	0	$0	$0
Medina Circle R Arpt	3/17/08	55	0	0	$0	$0
Bandera	7/20/09	39	0	0	$20,000	$0
Vanderpool	5/12/11	50	0	0	$10,000	$0
Medina A Bar A Arpt	6/4/17	52	0	0	$0	$0
Vanderpool	5/4/18	50	0	0	$0	$0
Vanderpool	5/24/20	53	0	0	$0	$0
Vanderpool	10/13/21	56	0	0	$25,000	$0
	1/15/22	46	0	0	$0	$0
Medina	4/17/22	56	0	0	$2,000	$0

Source: NCEI Storm Events Database

Significant Events

July 23, 2003

As the line of thunderstorms moved through the eastern part of Bandera County, it produced a downburst that damaged roofs of homes and knocked over trees in the Lakehills area of Medina Lake.

October 13, 2021

A complicated weather pattern developed over South Central Texas when a dryline and cold front moved out of West Texas as an upper-level low moved into the Central Plains. At the same time the remnants of Pacific Hurricane Pamela moved across northern Mexico. The airmass over the region was warm and moist with near record precipitable water values. This set up led to an excessive rain episode with considerable flash flooding and river flooding.

A thunderstorm produced wind gusts estimated at 65 mph. There were several large tree limbs down, broken windows, and the roof of a barn was completely lifted up and blown off at a residence north of Vanderpool.

Probability of Future Events

Windstorms are most likely to strike during the spring in the months of March, April, and May. There is also a brief period in September when the likelihood of windstorm hazards increases. The Bandera County planning area has experienced, on average, approximately 1 thunderstorm wind events every one to two years. Wind events categorized as Forces 10 and 11 on the Beaufort scale with hurricane force winds have routinely impacted the area and is the level of windstorm hazard the area should mitigate for in the future. The probability of future events is **likely**, meaning that an event is probable within the next three years for the planning area.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

Thunderstorm winds exist at different strength levels and occur randomly throughout the planning area with the potential to cause injury and property damage. All people, animals, existing and future structures, and facilities in Bandera County planning area could potentially be impacted and remain vulnerable to strong winds. A thunderstorm wind event can impact human health including injuries from windblown debris, direct injuries, traffic accidents, and in rare cases, fatalities. Debris from damaged structures can also cause damage to other buildings not directly impacted by the event. Infrastructure, such as power lines, poles, radio towers, water towers, and street lights are vulnerable to the impacts of severe thunderstorm winds. In addition, street signs, garbage cans, outdoor furniture, storage sheds, roofs, vehicles, trees, and other objects commonly found outdoors are at risk. While these vulnerabilities do exist, the overall impacts of thunderstorm wind are limited in scope and have not yet resulted in any reported injuries or fatalities.

The Bandera County planning area features mobile and manufactured home parks which are more vulnerable to hurricane winds than site-built structures. In addition, manufactured and temporary housing is located sporadically throughout rural portions of the planning area which are also vulnerable to the hurricane hazard but more prone to being isolated from essential needs and emergency services in the event of a disaster. Based on 2022 American Community Survey estimates, there are 8,532 housing units in Bandera County of which 28%, or 2,396 units, are mobile or manufactured homes. In addition, 1,833 (21%) of the housing units in the overall planning area were built before 1980. These structures are likely to have been built to lower or less stringent construction standards than newer construction and may be more susceptible to damages during significant events.

Table 8-3. Structures at Greater Risk by Jurisdiction

Jurisdiction	Total Housing Units	Mobile Homes	Housing units built prior to 1980
Bandera County*	8,532	2,396 (28%)	1,833 (21%)
City of Bandera	230	4 (2%)	118 (51%)

*County totals include all jurisdictions in addition to unincorporated areas.
Source: 2022 American Community Survey 5-year estimate, selected housing characteristics

Based on the ACS 2022 data, the City of Bandera is at higher risk of damage from windstorms when considering age of residential structures and the higher standard of building codes enacted after 1980. Unincorporated Bandera County as a whole is at a higher risk of damage from hurricanes when considering number and ratio of manufactured homes when compared to the City of Bandera.

Historic Windstorm Impacts

Below is the summary table, 8-4, for Bandera County that shows the 25-year column totals and the average annual (Per Year) losses in these categories. The bottom half of each table shows per capita dollar loss rates for the total and average annual losses. These rates are important measures for comparing losses between different areas. The average annual loss estimate of property and crop is $7,480 for Bandera County.

Table 8-4: Bandera County Loss Summary

Time Period	Fatalities	Injuries	Property Damage	Crop Damage
Loss Summary, Bandera County				
25-year Total	0	0	$187,000	$0
Per Year	0	0	$7,480	$0
Per Capita Dollar Losses (2020 Census Pop, 20,851)				
25-year Total	0	0	$8.97	$0
Per Year	0	0	$0.36	$0

SECTION 9: EXTREME HEAT

Description

Extreme heat is a condition where temperatures exceed local average high temperatures by ten degrees or more for an extended period of time and is also characterized by high humidity levels. Extreme heat is a common occurrence in Texas during the summer months. Extended periods of extreme heat are called heat waves and can lead to illness and death, particularly among vulnerable populations. In fact, heat waves have been the top cause of U.S. weather fatalities, on average, over the past 30 years.[8] Texas had a particularly deadly year in 2011, when 203 heat-related deaths were reported. The major human risks associated with severe summer heat include heat cramps, sunburn, dehydration, fatigue, heat exhaustion, and heat stroke. Extreme heat can lead to power outages as heavy demands for air conditioning strain the power grid and prolonged exposure to excessive temperatures can damage crops and injure or kill livestock. As the Earth's climate warms overall heat waves are expected to become more frequent, longer, and more intense.[9]

Location

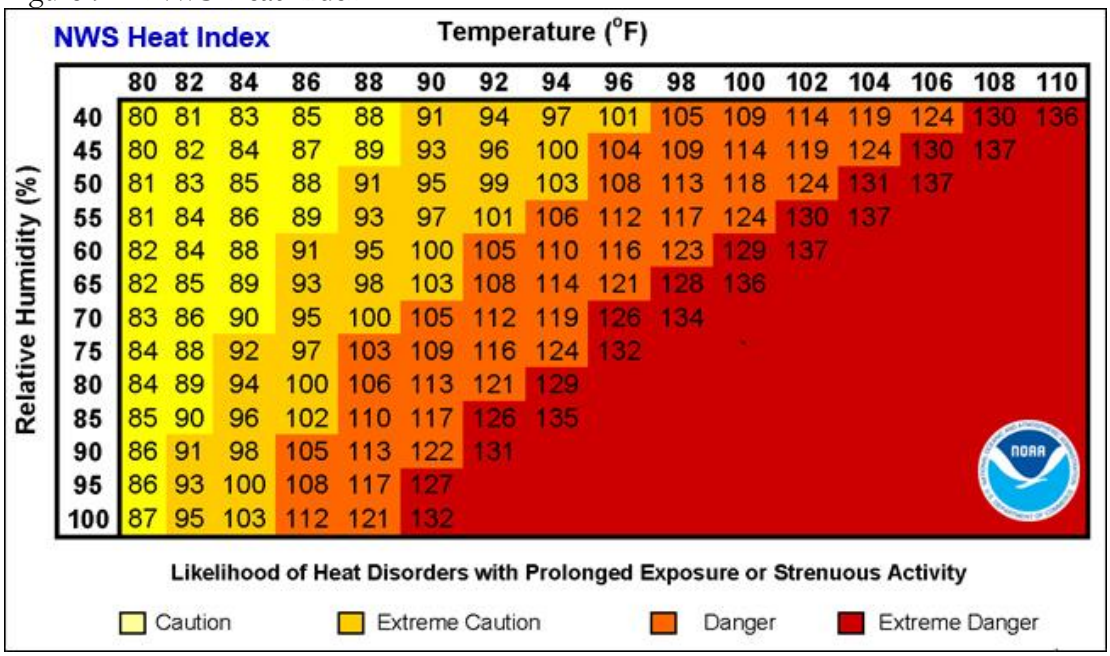
Extreme heat is not confined to any specific geographic area and can occur anywhere within the planning area. City residents can face a heightened risk to extreme heat because of warmer temperatures in cities from the urban heat island effect. The urban heat island effect is caused by large amounts of paved surfaces that absorb and re-radiate heat. The lack of green spaces and tree cover in these areas adds to the issue. Since Bandera County does not have any large major metropolitan areas, the urban heat island effect is not as pronounced. This results in a negligible variance in extreme temperatures from heat waves in the unincorporated areas of the counties versus the incorporated areas.

Extent

The "Heat Index" is the relationship between temperature and relative humidity established by the National Oceanic Atmospheric Administration (NOAA) to measure magnitude or intensity of an extreme heat event. This index combines the effect of high temperatures with high humidity to determine how hot it feels outside. Figure 9.1 below describes the heat index as it relates to the likelihood of heat disorders due to prolonged exposure or strenuous activity. As an example, if the air temperature is 98°F and the relative humidity is 65%, the heat index, or how hot it feels, is 128°F. The red area indicates extreme danger and the example above would fall into this category. Also, exposure to full sunshine can increase heat index values by up to 15°F since the heat index values in the chart below were devised for shady light wind conditions.

[8] http://www.nws.noaa.gov/om/hazstats.shtml
[9] Melillo, J.M., T.C. Richmond, and G.W. Yohe (eds.). 2014. Climate change impacts in the United States: The third National Climate Assessment. U.S. Global Change Research Program. http://nca2014.globalchange.gov.

Figure 9-1: NWS Heat Index



Source: NOAA

The likelihood of health disorders associated with ranges of heat index values are displayed below. The classifications of "Caution," "Extreme Caution," "Danger," and "Extreme Danger" are associated with increasingly harmful effects on the body. Effects on the body depend on the magnitude or intensity of the event with the shaded rows in the table below (Table 9.1) corresponding to the colors in the chart above (Figure 9.1). The National Weather Service will initiate alert procedures when the Heat Index is expected to exceed 105°-110°F, depending on local climate, for at least 2 consecutive days.

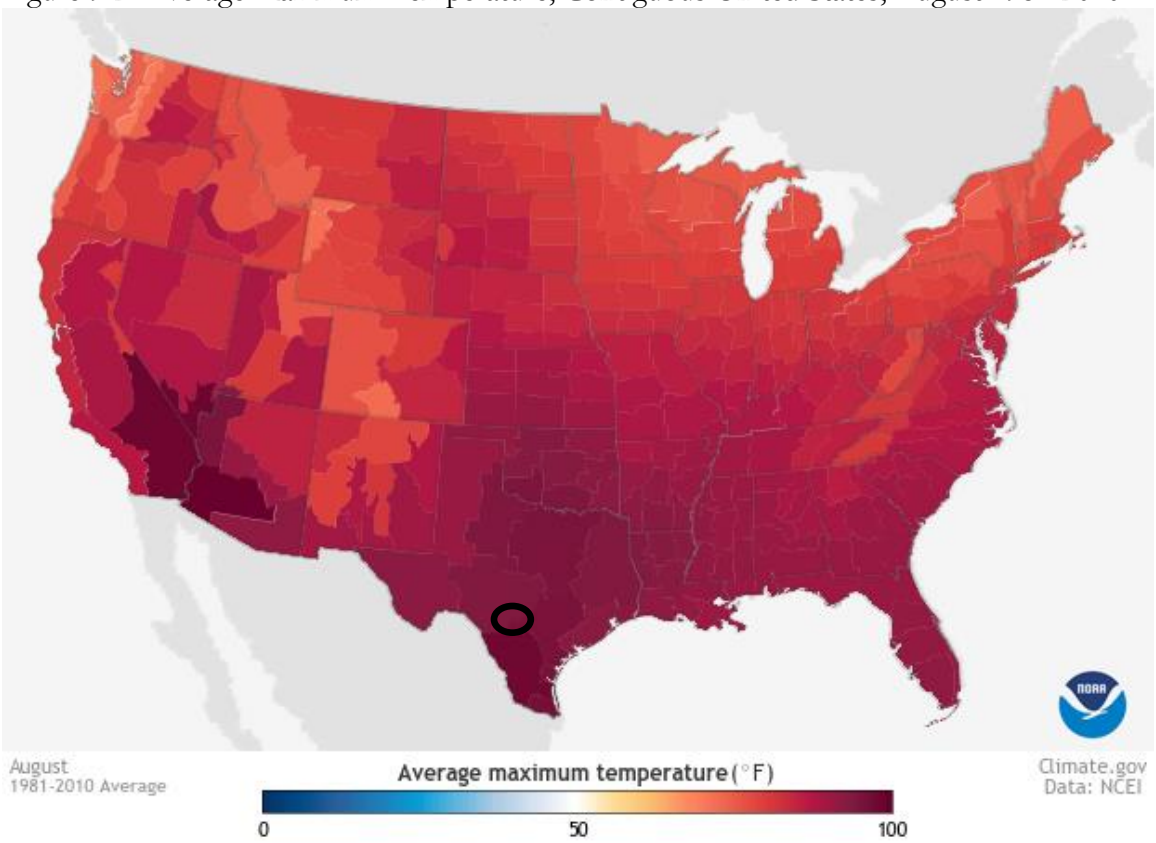
Table 9-1: Heat Index and Warnings

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

source: https://www.weather.gov/ama/heatindexH

The hottest month of the year for the Bandera County planning area is typically August with an average relative humidity of 65%. The National Oceanic and Atmospheric Administration (NOAA) provides the map below that shows the long-term average maximum temperature in each climate division across the contiguous United States for the month of August. This data is based on daily observations from 1981-2010. The planning area exhibits an average maximum temperature of 90-100°F or above based on historical data and has the potential to reach "dangerous" heat index levels at just 92°F and "extremely dangerous" heat index levels at 98°F.

Figure 9-2: Average Maximum Temperature, Contiguous United States, August 1981-2010



https://www.climate.gov/maps-data/data-snapshots/averagemaxtemp-monthly-1981-2010-cmb-0000-08-00?theme=Temperature

Based on the average maximum temperature (90-100°F) and the average relative humidity (65°F) in the Bandera County planning area, extreme heat events to the extent of "Danger" and "Extreme Danger" should be mitigated to reduce threats to humans, livestock, and pets. When the heat index reaches a "Danger" classification, effects can include sunstroke, muscle cramps, heat exhaustion, and prolonged exposure can bring on heatstroke. When the heat index reaches an "Extreme Danger" classification, effects on the body can include all of the above in addition to increasing the risk of heat stroke and even death.

Historical Occurrences

There is one historical occurrence of extreme heat found in the NCEI database for the Bandera County Planning Area for time period from 1998-2023. This doesn't necessarily indicate that the area has rarely experienced an extreme heat event that impacts people, property, and agriculture. The lack of many historical occurrences in the NCEI record simply reflects that injury, fatalities, property losses, or crop losses were not directly attributed to any particular extreme heat event at the time. There have not been any events recorded past the listed dates.

Table 9-2: Historical Excessive Heat Events Table, 1997-2023

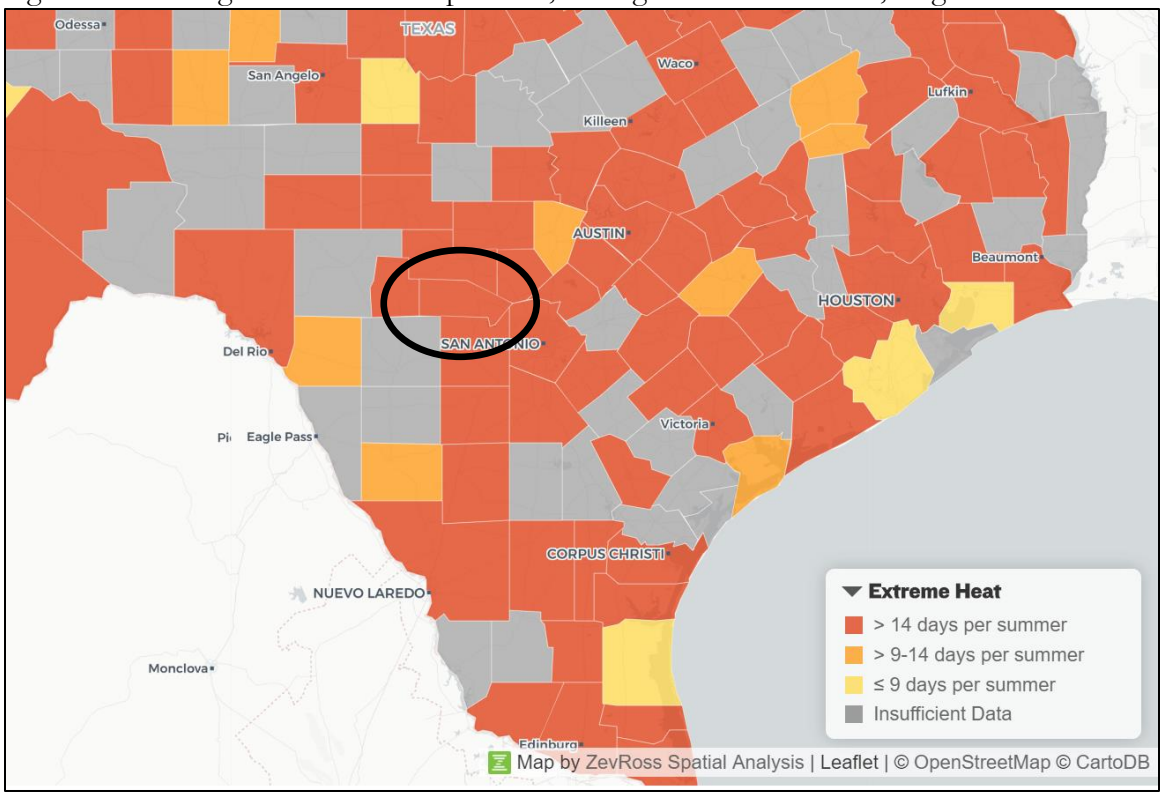
Jurisdiction	Date	Injuries	Fatalities	Property Damage	Crop Damage
Bandera	2018	0	0	$0	$0

***Source**: NOAA NCEI Storm Events Database*

The map below provides an analysis of extreme heat events based on weather station records from the Global Historical Climatology Network (GHCN), formerly the National Climatic

Data Center. With this analysis from the NRDC, "extreme heat days" are defined as those days from June 1 to August 31 in the years 2007 to 2016 on which the maximum temperature exceeded the 90th-percentile value. The June to August daily maximum temperatures from the 1961 to 1990 were used as a reference period for the same monitoring station to calculate the 90th percentile. The 90th percentile value is among the more common ways to define extreme heat and the map below is indicative of how the number of extreme heat days per summer periods are changing over time.

Figure 9-3: Average Maximum Temperature, Contiguous United States, August 1981-2010

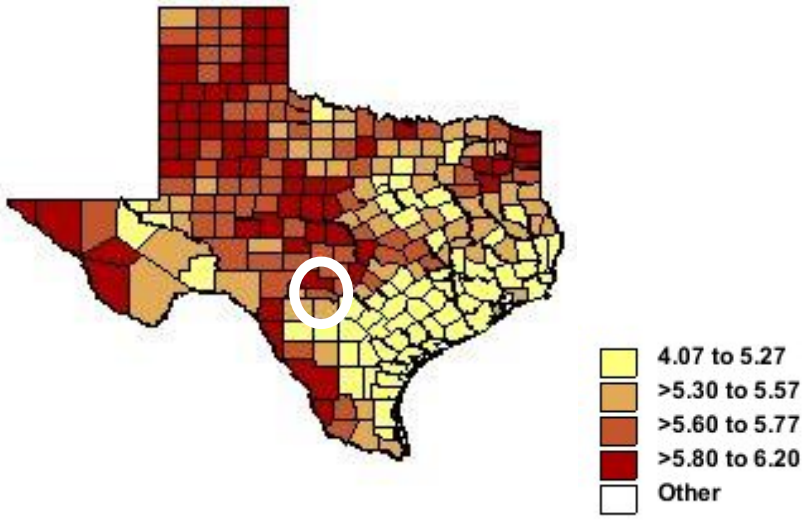


https://www.nrdc.org/climate-change-and-health-extreme-heat#/map/detail/TX

Based on historical monitoring station data from 1961-1990, areas with more than 9 days of extreme heat per summer in the map above are experiencing more days of extreme heat than they did in the past. The map above depicts Bandera County as having 9-14 days of extreme heat per summer. This analysis shows that the Bandera County planning area is experiencing more heat days during the summer than it did past.

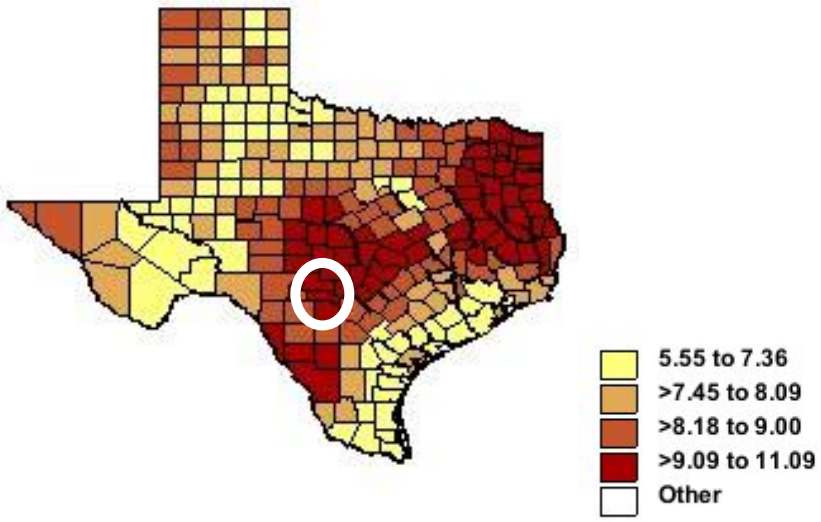
Data from CDC can also help tell a story of how the number of extreme heat days to be expected each summer are increasing. The two maps below depict a 29-year period from 1981-2010 and a 10-year period from 2000-2010. The Bandera County planning area is depicted within the white circle in Central Texas on the maps below.

Figure 9-4: 1981-2010 Average Heat Wave Days Based on Daily Maximum Heat Index for Texas



Source: https://wonder.cdc.gov/NCA-heatwavedays-historic.html

Figure 9-5: 2000-2010 Average heat wave days based on daily maximum heat index for Texas



Source: https://wonder.cdc.gov/NCA-heatwavedays-historic.html

The Extreme Heat Events data available on the CDC WONDER website are county-level measures of the number of heat wave days in the months of May through September spanning the years 1981-2010. The CDC defines heat wave days as those that are 95th percentile of daily maximum Heat Index. The number of heat wave days is computed at the county level and the choropleth map and associated legends show the average number of heat wave days occurring based on the selected time period and location.

Probability of Future Events

The planning area can expect 9-14 extreme heat days and at least one extreme heat event, or heat wave, each summer due to the warm, sunny, and humid subtropical climate in the Bandera County planning area. The probability of the area experiencing at least one extreme heat event in the next year is **highly likely**.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

The probability that the number of extreme heat days will continue to increase in the future is also highly likely. According to NOAA, the top 10 warmest years on record (1880-2023) across the globe have all occurred within the past 10 years. The table below ranks the warmest years on record with land and ocean annually averaged measurements compiled from 1880-2023.

Table 9-2: Top 10 warmest years, globally (NOAA, 1880-2023)

Rank	**Year**
1	2023
2	2016
3	2020
4	2019
5	2015
6	2017
7	2022
8	2021
9	2018
10	2014

"Global Climate Report – Annual 2022". NOAA. Retrieved 18 March 2024.

The average maximum temperature maps in Figures 9-6 and 9-7 on the following page are produced by the U.S. National Climatic Data Center and depict trends for the most recent complete 30-year period as well as the trend when looking at all recorded temperatures since 1896. The maps show average maximum temperature trends across the United States during the summer periods from 1991-2020 and 1896-2020 which show how trends from which forecasts are made can change drastically when looking at different periods of time. The Bandera County planning area is in an area that can expect an increase of 0.5-1.5^{0}F in average maximum summer temperatures over the next century.

Figure 9-6: Average Maximum Temperature Trends, Summer 1991-2020 (30 years)

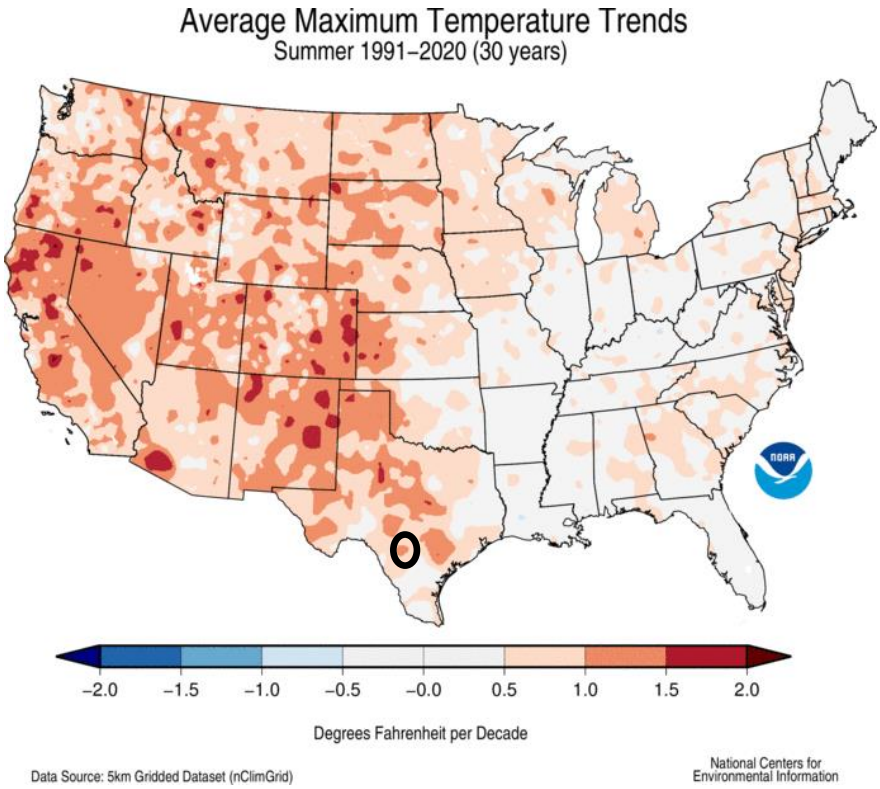
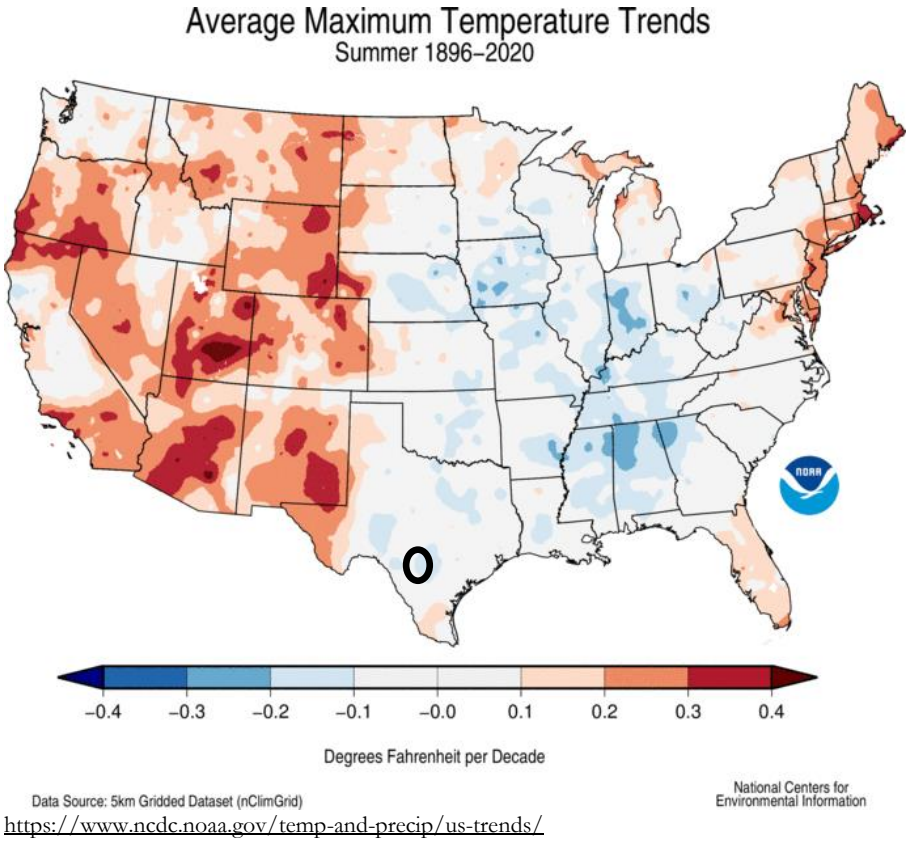


Figure 9-7: Average Maximum Temperature Trends, Summer 1896-2020



https://www.ncdc.noaa.gov/temp-and-precip/us-trends/

Vulnerability and Impacts

Residents of the area, especially vulnerable populations such as children under 5 and those over 65 should exercise caution by staying out of the heat for prolonged periods when a heat advisory or excessive heat warning is in effect. In addition to children and the elderly, the most vulnerable population to heat illnesses and casualties are the infirmed, who frequently live on low fixed incomes and cannot afford to run air-conditioning on a regular basis. This population is sometimes isolated, with no immediate family or friends to look out for their well-being so it is important for communities to get to know which immediate neighbors may be at highest risk to health impacts from heat. Those working or remaining outdoors for extended periods of time and overweight individuals are also at higher risk.

It is never safe to leave a baby, child, disabled person, or pet in a locked car. Cars heat up quickly in the sun and this is true even in the winter, the first toddler death due to being left in a locked car in the U.S. in 2018 occurred in February. The graphic in Figure 9-8 below is produced by NOAA with tips on how to practice heat safety in different situations.

Figure 9-8: NOAA Heat safety tips

https://www.weather.gov/safety/heat

Higher heat index values (which combine temperature and humidity to describe perceived temperature) are expected to increase discomfort and aggravate health issues. Conversely, cold spells are expected to decrease. In most locations, scientists expect daily minimum temperatures—which typically occur at night—to become warmer at a faster rate than daily maximum temperatures.[10] This change will provide less opportunity to cool off and recover from daytime heat. As the region continues to warm overall, it will be important to educate the public about strategies to stay cool during extreme heat events and how to recognize and respond to heat-related illnesses.

[10] National Research Council. 2011. Climate stabilization targets: Emissions, concentrations, and impacts over decades to millennia. Washington, DC: National Academies Press

SECTION 10: LIGHTNING

Description

Lightening is sudden charges of electricity that develop from storms or excessive heat. This massive electrostatic discharge can occur between electrically charged regions within clouds, or between a cloud and the Earth's surface. A bolt of lightning, or the visible sparks, can cause air temperatures surrounding the bolt to approach 50,000^{0}F causing rapid air expansion leading to thunder, which often accompanies lightning strikes. Lightning is most often affiliated with severe thunderstorms, and often strikes outside of heavy rain and can occur as far as 10 miles away from any rainfall.

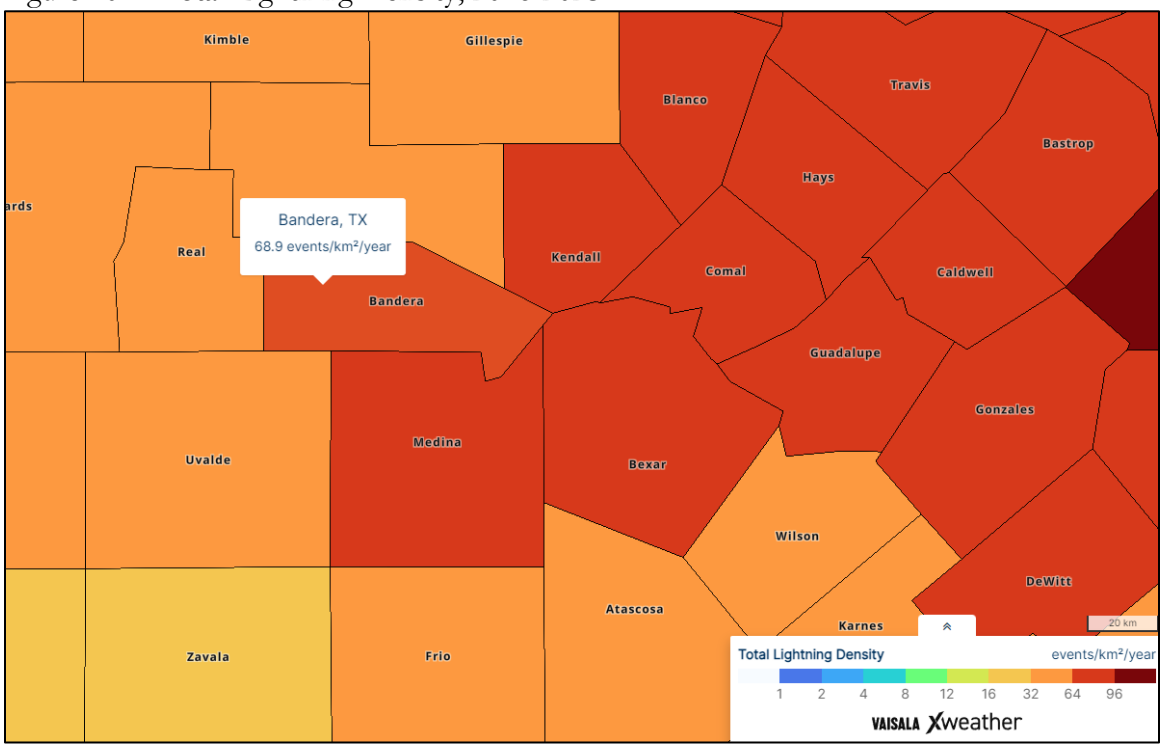
Location

The Bandera County planning area is located in a region of the country that is moderately susceptible to lightning strike. Lightning can occur at any location within the entire planning area and it is assumed that all areas within Bandera County are uniformly exposed to the threat of lightning due to the consistent geography and terrain found throughout.

Extent

Lightning extents is defined in terms of the frequency of lightning strikes within a defined geographic area and a set time period. The Vaisala's U.S. National Lightning Detection Network lightning flash density map, Figure 10-1, shows the average number of lightning events per km2 per year. According the map below, the Bandera County planning area has a total lightning density of 68.9 events/km^2/year for the planning area from 2016-2023.

Figure 10-1. Total Lightning Density, 2016-2023



Source: https://interactive-lightning-map.vaisala.com/

A total lightning density of more than 64 events/km2/year in an area is considered to be a major severity and a total lightning density of more than 96 events/km2/year in an area is considered to be an extreme severity. Any lightning strike that causes death or property

damage is likewise considered a major severity. The lightning hazard is considered to be a major severity for the planning area.

Historical Occurrences

While lightning occurs quite frequently in the planning area, the only lightning data contained within NOAA Storm Data are lightning events that result in fatality, injury and/or property and crop damage. There is one lightning event reported for the planning area according to the NOAA National Centers for Environmental Information (NCEI) data. Structural damages resulting from lighting events are considered severe with risk of injury or death representing the greatest risk. There have not been any events recorded past the listed dates.

Table 10-2: Historical Lightning Events in Bandera County, NCEI 1997-2023

Jurisdiction	Date	Injuries	Fatalities	Property Damage	Crop Damage
Vanderpool	7/24/2007	2	1	$0	$0

Significant Events

July 24, 2007 – Vanderpool

Thunderstorms associated with a persistent upper-level low produced heavy rain and flash flooding in the afternoon and evening of July 24. A father and two sons took shelter under a medium-sized cedar tree at Lost Maples State Natural Area in western Bandera County as a storm approached. Lightning hit the tree, injuring all three, with the father the most serious. One son was still able to go for help. A park ranger and a trained medical responder who was visiting the park came quickly but could not revive the father. Both of his sons were taken to a hospital.

Texas A&M Forest Service (Wildfires Caused by Lightning)

Lightning occurrences and damages are not well documented in the NCEI data but other sources and accounts from the Core planning team members indicate that lightning strikes occur frequently in the planning area. The Texas A&M Forest Service maintains a wildfire occurrence database based on state and local reports. The local reports are based on a voluntary online fire department reporting system that is used by both paid and volunteer fire departments. Table 10-3 lists wildfires caused by lightning strikes recorded by the Texas Forest Service from 2005-2023 within the planning area.

Table 10-3: Texas A&M Forest Service (TFS), Wildfire Ignition History 2005-2023

Location	Date	Name	Responder	Area Burned (Acres)
Bandera	4/19/2006		TFS - Fredericksburg	40
Bandera	7/16/2009	23000 Hwy 187 N	FD – Utopia VFR	1
Bandera	7/10/2011	Lone Hollow Fire	FD – Vanderpool VFD	7
Bandera	9/19/2011	Mill Creek Fire	TFS - Fredericksburg	67

Source: Texas Wildfire Risk Assessment Portal (TWRAP)

Probability of Future Events

With limited reported incidents in the planning area, the team utilized the most current lightning flash density estimate developed by Vaisala, Figure 10-1, for the risk assessment. The most current lightning flash density estimate indicates a probability of occurrence of

approximately 68.3 lightning events per square kilometer per year. Bandera County is 798 square miles or 2,070 square kilometers. The Vaisala flash density estimate combined with the total area produces an estimate of approximately 141,381 flashes per year. With total thunderstorm days for that area at 1-2 events per year, this gives a flash density of approximately 70,691 per event. A **highly likely** probability of occurrence for future lightning events in the Bandera County planning area is supported by this frequency. This means that an event is probable in the next year.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

Lighting strikes are random making all property and people within the Bandera County planning area vulnerable to the impact of lightning. Lightning can also be responsible for damage to buildings, electrical systems, forest and/or wildfires, and damage to infrastructure such as power transmission lines and communication towers. Lightning is attracted to tall metal structures making water towers, electric power stations, and power poles particularly vulnerable to strikes. Lightning strikes can disrupt communication systems, including telephone and internet services, which can impact emergency response times and communication between businesses and customers. Lightning strikes can cause power outages that can affect large areas and cause disruption to businesses, transportation, and other essential services. The damage caused by lightning strikes can have a significant economic impact on cities, particularly in areas where businesses and tourism are major industries. Damage to buildings and electrical equipment can result in costly repairs and downtime. Lightning strikes can cause fires that can spread quickly and cause extensive damage to buildings and surrounding areas and are a cause of wildfires making agricultural land vulnerable as well. Agricultural losses from this hazard can be extensive.

Lightning strikes can also pose a risk to public safety, particularly in outdoor areas such as parks, sports fields, and other public spaces. The peak lightning season in the State of Texas is from June to August; however, the most fatalities occur in July as fatalities occur most often when people are outdoors, working or participating in some form of recreation. Moving inside will decrease a person's vulnerability to injury or death due to lightning strike.

Communities can take steps to mitigate the impact of lightning strikes by implementing lightning protection systems, maintaining electrical infrastructure, and educating the public on lightning safety measures. Doing so can minimize the risks associated with lightning strikes and ensure the safety and well-being of their residents and visitors.

SECTION 11: TORNADO

Description

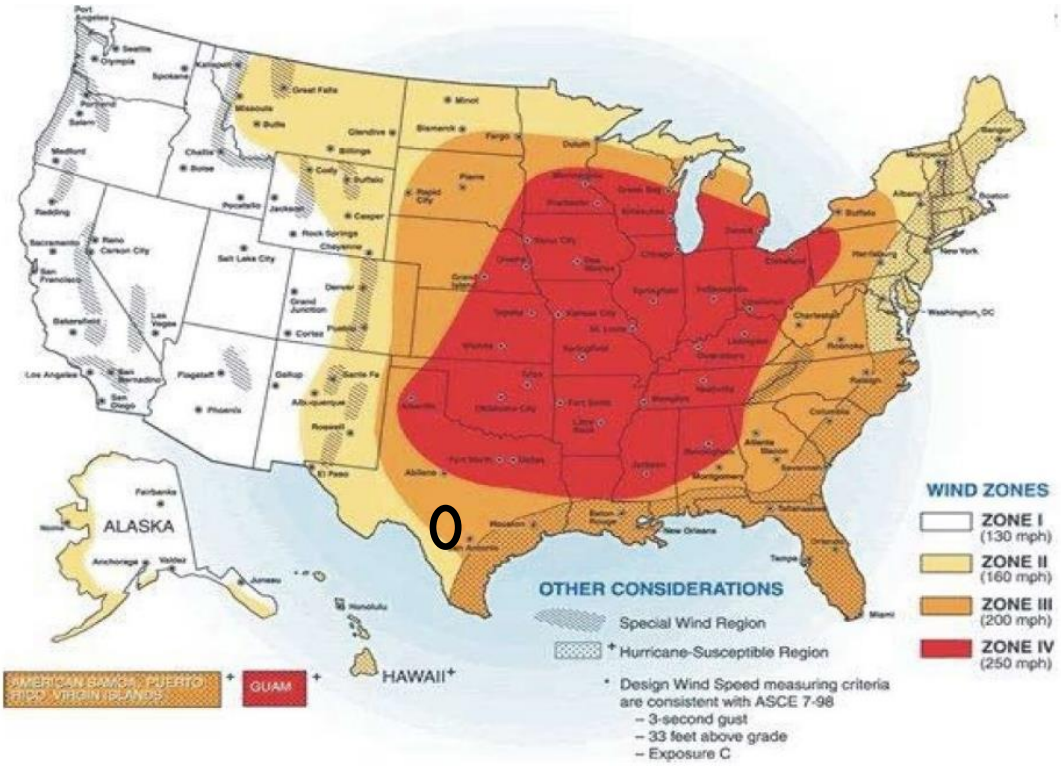
A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. Tornadoes, among the most violent storms on the planet, are capable of tremendous destruction with wind speeds that can reach as high as 250-300mph. Typically, the vortex of air will remain suspended in the atmosphere and be visible as a funnel cloud. If the lower tip of the vortex touches the ground, however, the path of the tornado will often leave destruction in its wake and can be more than one mile wide and 50 miles long. Supercell thunderstorms, created when horizontal wind shears (winds moving in different directions at different altitudes) begin to rotate the storm, can produce the most extreme and powerful tornadoes.

The economic and financial impacts of a tornado event on a community can be devastating depending on the scale of the event and the population density of the area that is hit. The damage caused in the aftermath of a tornado event can be minimized with collaborative preparedness and pre-event planning by government, businesses, and citizens.

Location

Tornadoes do not have any specific geographic boundary and can occur uniformly throughout the planning area. Bandera County is located in Wind Zone III along the Texas gulf coast (Figure 11-1), where tornado winds can be as high as 200 mph.

Figure 11-1: United States Wind Zones

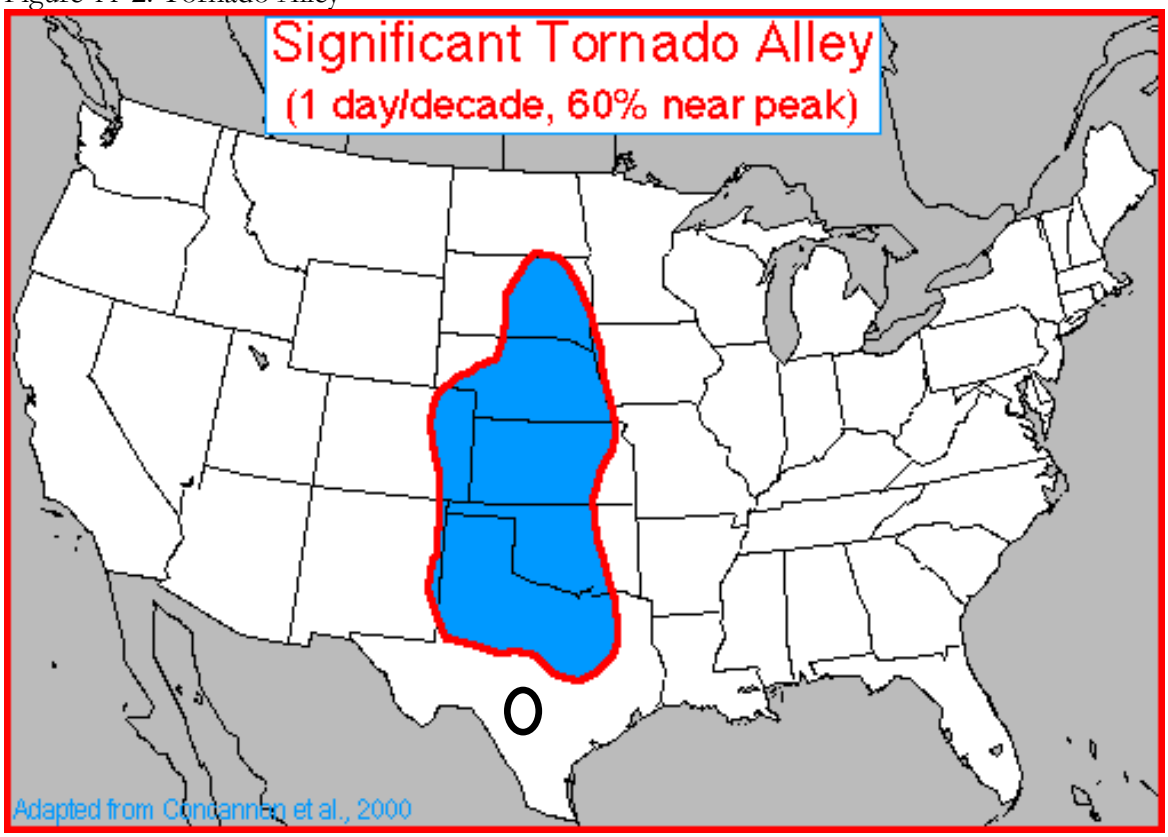


www.fema.gov/plan/prevent/saferoom/tsfs02_wind_zones.shtm

Tornado Alley refers to an area in the southern plains of the central United States that experiences a higher-than-normal frequency of tornadoes each year due to weather patterns and geography. This area extends from central Texas to northern Iowa, and from central

Kansas and Nebraska east to Western Ohio (Figure 11-2). Tornadoes in this region typically occur in late spring and occasionally in the early fall. The Bandera County planning area is 150-200 miles south of the southern border of Tornado Alley.

Figure 11-2: Tornado Alley



https://www.ncdc.noaa.gov/file/1535

Extent

Tornado events prior to 2007 follow the original Fujita scale, Table 11-1 on the following page. The current measure of the extent of tornado damage is the enhanced Fujita scale and it took effect on February 1st, 2007. The scale ranges from EF0, generally weak tornadoes with the ability to do minor damage, to EF5, tornadoes with winds in excess of 200mph and the ability to do devastating damage to areas they come in contact with. Tornados can range from weak to violent and typically cause the greatest damage to structures of light construction, such as single-family, manufactured, and mobile homes.

Table 11-1: The Fujita Tornado Scale

Scale	Wind speed estimate (mph)	Potential damage	Example of damage
F0	40-72	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.	
F1	73-112	Moderate damage. The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving vehicles pushed off the roads; attached garages may be destroyed.	
F2	113-157	Significant damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; high-rise windows broken and blown in; light-object missiles generated.	
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forests uprooted; heavy cars lifted off the ground and thrown.	
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.	
F5	261-318	Incredible damage. Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air farther than 100 meters (110 yards); trees debarked; steel-reinforced concrete structures badly damaged and skyscrapers toppled	

Source: https://www.spc.noaa.gov/faq/tornado/f-scale.html

Table 11-2: The Enhance Fujita Tornado Scale

Scale	Wind speed estimate (mph)	Potential damage	Example of damage
EF0	65–85	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.	
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 from 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 are badly damaged.	
EF4	166–200	Devastating damage. Well-constructed and whole frame houses completely leveled; cars and other large objects thrown and small missiles generated.	
EF5	>200	Incredible damage. Strong-framed, well-built houses leveled off foundations are swept away; steel-reinforced concrete structures are critically damaged; tall buildings collapse or have severe structural deformations; some cars, trucks, and train cars can be thrown approximately 1 mile (1.6 km).	

Source: https://www.spc.noaa.gov/efscale/ef-scale.html

The Enhanced Fujita Scale has 28 Damage Indicators (DI), or types of structures and vegetation, each with a varying number of Degrees of Damage (DoD). Larger degrees of damage done to the damage indicators correspond to higher wind speeds. Each damage indicator has a unique Degree of Damage scale, summarized in Table 11-3. For example, damage indicator 2, One and Two-family Residences, Degree of Damage Scale is provided as Figure 11-3. For Degree of Damage Scales for the remaining Damage Indicators refer to National Oceanic and Atmospheric Administration website.
http://www.spc.noaa.gov/faq/tornado/ef-scale.html

Table 11-3: Degrees of Damage Scale

DI No.	Damage indicator (DI)	Degrees of damage (DOD)
1	Small barns or farm outbuildings (SBO)	8
2	One- or two-family residences (FR12)	10
3	Manufactured home – single wide (MHSW)	9
4	Manufactured home – double wide (MHDW)	12
5	Apartments, condos, townhouses [three stories or less] (ACT)	6
6	Motel (M)	10
7	Masonry apartment or motel building (MAM)	7
8	Small retail building [fast-food restaurants] (SRB)	8
9	Small professional building [doctor's office, branch banks] (SPB)	9
10	Strip mall (SM)	9
11	Large shopping mall (LSM)	9
12	Large, isolated retail building [K-Mart, Wal-Mart] (LIRB)	7
13	Automobile showroom (ASR)	8
14	Automobile service building (ASB)	8
15	Elementary school [single-story; interior or exterior hallways] (ES)	10
16	Junior or senior high school (JHSH)	11
17	Low-rise building [1–4 stories] (LRB)	7
18	Mid-rise building [5–20 stories] (MRB)	10
19	High-rise building [more than 20 stories] (HRB)	10
20	Institutional building [hospital, government or university building] (IB)	11
21	Metal building system (MBS)	8
22	Service station canopy (SSC)	6
23	Warehouse building [tilt-up walls or heavy-timber construction] (WHB)	7
24	Electrical transmission lines (ETL)	6
25	Free-standing towers (FST)	3
26	Free-standing light poles, luminary poles, flag poles (FSP)	3
27	Trees: hardwood (TH)	5
28	Trees: softwood (TS)	5

Figure 11-3: One and Two-Family Residences Degree of Damage Indicator

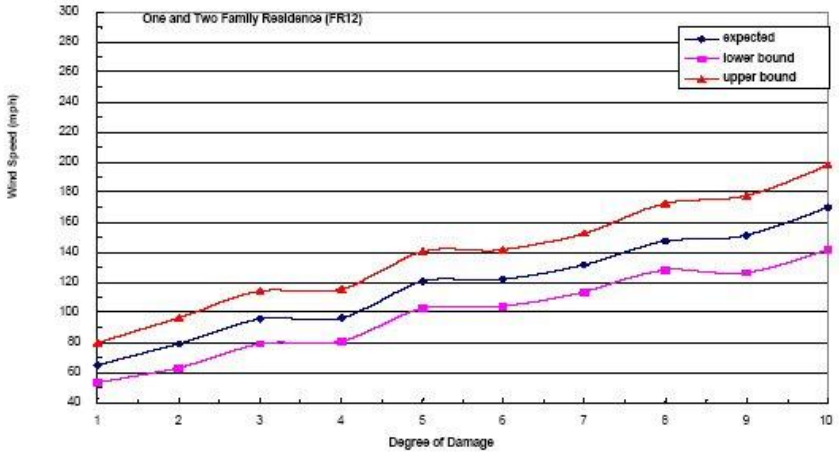
2. ONE-AND TWO-FAMILY RESIDENCES (FR12)
(1000 – 5000 sq. ft.)

Typical Construction

- Asphalt shingles, tile, slate, or metal roof covering
- Flat, gable, hip, mansard, or mono-sloped roof or combinations thereof
- Plywood/OSB or wood plank roof deck
- Prefabricated wood trusses or wood joist and rafter construction
- Brick veneer, wood panels, stucco, EIFS, vinyl, or metal siding
- Wood or metal stud walls, concrete blocks or insulating-concrete panels
- Attached single or double garage

DOD*	Damage description	EXP	LB	UB
1	Threshold of visible damage	65	53	80
2	Loss of roof covering material (<20%), gutters and/or awning; loss of vinyl or metal siding	79	63	97
3	Broken lass in doors and windows	96	79	114
4	Uplift of roof deck and loss of significant roof covering material (>20%); collapse of chimney; garage doors collapse inward; failure of porch or carport	97	81	116
5	Entire house shifts off foundation	121	103	141
6	Large sections of roof structure removed; most walls remain standing	122	104	142
7	Top floor exterior walls collapsed	132	113	153
8	Most interior walls of top story collapsed	148	128	173
9	Most walls collapsed in bottom floor, except small interior rooms	152	127	178
10	Total destruction of entire building	170	142	198

* Degree of Damage



The Bandera County planning area has not experienced any reported tornadic events in the 25-year period (Table 11-4). However, because Bandera County is in Wind Zone III, the planning area could experience a tornado with a magnitude anywhere from EF0 to an EF4. Since record keeping began in 1950 the planning area has not experienced any recorded tornados, therefore, the range of intensity that the planning area would be expected to mitigate is a tornado event that would be a low to moderate risk, an EF0 to EF2.

Historical Occurrences

There have been no reported tornadoes in the Bandera County planning area since 1997.

Table 11-5: Historical Tornado Events Magnitude Summary, 1997 - 2006

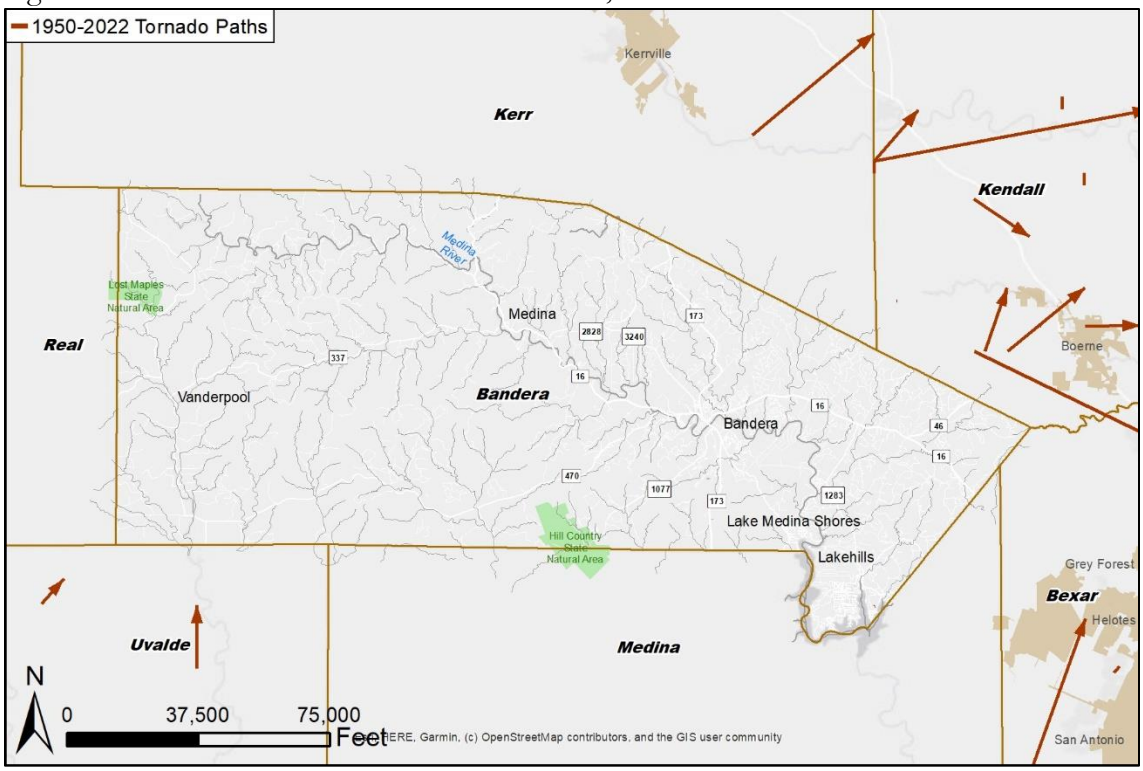
Number of Events	Magnitude (Fujita Scale)						
	N/A	F0	F1	F2	F3	F4	F5
0		0	0	0	0	0	0

Table 11-6: Historical Tornado Events Magnitude Summary, 2007-2023

Number of Events	Magnitude (Enhanced Fujita Scale)						
	N/A	EF0	EF1	EF2	EF3	EF4	EF5
0	0	0	0	0	0	0	0

The locations of previous occurrences from 1950 through 2022 in the planning area are shown in figure 11-5. This map displays the historic tornado tracks, the distance travelled, and the direction in which they travelled. Only reported tornadoes were plotted and factored into the risk assessment, however it is likely that several occurrences have gone unreported over the past 72 years.

Figure 11-4: Historic Tornado Tracks 1950-2022, Distance Travelled and Direction



Significant Events

There has been no significant tornadic activity reported in the planning area since 1997.

Probability of Future Events

Tornadic storms are typically more common in the spring months during the late afternoon and evening hours but can occur at any time of year and at any time of day. A smaller, high

frequency period can also emerge in the fall during the brief transition between the warm and cold seasons. Table 11-7 provides a general overview of tornado severity, probability, fatality impacts, and defining characteristics.

Table 11-7: Tornado Severity and Probability

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

According to historical records there were no tornadic events in the planning area for the 25-year reporting period. This provides a probability of occurrence of possible in the next 10 years for the Bandera County planning area. This frequency supports an **unlikely** probability of future events for the planning area, including all participating jurisdictions.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

All existing and future buildings, facilities and populations in the Bandera County planning area are considered to be vulnerable to tornados and could potentially be impacted. High wind velocity, wind-blown debris, lightning, and large hail are typically the cause of damage done by a tornado. The high winds and flying debris can cause roofs to collapse, windows to shatter, and walls to crumble. Tornadoes can also cause significant damage to buildings, roads, bridges, and other infrastructure in cities. First responders and those needing to evacuate an area may encounter blocked roads as a result of the debris rendering some areas inaccessible or inescapable. Tornadoes can have a significant impact on the local economy as well, causing damage to businesses and homes, as well as disrupting transportation and causing productivity losses. The psychological trauma of experiencing a tornado, losing property or loved ones, or being displaced from one's home can have lasting effects on mental health.

Tornadoes pose a severe threat to communities as they often result in power outages, which could cause health and safety risks to vulnerable populations who rely on electricity for medical necessities, as well as patients in hospitals. Power outages can also disrupt electricity supply to neighborhoods and even entire cities, causing problems with heating, cooling, lighting, and communication. Anyone in the path of a tornado can incur serious injuries or even fatalities. Falling trees, branches, utility lines, poles, and flying debris pose safety risks, and people caught in the open or unable to take adequate cover are at the highest risk of injury or death. Certain buildings and structures are more prone to damage than others from the high wind velocity associated with tornado events. The three most susceptible types of structures to tornado damage are:

1. Manufactured Homes
2. Homes on crawlspaces (more susceptible to lift), and

3. Buildings with large spans, such as shopping malls, gymnasiums, and factories.

The Bandera County planning area features mobile and manufactured home parks which are more vulnerable to tornadoes than site-built structures. In addition, manufactured and temporary housing is located sporadically throughout rural portions of the planning area which are also vulnerable to the tornado hazard but more prone to being isolated from essential needs and emergency services in the event of a disaster. Based on 2022 American Community Survey estimates, there are 8,532 housing units in Bandera County of which 28%, or 2,396 units, are mobile or manufactured homes. In addition, 1,833 (21%) of the housing units in the overall planning area were built before 1980. These structures are likely to have been built to lower or less stringent construction standards than newer construction and may be more susceptible to damages during significant events.

Table 8-3. Structures at Greater Risk by Jurisdiction

Jurisdiction	Total Housing Units	Mobile Homes	Housing units built prior to 1980
Bandera County*	8,532	2,396 (28%)	1,833 (21%)
City of Bandera	230	4 (2%)	118 (51%)

*County totals include all jurisdictions in addition to unincorporated areas.
Source: 2022 American Community Survey 5-year estimate, selected housing characteristics

Based on the ACS 2022 data, the City of Bandera is at higher risk of damage from tornadoes when considering age of residential structures and the higher standard of building codes enacted after 1980. Unincorporated Bandera County as a whole is at a higher risk of damage from hurricanes when considering number and ratio of manufactured homes when compared to the City of Bandera. To mitigate the risks associated with the impacts of tornadoes, it's important to have early warning systems in place, build structures that can withstand high winds, and establish emergency response plans to quickly respond to disasters.

Historic Tornado Impacts

The summary table on the following page, 11-9, shows the 25-year property and crop damage totals as well as the average annual (Per Year) losses summarizing historic tornado impacts. The bottom half of the table shows per capita dollar loss rates for the total and average annual losses. These rates are important measures for comparing losses between different hazards and areas. The average annual loss estimate of property and crop is $0 for Bandera County.

Table 11-9, Bandera County Loss Summary

Time Period	Fatalities	Injuries	Property Damage	Crop Damage
Loss Summary, Bandera County				
25-year Total	0	0	$0	$0
Per Year	0	0	$0	$0
Per Capita Dollar Losses				
25-year Total	0	0	$0	$0
Per Year	0	0	$0	$0

Table 11-10 below displays the tornado losses by jurisdictions within the planning area.

Table 11-10: Tornado Losses by Jurisdiction 1997-2023

Jurisdiction	Est. Prop. Losses	Est. Crop Losses	Total Est. Losses
Bandera County, 20,851	$0	$0	$0
City of Bandera, 829	$0	$0	$0
Bandera FWSD #1	$0	$0	$0
Bandera ISD	$0	$0	$0
Medina ISD	$0	$0	$0
Flying L PUD	$0	$0	$0
Utopia ISD	$0	$0	$0
Medina WSC	$0	$0	$0
Total Losses	$0	$0	$0

SECTION 12: HAILSTORMS

Description

Hail is showery precipitation in the form of irregular pellets or balls of ice that typically measures 0.2 inches and 6 inches in diameter. It is a particularly damaging form of frozen participation resulting from thunderstorms with the size of the hail a direct result of the size and severity of the storms. Hail is produced when warm air rapidly rises into the upper atmosphere and the air mass is cooled. Frozen droplets within the cooled air mass accumulate to form ice crystals that then fall to the Earth as precipitation. The strength of the updraft is dependent on heating on the surface of the Earth with larger temperature gradients between the upper atmosphere and the surface responsible for increased suspension time and, therefore, increased hailstone size.

Location

Hailstorms are not confined to any specific geographic location, and can vary greatly in size, location, intensity and duration. As a result, all areas within the Bandera County planning area are equally at risk to the hazard of hail.

Extent

The NCEI Intensity Scale, depicted in Table 12-1, shows how the intensity category of a hailstorm depends on hail size and the potential damage it could cause. The intensity scale ranges from H0 to H10, with increments of intensity or damage potential in relation to hail size (distribution and maximum), texture, fall speed, speed of storm translation, and strength of the accompanying wind. The National Weather Service (NWS) classifies a storm as "severe" if there is hail one inch in diameter (approximately the size of a quarter) or greater, based on radar intensity or as seen by observers. Based on historical data, hail of up to 2.5 inches can be expected in the planning area.

Table 12-1: Hail Intensity and Magnitude

Size Code	Intensity Category	Size (Diameter Inches)	Descriptive Term	Typical Damage
H0	Hard Hail	Up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33 - 0.60	Marble	Slight damage to plants and crops
H2	Potentially Damaging	0.60 - 0.80	Dime	Significant damage to plants and crops
H3	Severe	0.80 - 1.2	Nickel	Severe damage to plants and crops
H4	Severe	1.2 - 1.6	Quarter	Widespread glass and auto damage
H5	Destructive	1.6 - 2.0	Half Dollar	Widespread destruction of glass, roofs, and risk of injuries
H6	Destructive	2.0 - 2.4	Ping Pong Ball	Aircraft bodywork dented and brick walls pitted
H7	Very Destructive	2.4 - 3.0	Golf Ball	Severe roof damage and risk of serious injuries
H8	Very Destructive	3.0 - 3.5	Hen Egg	Severe damage to all structures

H9	Super Hailstorms	3.5 - 4.0	Tennis Ball	Extensive structural damage, could cause fatal injuries
H10	Super Hailstorms	4.0 +	Baseball	Extensive structural damage, could cause fatal injuries

Source: NCEI Intensity Scale, based on the TORRO Hailstorm Intensity Scale.

The Bandera County area may experience hailstorms ranging from an H0 to an H10 based on previous occurrences for the area discussed further below. The planning area can plan to mitigate storms ranging from hard hail (low risk) to super hailstorms (high risk), the latter potentially leading to widespread destruction of glass, roofs, and potential risk of injuries.

Historical Occurrences

Historical evidence for Bandera County suggests that the entire planning area is vulnerable to hail events. Historical events with reported damage, injuries or fatalities are shown in Table 12-2 below. A total of 91 reported historical hail events and 49 unique events impacted Bandera County during the 25-year period from 1997 through 2023. These reported events may not represent all hail events to have occurred during this time since they were only the events reported to the NCEI. There have not been any events recorded past the listed dates.

Table 12-2: Historical Hail Events in Bandera County, 1997-2023

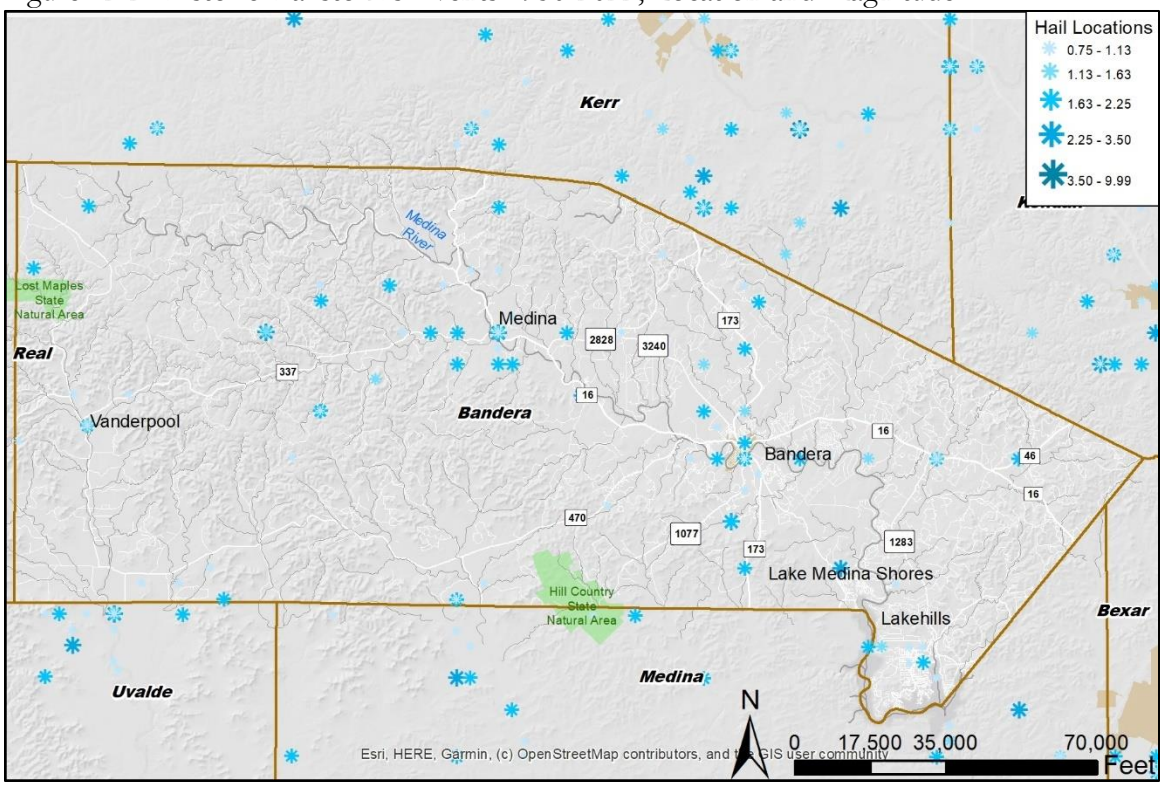
Location	Date	Magnitude (Diameter, Inches)	Deaths	Injuries	Property Damage	Crop Damage
Bandera	3/2/1997	0.75	0	0	$0	$0
Pipecreek	4/4/1997	0.75	0	0	$0	$0
Pipecreek	5/15/1997	0.75	0	0	$0	$0
Tarpley	12/23/1997	0.75	0	0	$0	$0
Medina	2/10/98	0.75	0	0	$0	$0
Pipecreek	2/25/98	0.75	0	0	$0	$0
Bandera	2/25/98	0.75	0	0	$0	$0
Bandera	5/25/98	1	0	0	$0	$0
Vanderpool	5/11/99	1.75	0	0	$0	$0
Bandera	5/26/99	1.5	0	0	$0	$0
Bandera	4/30/00	0.75	0	0	$0	$0
Tarpley	4/15/01	1.75	0	0	$0	$0
Tarpley	11/14/01	1.75	0	0	$0	$0
Medina	5/2/02	1.75	0	0	$0	$0
Medina	4/10/05	1	0	0	$0	$0
Tarpley	4/10/05	1.75	0	0	$0	$0
Bandera	4/10/05	1	0	0	$0	$0
Vanderpool	6/1/05	1.75	0	0	$0	$0
Medina	3/8/06	1.75	0	0	$0	$0
Tarpley	4/20/06	1	0	0	$0	$0
Bandera	4/20/06	1.75	0	0	$0	$0
Medina	4/21/06	1.75	0	0	$0	$0

Pipecreek	3/12/07	0.88	0	0	$0	$0
Bandera	5/1/07	1.75	0	0	$0	$0
Vanderpool	3/17/08	1	0	0	$0	$0
Vanderpool	3/17/08	1.25	0	0	$0	$0
Medina Circle R Arpt	3/17/08	1.75	0	0	$0	$0
Medina Circle R Arpt	3/17/08	0.75	0	0	$0	$0
Bandera	4/17/08	0.88	0	0	$0	$0
Medina Circle R Arpt	4/25/08	1	0	0	$0	$0
Vanderpool	4/25/08	0.88	0	0	$0	$0
Pipecreek	5/27/09	0.88	0	0	$0	$0
Vanderpool	4/7/10	1.5	0	0	$0	$0
Medina	4/7/10	1	0	0	$0	$0
Bandera	4/7/10	1.75	0	0	$0	$0
Medina	9/21/11	0.88	0	0	$0	$0
Vanderpool	3/19/12	1.75	0	0	$0	$0
Vanderpool	3/19/12	1.75	0	0	$0	$0
Medina Lake	3/9/13	1	0	0	$0	$0
Medina Lake	3/10/13	1	0	0	$0	$0
Bluff	3/31/13	1	0	0	$0	$0
Vanderpool	5/9/14	1	0	0	$0	$0
Bandera	5/27/14	1.75	0	0	$0	$0
Bandera	5/27/14	0.75	0	0	$0	$0
Vanderpool	5/27/14	1.25	0	0	$0	$0
Bandera	4/17/15	0.75	0	0	$0	$0
Medina	3/18/16	1	0	0	$0	$0
Medina	3/18/16	1	0	0	$0	$0
Bandera	4/12/16	0.75	0	0	$0	$0
Vanderpool	1/15/17	1.75	0	0	$0	$0
Medina Circle R Arpt	1/15/17	1	0	0	$0	$0
Medina	1/15/17	3	0	0	$0	$0
Medina	1/15/17	2.75	0	0	$0	$0
Medina	1/15/17	1.75	0	0	$0	$0
Medina A Bar A Arpt	1/15/17	2	0	0	$0	$0
Medina	1/15/17	2.5	0	0	$0	$0
Medina	1/15/17	1.75	0	0	$0	$0
Bandera	1/15/17	1.25	0	0	$0	$0
Vanderpool	5/15/18	1	0	0	$0	$0
Medina	6/16/19	1	0	0	$0	$0
Bandera	1/10/20	0.75	0	0	$0	$0

Medina Lake	1/10/20	0.88	0	0	$0	$0
Bandera	5/27/20	1	0	0	$0	$0
Bandera	5/27/20	1.75	0	0	$0	$0
Pipecreek	5/27/20	1.5	0	0	$0	$0
Medina Lake	5/27/20	1.25	0	0	$0	$0
Medina	5/27/20	1	0	0	$0	$0
Vanderpool	5/27/20	1	0	0	$0	$0
Medina Circle R Arpt	4/28/21	0.75	0	0	$0	$0
Medina Lake	5/3/21	2	0	0	$0	$0
Bandera	6/15/21	1	0	0	$0	$0
Tarpley	12/18/21	1	0	0	$0	$0
Medina Circle R Arpt	4/17/22	1	0	0	$0	$0
Medina	4/17/22	1.75	0	0	$0	$0
Medina	4/17/22	2	0	0	$0	$0
Medina	4/17/22	2.5	0	0	$0	$0
Medina	4/17/22	1	0	0	$0	$0
Bandera	4/17/22	1	0	0	$0	$0
Medina	4/17/22	2.5	0	0	$0	$0
Medina Lake	5/4/22	1	0	0	$0	$0
Bluff	5/21/22	1.75	0	0	$0	$0
Medina	5/21/22	1.75	0	0	$0	$0
Medina Lake	3/2/23	1	0	0	$0	$0
Bandera	4/28/23	2	0	0	$0	$0
Bandera	4/28/23	1.75	0	0	$0	$0
Bandera	4/28/23	1	0	0	$0	$0
Pipecreek	4/28/23	1.5	0	0	$0	$0
Pipecreek	4/28/23	1	0	0	$0	$0
Medina Lake	5/8/23	1	0	0	$0	$0

Figure 12-2 plots this historical evidence by locating past hail events in the Bandera County planning area where latitude and longitude were available.

Figure 12-2: Historic Hailstorms Events 1950-2022, Location and Magnitude



Source: NOAA Storm Prediction Center

Significant Events

There were no significant hail events in the Bandera County planning area since 1998.

Probability of Future Events

Based on available records of historic events there were 49 unique events in a 25-year reporting period for the Bandera County planning area. This provides a probability of at least one event every year. This frequency supports a **highly likely** probability of future events meaning that an event is probable somewhere in the planning area in the next year.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

Hail can cause significant injury to humans and has been fatal in some circumstances. People could be struck by hail, falling trees, and branches. Also, hail could cause power outages which could cause health and safety risks to more vulnerable populations in the planning area. The most common impacts of hailstorms are to crops, trees, and landscaping since even small hail can tear plants apart in a short amount of time. Vehicles, roofs of buildings and homes, are also commonly damaged by hail. Older structures not built to current codes may be more susceptible to damages from hail than newer structures. HVAC and electrical service systems, particularly those on roofs, at schools, and critical facilities would be vulnerable and could also be damaged.

The Bandera County planning area features mobile and manufactured home parks which are more vulnerable to hailstorms than site-built structures. In addition, manufactured and temporary housing is located sporadically throughout rural portions of the planning area which are also vulnerable to the hurricane hazard but more prone to being isolated from essential needs and emergency services in the event of a disaster. Based on 2022 American Community Survey estimates, there are 8,532 housing units in Bandera County of which 28%, or 2,396 units, are mobile or manufactured homes. In addition, 1,833 (21%) of the housing units in the overall planning area were built before 1980. These structures are likely to have been built to lower or less stringent construction standards than newer construction and may be more susceptible to damages during significant events.

Table 12-3. Structures at Greater Risk by Jurisdiction

Jurisdiction	Total Housing Units	Mobile Homes	Housing units built prior to 1980
Bandera County*	8,532	2,396 (28%)	1,833 (21%)
City of Bandera	230	4 (2%)	118 (51%)

*County totals include all jurisdictions in addition to unincorporated areas.
Source: 2022 American Community Survey 5-year estimate, selected housing characteristics

Based on the ACS 2022 data, the City of Bandera is at higher risk of damage from hailstorms when considering age of residential structures and the higher standard of building codes enacted after 1980. Unincorporated Bandera County as a whole is at a higher risk of damage from hurricanes when considering number and ratio of manufactured homes when compared to the City of Bandera.

Historic Hailstorm Impacts

The summary table below, 12-4, shows the 25-year property and crop damage totals as well as the average annual (Per Year) losses summarizing historic hailstorm impacts. The bottom half of the table shows per capita dollar loss rates for the total and average annual losses. These rates are important measures for comparing losses between different hazards and areas. The average annual loss estimate of property and crop is $0 for Bandera County.

Table 12-4. Bandera County Loss Summary

Time Period	Fatalities	Injuries	Property Damage	Crop Damage
Loss Summary, Bandera County				
25-year Total	0	0	$0	$0
Per Year	0	0	$0	$0
Per Capita Dollar Losses				
25-year Total	0	0	$0	$0
Per Year	0	0	$0	$0

Since weather varies year-to year, forecasts of specific years are less likely to be true (less reliable) than these totals and averages for the period. The second summary table shows per capita dollar loss rates based on 2020 Census population counts. This is an important measure for comparing historical losses between different hazards and areas. Table 12-5 below displays the hailstorm losses by jurisdictions within the planning area.

Table 12-5: Hailstorm Losses by Jurisdiction 1997-2023

Jurisdiction	Est. Prop. Losses	Est. Crop Losses	Total Est. Losses
Bandera County, 20,851	$0	$0	$0
City of Bandera, 829	$0	$0	$0
Bandera FWSD #1	$0	$0	$0
Bandera ISD	$0	$0	$0
Medina ISD	$0	$0	$0
Flying L PUD	$0	$0	$0
Utopia ISD	$0	$0	$0
Medina WSC	$0	$0	$0
Total Losses	$0	$0	$0

SECTION 13: WILDFIRE

Description

Source: http://texasforestservice.tamu.edu

Wildfires are an unplanned, unwanted fire burning uncontrolled in a natural area rich with vegetative fuels, like a forest, grassland, or prairie. Meteorological conditions such as high temperatures, low humidity, droughts, and high wind increase wildfire risk. Sparks from agricultural, industrial, or automobile activity are often the cause of a wildfire with humans the most common source of initial ignition. Wildfires can also be naturally ignited by lightning strike as a part of the natural management of forest ecosystems. While wildfires can occur any time of year, they are especially likely over the spring and summer months, when fuel is often dry so flames can move unchecked through a highly vegetative area.

Location

Wildfires are most likely to occur in open grasslands but are not confined to any specific geographic location and can vary greatly in terms of size, location, intensity, and duration. The populated, urban areas of the planning area are less likely to experience large, sweeping fires. The more rural and sparsely populated unincorporated areas of Bandera County are more vulnerable to large sweeping wildfire events. The threat to people and property is greatest in the wildland urban interface/intermix, however, the entire planning area of Bandera County is at risk for wildfires.

Extent

The likelihood that a wildfire event will occur in the planning area is measured using the Keetch Byram Drought Index (KBDI) and the Texas Forest Service's Fire Intensity Scale (FIS). The KBDI describes the potential for wildfire based upon weather conditions such as daily water balance, precipitation, and soil moisture (Table 13-1). The index ranges from 0-800 with a score of 0 indicating no moisture depletion and a score of 800 representing completely dry conditions.

Table 13-1, Keetch Byram Drought Index (KBDI)

KBDI Score Range	Description
0-200	Soil moisture and large class fuel moistures are high and do not contribute much to fire intensity. Typical of early spring following winter precipitation.
200-400	Fuels are beginning to dry and contribute to wildfire intensity. Heavier fuels will still not readily ignite and burn. This is often seen in late spring or early summer.
400-600	Lower litter and duff layers contribute to fire intensity and will burn actively. Wildfire intensity begins to increase significantly. Larger fuels could burn or smolder for several days. This is often seen in late summer and early fall.
600-800	Often associated with more severe drought with increased wildfire occurrence. Intense, deep-burning fires with extreme intensities can be expected. Live fuels can also be expected to burn actively at these levels.

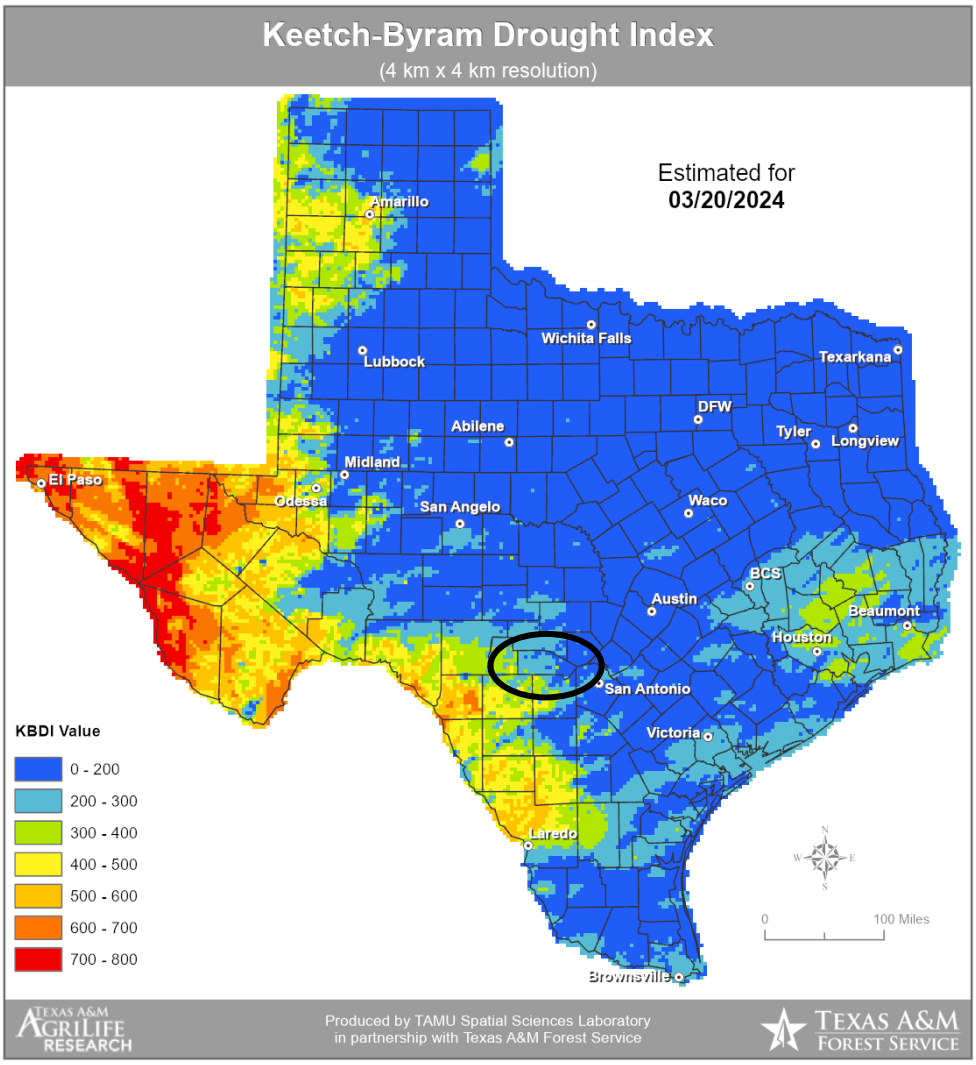
Table 13-2, Bandera County Planning Area KBDI Values, 3/20/24

	KBDI Mean	KBDI Maximum	KDBI Minimum
Bandera	219	350	131

Source: https://twc.tamu.edu/kbdi

The average KBDI values for the planning area is approximately 219 at this time and is the average extent to be mitigated (Table 13-2). Based on figure 13-1 below, the Bandera County planning area exhibits values in the 0-300 range throughout its entirety as of the time of this report. At these levels, often associated with more severe drought, fire intensity and occurrence increases significantly and fires readily burn in all directions. The KBDI is a good measure of the readiness of fuels to ignite in the event of a wildfire. Drought or extreme weather conditions have the ability to greatly influence the KDBI in a short period of time so current KBDI should always be monitored to more accurately assess risk. The figure and data below are provided by the Texas Weather Service at Texas A&M Department of Ecosystem Science and Management and the following website can be regularly checked for updated information.

Figure 13-1, KBDI for the State of Texas on 3/20/2024



https://twc.tamu.edu/kbdi

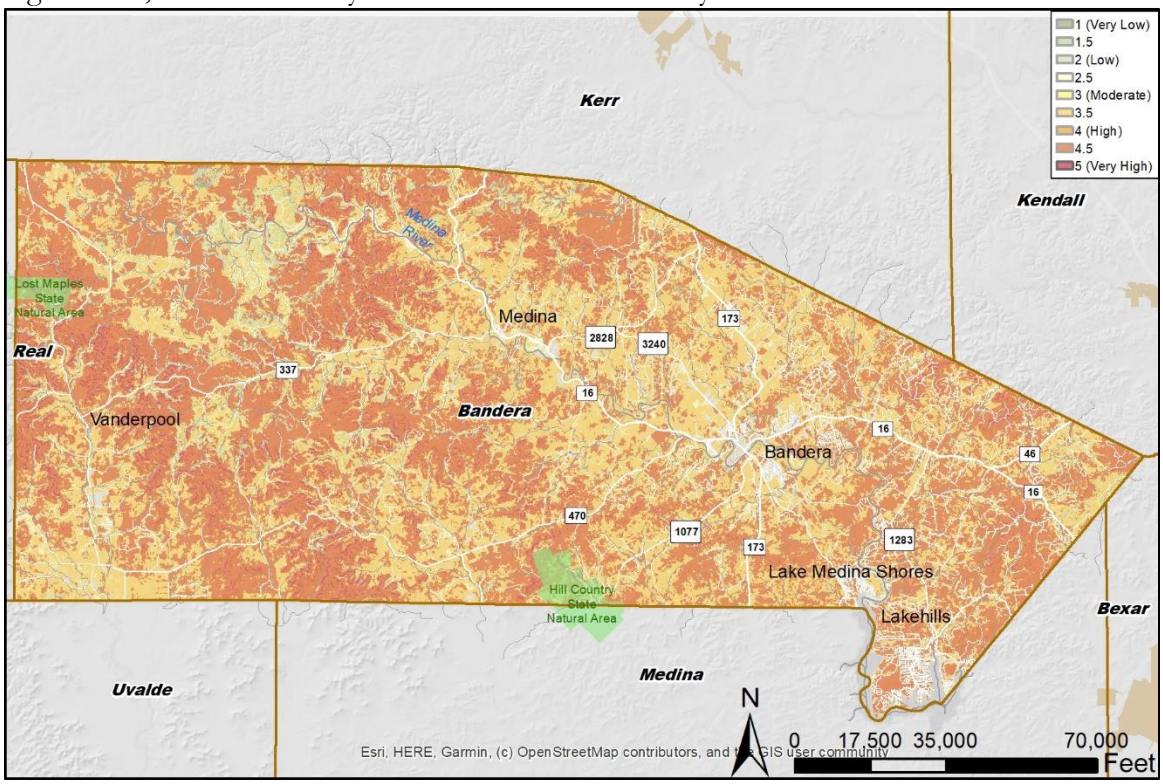
The Texas Wildfire Risk Assessment Portal (TXWRAP) is the primary mechanism for the Texas A&M Forest Service to deploy risk information and create awareness about wildfire issues across the state. www.TexasWildfireRisk.com The tool uses the Fire Intensity Scale (FIS) layer to determine the potential fire intensity for the specified location. FIS quantifies potential fire intensity based on high to extreme weather conditions, fuels, and topography. It is similar to the Richter scale for earthquakes, providing a standard scale to measure potential wildfire intensity by magnitude. FIS consist of 5 classes where the order of magnitude between classes is ten-fold. The minimum class, Class 1, represents very low wildfire intensities and the maximum class, Class 5, represents very high wildfire intensities.

Class 1 (Very Low)	Class 2 (Low)	Class 3 (Moderate)	Class 4 (High)	Class 5 (Very High)

- **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 two 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 dozer 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. 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.

The Fire Intensity Scale evaluates the potential fire behavior for an area, regardless if any fires have occurred there in the past. This additional information allows local officials and mitigation planners to quickly identify areas where dangerous fire behavior potential exists in relationship to nearby homes or other valued assets. **The wildfire risk for the Bandera County planning area is high to very high based on the characteristic wildfire intensity scale.**

Figure 13-2, Bandera County Characteristic Fire Intensity Scale



Source: https://wrap.texaswildfirerisk.com

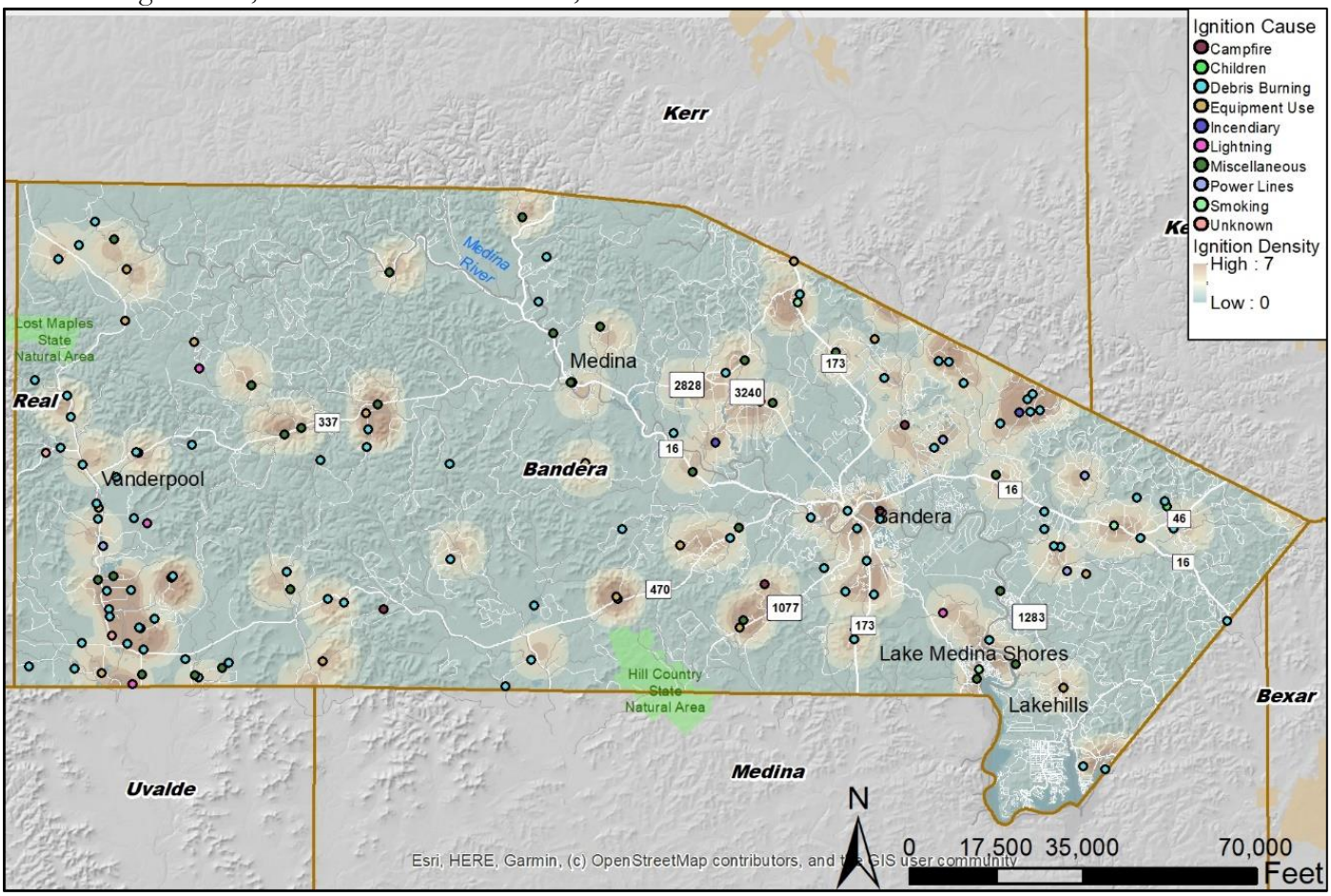
Historical Occurrences

The NCEI storm events database carries limited information on wildfire occurrence information with damage estimates of impacts, injuries, or fatalities in the planning area from 1997-2023. There have not been any wildfire events recorded in the NCEI storm events database for Bandera County since 1997.

Significant Events

The Texas Forest Service (TFS), started collecting wildfire data in 1985 and volunteer fire departments started reporting events in 2005. This data does not have estimated impact information, but it does provide a snapshot of historical wildfire occurrence to estimate a future frequency of events. The Texas Forest Service reported 168 wildfire events in the Bandera County planning area between 2005 and 2021. Due to a lack of recorded data for wildfire events prior to 2005, frequency calculations are based on the sixteen-year period from 2005 to 2021. The map below shows approximate locations of wildfires in Bandera County and the cause of ignitions.

Figure 13-4, Historical Wildfire Events, 2005 – 2021



Source: https://wrap.texaswildfirerisk.com

Table 13-3 below lists the ignition causes for all wildfires in the planning area between 2005-2021, the number of times of each unique ignition cause, and the percent of total ignitions.

Table 13-3, Wildfire ignition causes from 2005-2021

Ignition Cause	Count	% of Total
Campfire	5	3%
Children	1	1%
Debris burning	89	53%
Equipment use	18	11%
Incendiary	3	2%
Lightning	4	2%
Miscellaneous	39	23%
Power Lines	4	2 %
Smoking	3	2%
Unknown	2	1%
Grand Total	168	100%

Source: Texas Wildfire Risk Assessment Portal (TxWRAP)

Probability of Future Events

Based on reported historical occurrences of wildfire, 168 wildfire events occurred in an 16-year reporting period for Bandera County. This data establishes an approximate probability of occurrence of 15 events per year. This frequency supports a **highly likely** probability of future events, meaning a wildfire event is highly probable within the next year. The risk of future wildfires with greater impact to people and property will increase if existing development patterns continue into the wildlands.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

Populations and structures that are most susceptible to wildfire risk are located in the wildland urban interface and/or intermix (WUI). WUI fires occur in areas where the built environment, structures and other improvements, meet undeveloped wildland or vegetative fuels. Natural vegetation provides the fuel for wildfires in natural uninhabited areas, while WUI fires consume both vegetation and materials from the built environment. Since the WUI for the City of Bandera contains nearly all the land area within the city limits, nearly all critical facilities are located within the Wildland Urban Interface. This is true for the unincorporated communities with the Bandera County planning area as well. Bandera FWSD #1 and Medina WSC will implement a mitigation action to electronically document and map assets in their service area.

The severity of impact from major wildfire events can be substantial. Such events have caused deaths and injuries, damaged or destroyed property and critical facilities, and disrupted infrastructure and services. Severity of impact is gauged by homes and structures lost, acreage burned, and the number of resulting injuries and fatalities. The vulnerability of the jurisdictions in the planning area to wildfire events is increased where critical facilities are in the WUI as they are more likely to sustain damage from the hazard event.

Figure 13-6: Wildland Urban Interface, City of Bandera

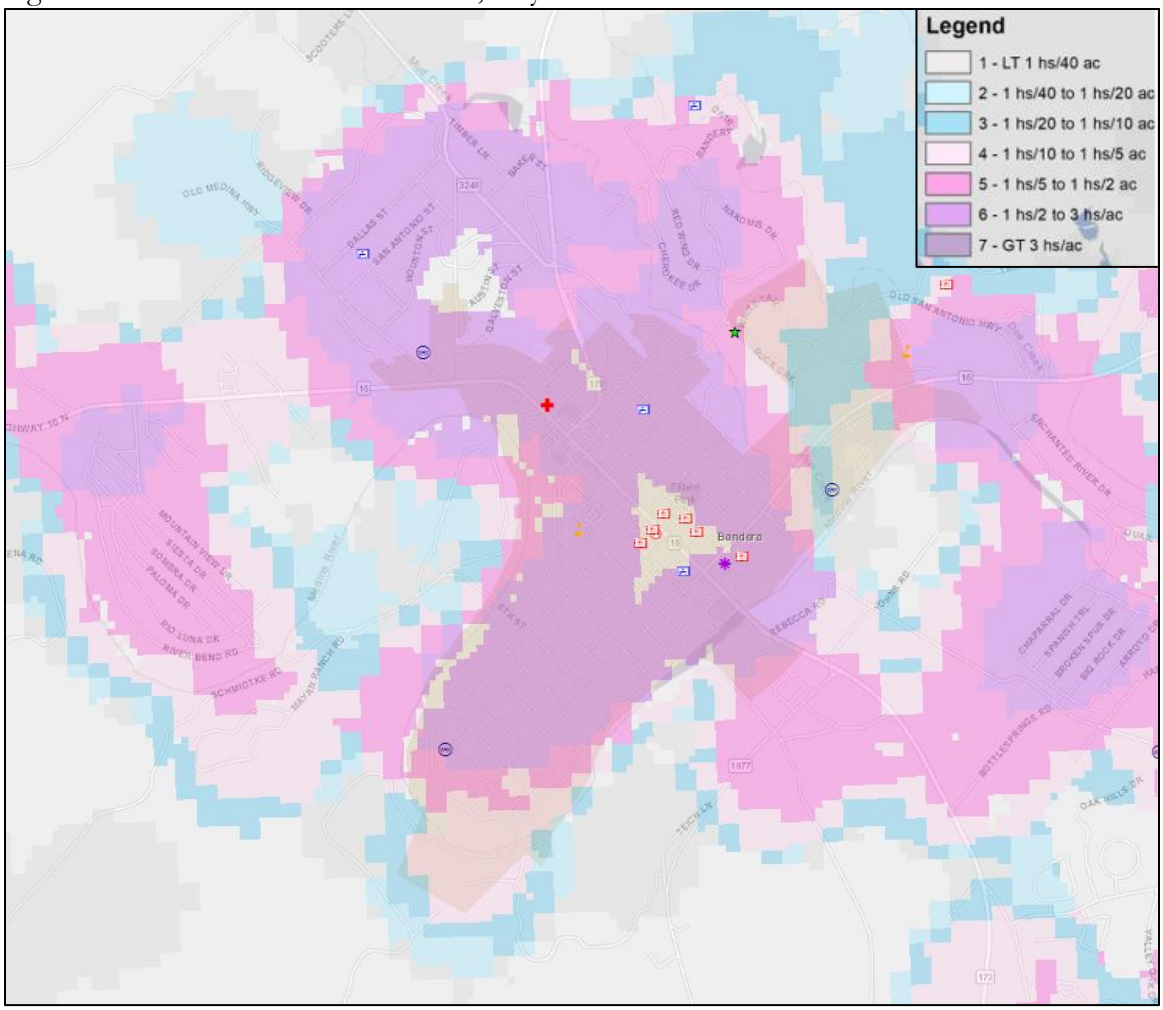


Figure 13-7: Wildland Urban Interface, Community of Medina

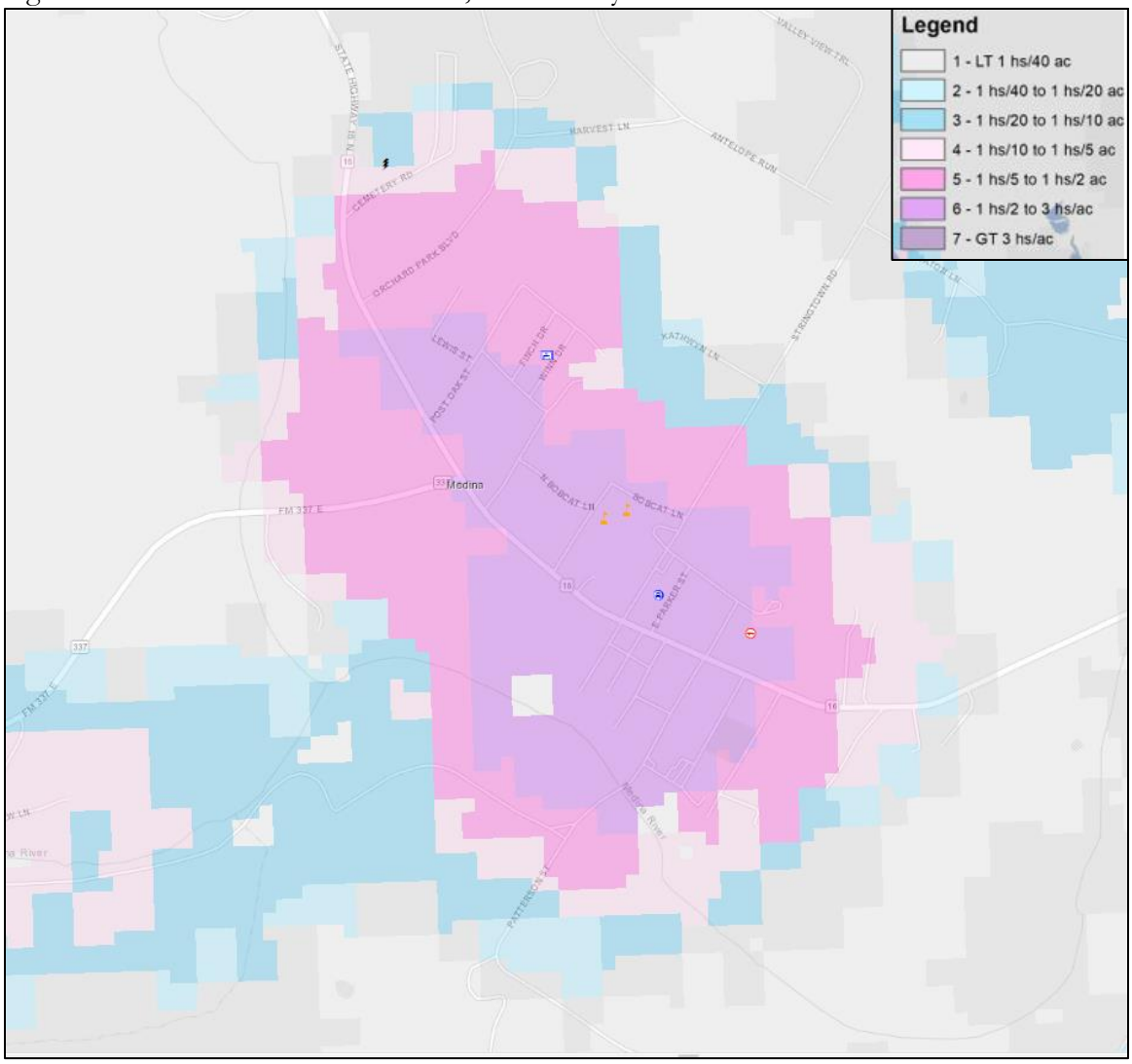


Figure 13-8: Wildland Urban Interface, Community of Lakehills

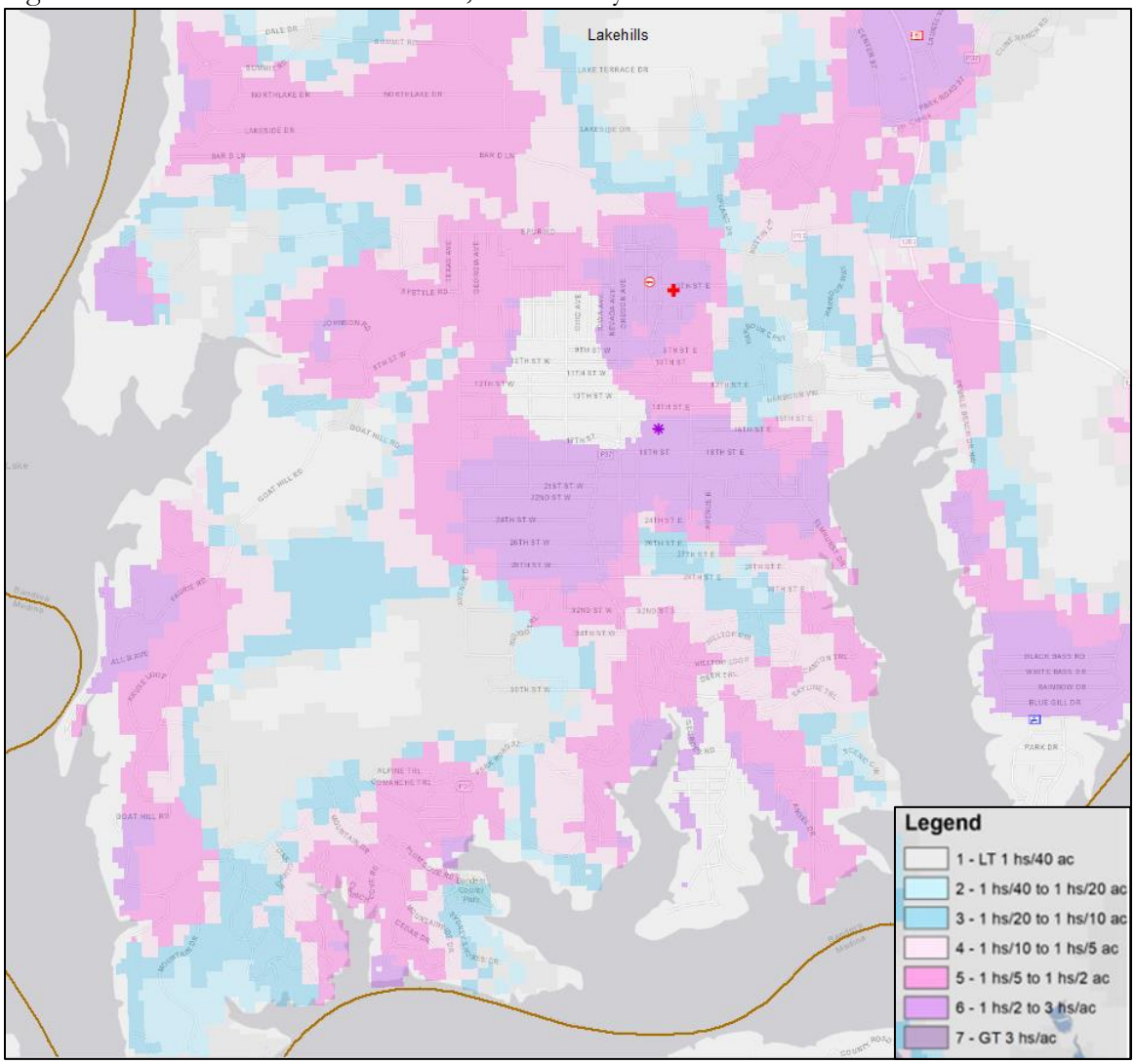


Figure 13-8: Wildland Urban Interface, Community of Lake Medina Shores

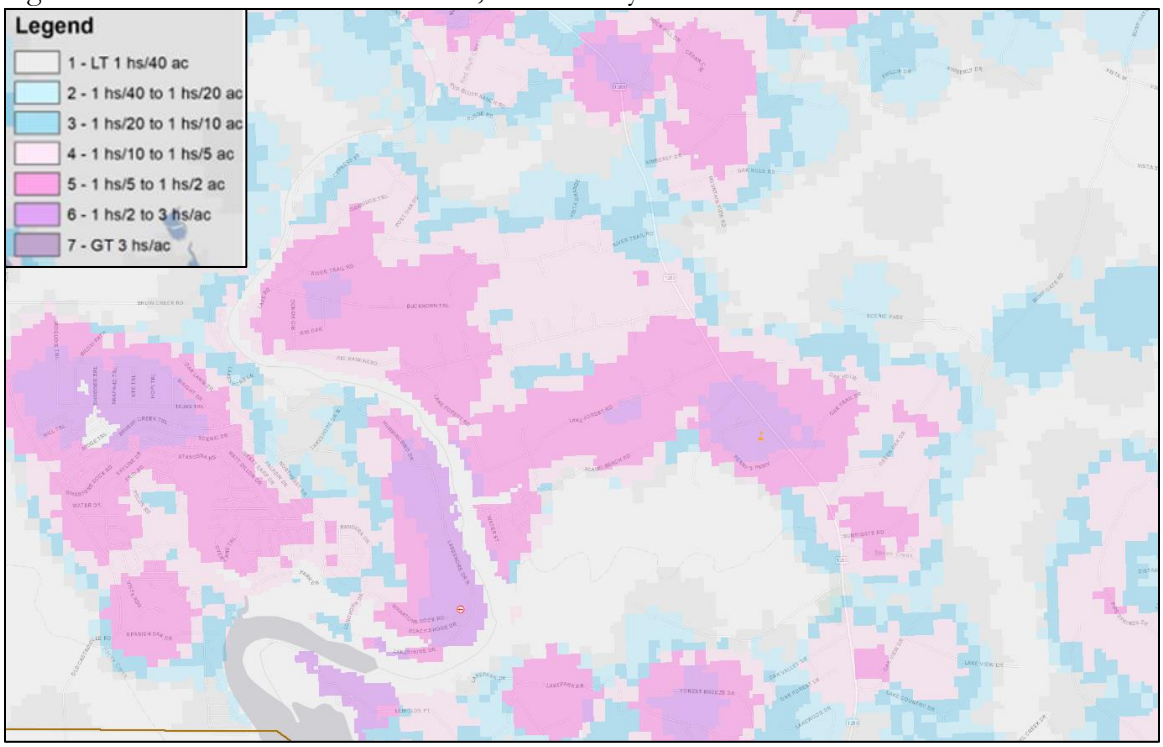


Figure 13-8: Wildland Urban Interface, Community of Pipecreek

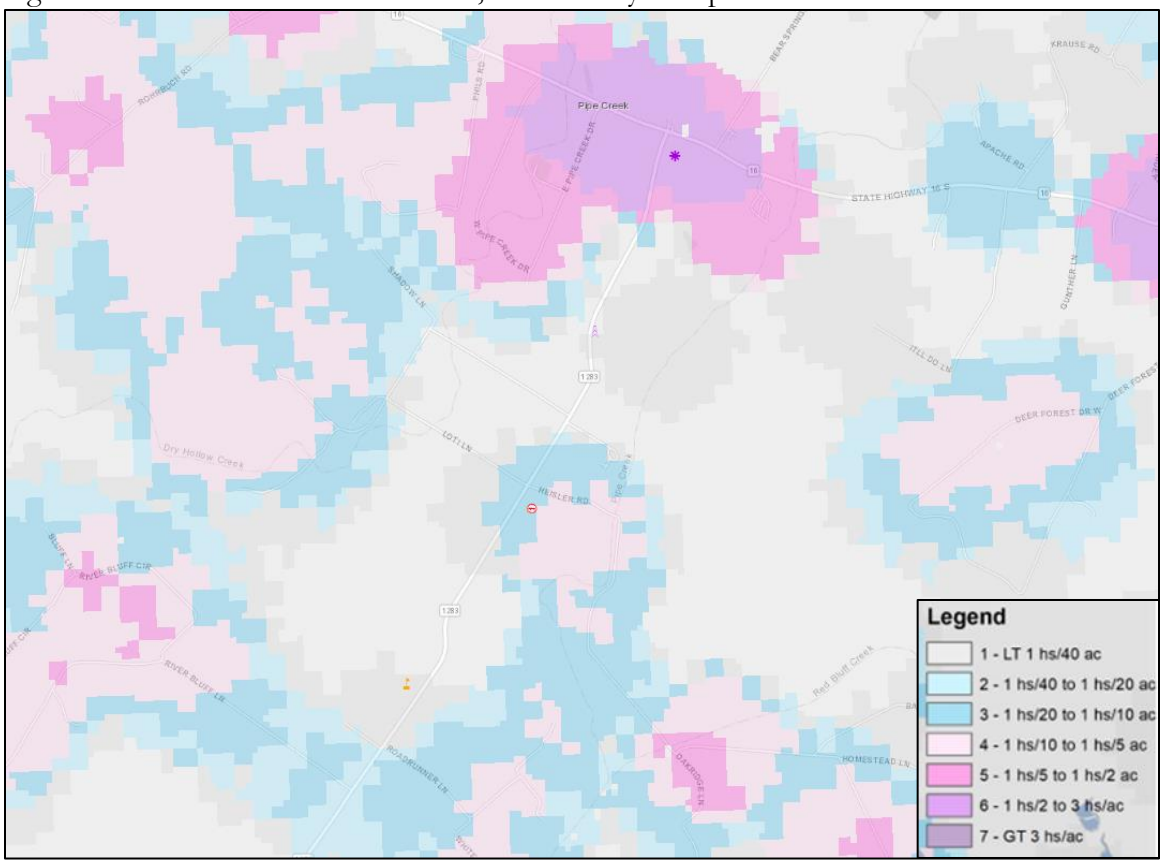
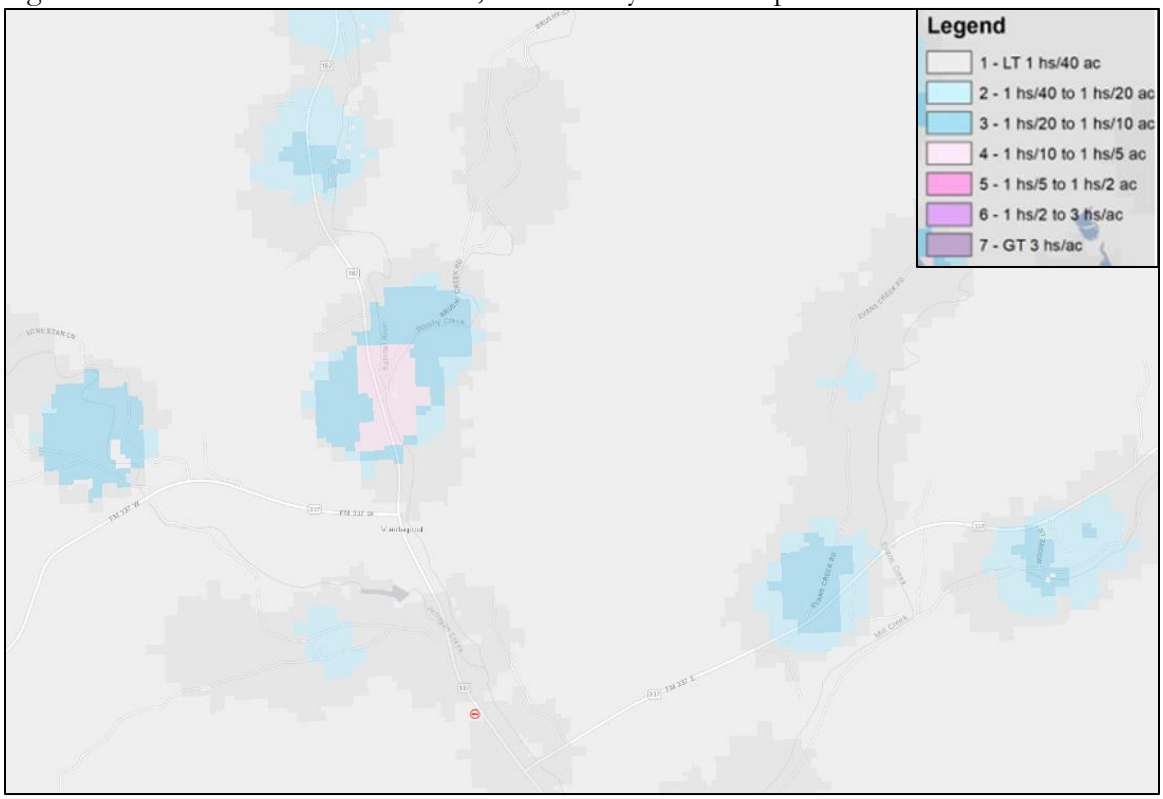
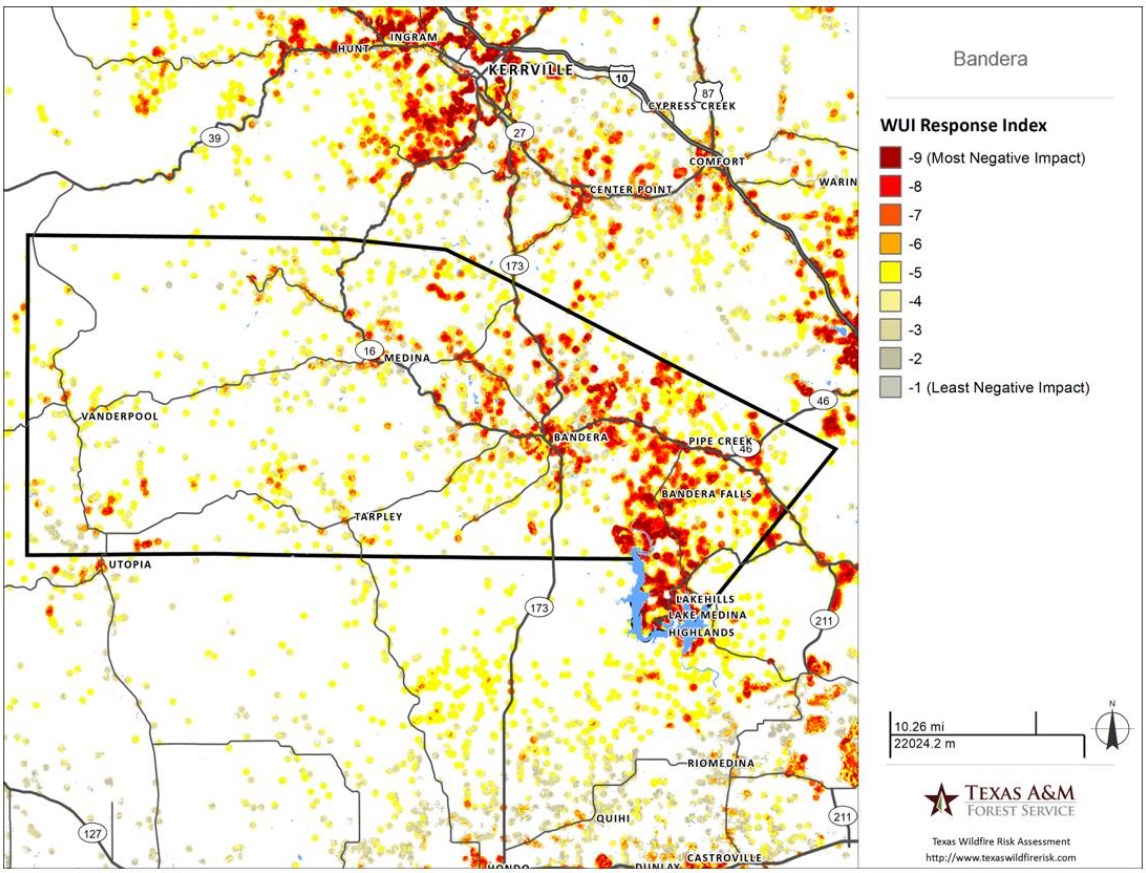


Figure 13-8: Wildland Urban Interface, Community of Vanderpool



The Wildland Urban Interface (WUI) Response Index layer 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. The location of people living in the Wildland Urban Interface and rural areas is key information for defining potential wildfire impacts to people and homes. Figure 13-8 on the following page shows Bandera County and the threat of wildfire across the planning area based on this response function modeling approach. The most negative impacts can be seen affecting the fringe of the more populated areas within the county such as the City of Bandera as well as the communities of Lakehills, Medina and Pipecreek.

Figure 13-8: Wildland Urban Interface (WUI) Response



Source: https://wrap.texaswildfirerisk.com

The impacts from a wildfire to the Bandera County planning area would be severe based on the overall high to very high-risk rating. Includes would be air quality degradation due to the wildfire producing large amounts of smoke and other pollutants. This situation can cause health problems for residents, especially those with respiratory issues. If the wildfire is severe enough, or close enough to populated areas, it can result in the need for evacuations. Evacuating can be a traumatic experience for many people, especially if they must leave their homes and possessions behind, including pets. Wildfires often harm or destroy homes, businesses, and other buildings, leading to significant property damage. They can cause power outages, which can disrupt normal life and can cause economic impacts, especially to places that depend on tourism or agriculture. The loss of power and disruption to normal life can result in financial losses for businesses and individuals.

To reduce these vulnerabilities and impacts, cities can take steps to prepare for wildfires, such as creating evacuation plans, conducting regular fire drills, implementing building codes and other regulations to reduce fire risk, and working with fire departments to improve fire suppression and response capabilities.

SECTION 14: SEVERE WINTER STORMS

Description

A severe winter storm event is when temperatures hover below freezing and precipitation includes freezing ice, snow, and sleet. Strong winds often accompany severe winter storms and combines with freezing precipitation to produce a low wind chill. Severe winter storms may include snowstorms, blizzards, cold waves and ice storms. Snowstorms include four or more inches of snow in a 12-hour period. Blizzards are characterized by low temperatures and strong winds in excess of 35 mph with large amounts of drifting snow. A cold wave is a winter cold front with a drastic drop in temperature. An ice storm occurs when rain falls out of the warm and moist upper layers of the atmosphere into a cold and dry layer near the ground. The rain freezes on contact with the cold ground and accumulates on exposed surfaces. If a half inch of rain freezes on trees and utility wires, damage can occur, especially if accompanied by high winds. Half an inch is used as the criteria before an icing event is categorized as an "ice storm." Winter storm events are generally mild and short-lived in the South-Central Texas region. Figure 14-1 below lists the types of severe winter storms that can impact the planning area and a description of the winter weather conditions that accompany the severe weather alert issued by the National Weather Service (NWS).

Table 14-1: Extent Scale – Winter Weather Alerts

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

Location

Severe winter storm events are not confined to specific geographic boundaries and vary in intensity and duration. All existing and future buildings, facilities, and populations in the Bandera County planning area are considered to be uniformly exposed to a winter storm hazard and could potentially be impacted.

Extent

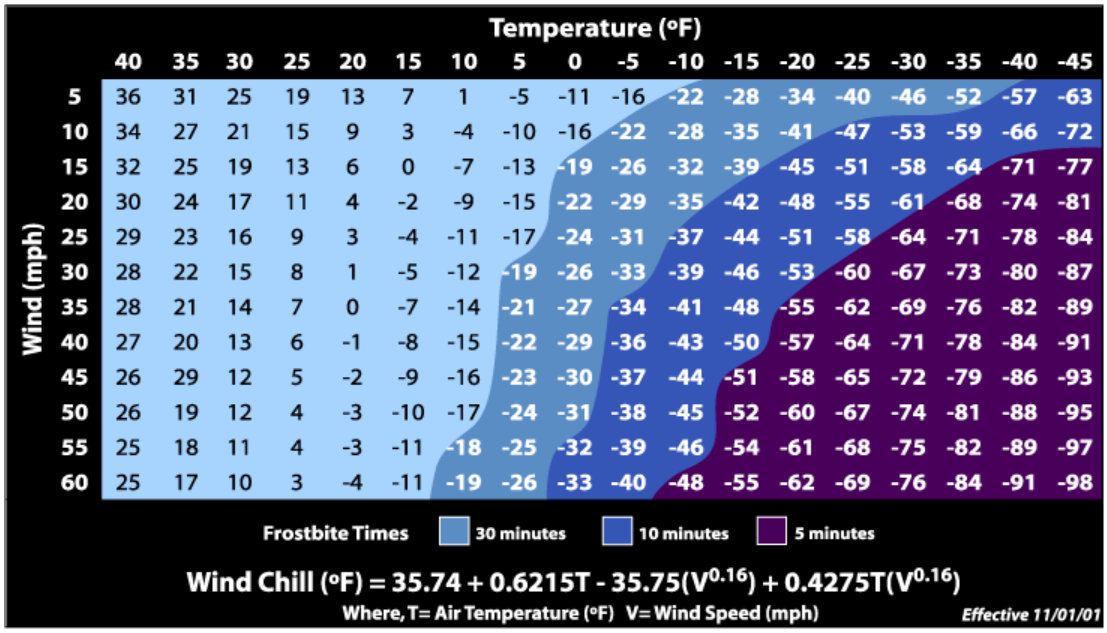
The extent or magnitude of a severe winter storm is measured by on an intensity scale from "Mild" to "Severe" based on temperature ranges and snow accumulation levels. Table 14-1, Magnitude of Severe Winter Storms, is an index developed by the National Weather Service (NWS). This table should be referenced with the wind chill factor, Figure 14-2, to better determine the intensity of a winter storm. Based on past events, the planning area can expect to experience severe winter storms with extreme intensity in the future.

Table 14-2: Magnitude of Severe Winter Storms

Intensity	Temperature Range (Fahrenheit)	Extent Description
Mild	40˚-50˚	Winds less than 10 mph and freezing rain or light snow falling for short durations with little or no accumulations
Moderate	30˚-40˚	Winds 10 – 15 mph and sleet and/or snow up to 4 inches
Significant	25˚-30˚	Intense snow showers accompanied with strong gusty winds, between 15 and 20 mph with significant accumulation
Extreme	20˚-25˚	Wind driven snow that reduces visibility, heavy winds (between 20 to 30 mph), and sleet or ice up to 5 millimeters in diameter
Severe	Below 20˚	Winds of 35 mph or more and snow and sleet greater than 4 inches

Wind chill temperature is a measure of how cold the wind makes real air temperature feel to the human body. Since wind can dramatically accelerate heat loss from the body, a 30° day would feel just as cold as a calm day with 0° temperatures. Figure 14-2 is a chart for calculating wind chill using the wind speed and air temperature. Please note that it is not applicable in calm winds or when the temperature is over 50°F.

Figure 14-1: Wind Chill Chart



Source: National Weather Service

Historical Occurrences

Based on NCEI data, from 1997 through 2023 the Bandera County planning area experienced 23 severe winter events in the form of winter storms, winter weather, extreme cold and heavy snow. No injuries or fatalities were reported for the following severe winter events.

Table 14-3: Historical Occurrences of Severe Winter Weather Events in Bandera County, 1997-2023

Location	Date	Deaths	Injuries	Property Damage	Crop Damage
Countywide	1/7/97	0	0	$0	$0
Countywide	1/11/97	0	0	$0	$0
Countywide	12/12/00	0	0	$0	$0
Countywide	11/28/01	0	0	$0	$0
Countywide	2/24/03	0	0	$0	$0
Countywide	1/15/07	0	0	$0	$0
Countywide	2/3/11	0	0	$0	$0
Countywide	11/26/13	0	0	$0	$0
Countywide	2/7/14	0	0	$0	$0
Countywide	12/31/14	0	0	$0	$0
Countywide	1/9/15	0	0	$0	$0
Countywide	1/23/15	0	0	$0	$0
Countywide	12/7/17	0	0	$0	$0
Countywide	1/16/18	0	0	$0	$0
Countywide	11/11/19	0	0	$0	$0
Countywide	2/5/20	0	0	$0	$0

Countywide	2/13/21	0	0	$0	$0
Countywide	2/14/21	0	0	$0	$0
Countywide	2/16/21	0	0	$0	$0
Countywide	2/3/22	0	0	$0	$0
Countywide	12/22/22	0	0	$0	$0
Countywide	1/30/23	0	0	$0	$0
Countywide	2/1/23	0	0	$0	$0

Significant Events

February 13, 2021 – Bandera County

A series of weather systems brought several rounds of winter weather to South Central Texas from February 11 through February 18. The first episode of winter weather started when a cold front moved through South Central Texas on February 10 and stalled over South Texas. This brought cold air to the region and once it was in place, a combination of isentropic flow over the frontal boundary and an upper-level shortwave trough produced sufficient lift to produce precipitation. With warm air above the boundary layer and sub-freezing air near the surface, the precipitation fell as freezing rain.

Probability of Future Events

According to historical records the Bandera County planning area experiences approximately one winter storm event every 2-3 years. The probability of a future winter storm event occurring in the planning area is **likely**, with a winter storm likely to occur within the next three years.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

All infrastructure, critical facilities, populations, and buildings in the Bandera County planning area are vulnerable to severe winter events. Winter weather such as ice hazards and extremely cold temperatures, as well as snow present a risk to the planning area.

Populations of people and animals are subject to direct health risks from extended exposure to cold air and precipitation. Animals, such as pets and livestock, typically cannot survive the effects of direct exposure to severe winter weather and should be provided shelter. In addition, House fires can occur more frequently during winter storm events due to increased and improper use of alternative heating sources which can cause injury or deaths. Moreover, house fires during winter storms present a greater danger because some areas may not be easily accessible due to icy roads and water supplies may freeze and impede firefighting efforts. The people most at risk to the effects of severe winter storms are children younger than 5 and older adults over 65. Vulnerable populations are at greater risk of death from hypothermia during these events, especially in the rural areas of the county where populations are sparse, icy roads may impede travel, and there are fewer neighbors to check in on the elderly.

The planning area has a total population of 21,182 according to the 2022 ACS population estimate. Those over the age of 65 represent 27.9% (5,919) of the total population and children under the age of 5 represent 3.5% (732) of the total population. The total population of the county that is estimated to be below the poverty level is 14.3% (2,968). Table 7-4 presents the 2022 American Community Survey population and age cohort estimates below.

Table 7-4: Populations at Greater Risk by Jurisdiction

Jurisdiction	Population 65 and Older	Population Under 5	Population Below Poverty Level
Bandera County	5,919/27.9%	732/ 3.5%	2,968/14.3%
City of Bandera	565	29/5.1%	83/16.3%
Bandera ISD			
Bandera FWSD #1			
Medina WSC			
Medina ISD			
Flying L PUD			
Utopia ISD			

Source: 2022 American Community Survey (Note: County totals include both incorporated and unincorporated areas)

Public and private infrastructure is also vulnerable to severe winter storms. These events can disrupt electric service for long periods of time. In addition, extended periods of freezing temperatures can cause water pipes to freeze and crack. The buildup of ice can cause power lines and tree limbs to break under the weight, potentially causing damage to property or the electric grid. During these times of ice and snow accumulation, response times will increase until public works road crews are able to clear roads of ice, snow, and other obstructions.

Historic Severe Winter Storm Impacts

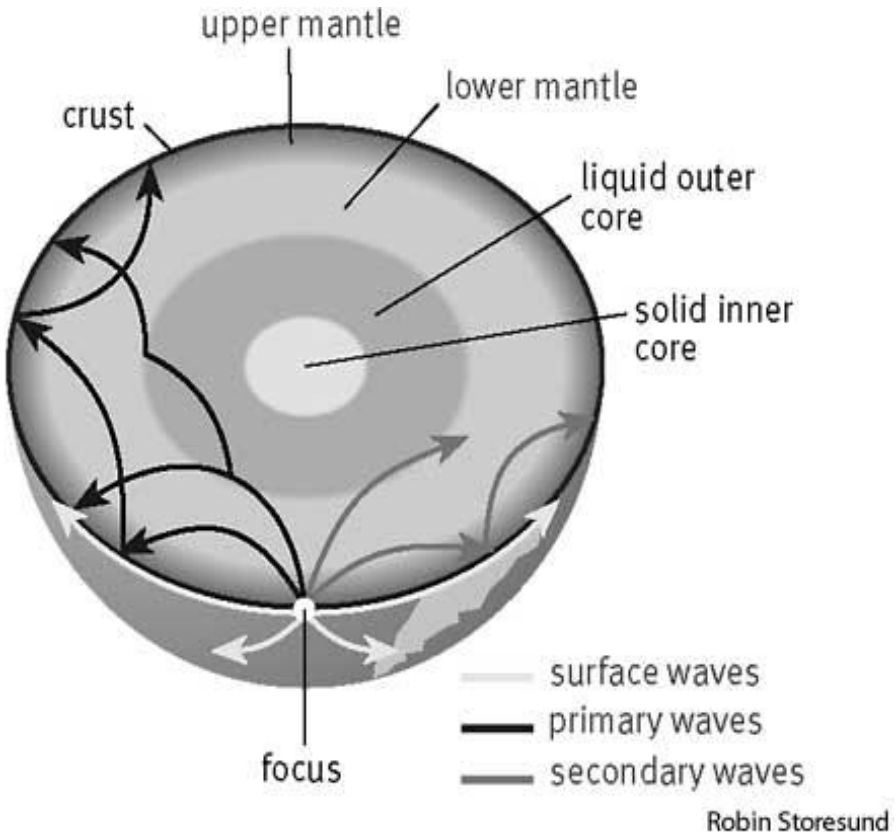
Based on historical records of no annual property or crop losses due to severe winter storms, risk and impacts and are considered to be low.

SECTION 15: EARTHQUAKES

Description

An earthquake is the shaking of the surface of the Earth resulting from the sudden release of energy created by a movement along fault lines in the earth's crust. Earthquakes can range in size from those that are so weak that they cannot be felt to those violent enough to throw people and destroy whole cities. Most earthquake-related property damage and deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage that results from an earthquake depends on the extent and duration of the shaking. Earthquakes produce three type of energy waves as described in Figure 15-1 below.

Figure 15-1: Energy Waves Caused by Earthquakes



Source: *"earthquake". The American Heritage® Science Dictionary. Houghton Mifflin Company. 20 Oct. 2017. <http://www.dictionary.com/browse/earthquake>.*

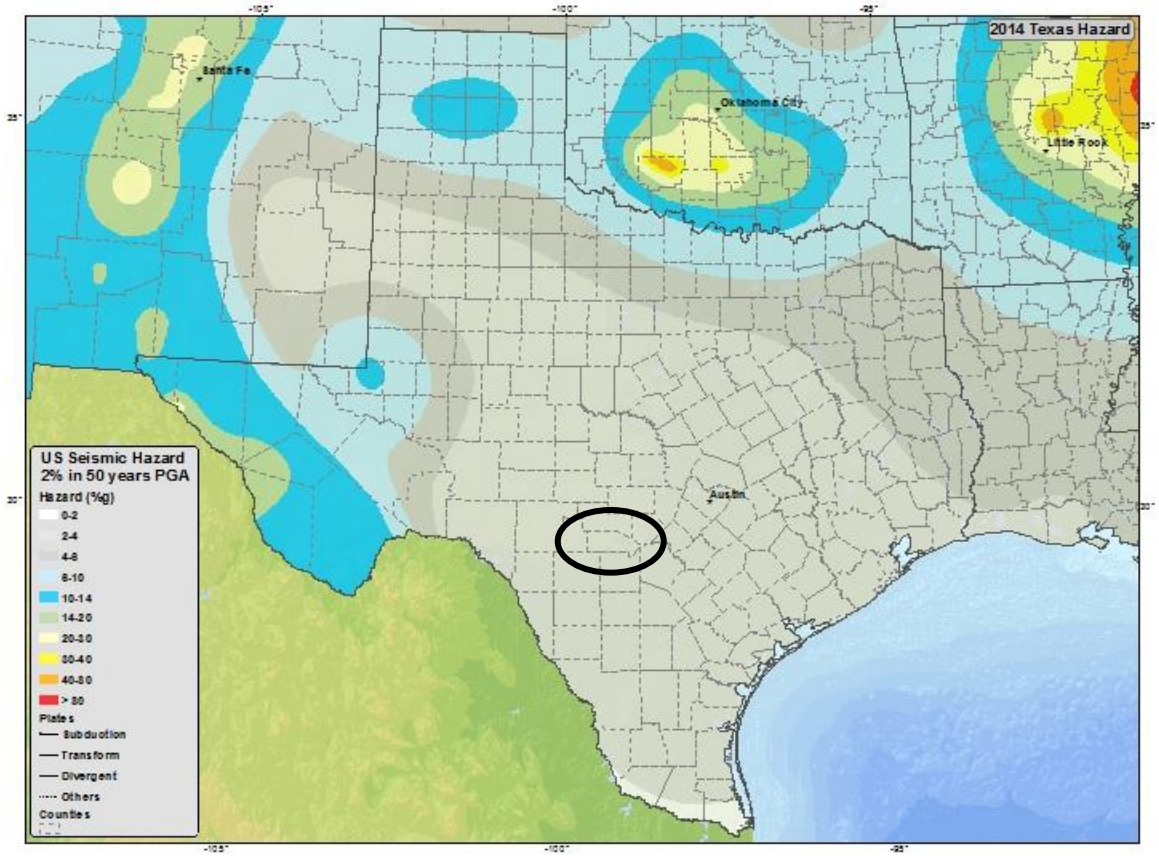
Primary (P) waves have a push-pull type of vibration. Secondary (S) waves have a side-to-side type of vibration. Both P and S waves travel deep into Earth, reflecting off the surfaces of its various layers. S waves cannot travel through the liquid outer core. Surface (L) waves—named after the nineteenth-century British mathematician A.E.H. Love—travel along Earth's surface, causing most of the damage of an earthquake.

Location

Locations in West Texas and the Panhandle experience the highest frequency of earthquakes in the state. Figure 15-2 below shows locations of earthquake hazard with 2% variations in the

probability for Peak Ground Acceleration of various intensities over 50 years in Texas. The map illustrates the generally low risk of earthquakes in Texas with most of the state having less than a 4-8% probability of having a very weak ground shaking event over 50 years. The planning area encompassed by Bandera County shares the same probability of 4-8% likelihood of an earthquake over 50 years. Core Planning Team Members have indicated that this frequency is consistent with what they have experienced.

Figure 15-2. USGS Seismic Hazard Risk Map



Source: https://www.usgs.gov/programs/earthquake-hazards

Extent

The magnitude or extent of an earthquake is measured on the Richter Scale. An earthquake's magnitude is determined by the amount of ground motion measured on a seismograph. This measurement is then corrected to compensate for the distance from the epicenter. The scale is a logarithmic or a 'power of ten' scale. For example, if a magnitude 4.8 earthquake caused ground motion of 1 inch at a particular location, a 5.8 would cause ground motion of 10 inches at the same epicenter. Earthquakes above 7 on the Richter scale are considered severe. Table 15-1 provides examples of the effects of earthquakes at different magnitudes. Based on historical evidence, a 4.1 magnitude earthquake is the highest that can be expected in the planning area.

Table 15-1: Earthquake magnitude and corresponding effects

Magnitude	Earthquake Effects
Less than 2.5	Usually not felt, but can be recorded by seismograph
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake. Serious damage
Greater than 8.0	Great earthquake. Can totally destroy communities near the epicenter

Most of the damage done by an earthquake typically occurs in the areas nearest the epicenter which have the highest intensities. Each earthquake occurrence only has one magnitude rating but different locations experience difference surface intensities since damage will usually become less severe as one moves away from the epicenter.

The Modified Mercalli Intensity (MMI) scale is used by scientists to describe the extent of an earthquake felt in different locations. The MMI uses Roman numerals to avoid confusion with the Richter Scale and is numbered between 1-12. Table 15-2 below provides descriptions of the MMI levels.

Table 15-2: Modified Mercalli Intensity (MMI) scale

MMI	What people feel, or what damage occurs.
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on the upper floors of buildings. Suspended objects may swing.
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors, by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many people are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction.
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse. Underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.

XII	Virtually total destruction. Waves are seen on the ground surface. Objects are thrown into the air.

Source: USGS - https://pubs.usgs.gov/gip/earthq4/severitygip.html

Historical Occurrences

Based on United States Geographical Services (USGS) Earthquake Catalog of events, from 1923 through 2023 the Bandera County planning area did not experience any earthquakes. This is consistent with accounts by Core Planning Team Members that earthquakes have not occurred in the past.

Table 15-3 below provides details for each earthquake in or around the planning area with date, locational, and specific magnitude information. There have been no seismic events of sufficient size recorded in the planning area, however, there was one event to the south in Comal County which was recorded in 1982.

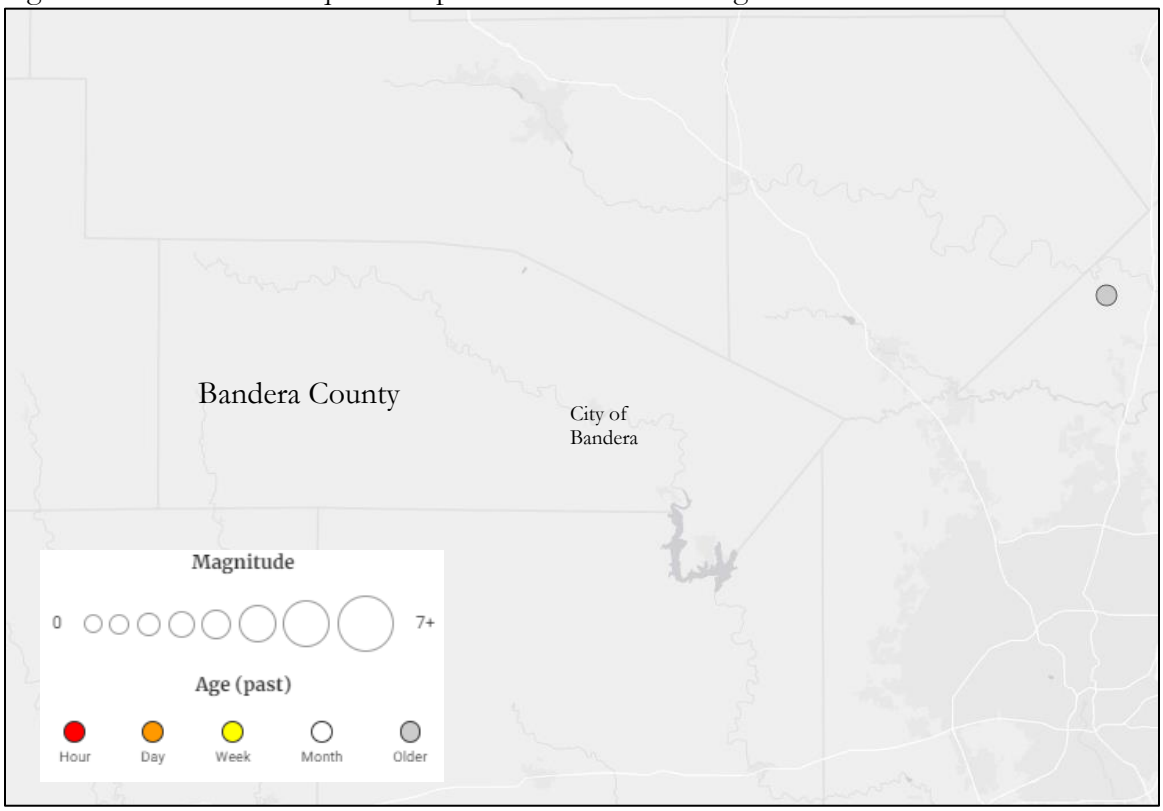
Table 15-3: Historical Occurrences of Earthquakes in and around the Bandera County planning area

Date	Location	Magnitude
3/28/1982	11 kilometers north of Bulverde (Comal Co)	3.0

Source: https://earthquake.usgs.gov/earthquakes

The USGS earthquake map, Figure 15-4, shows the location and magnitude of the earthquakes that have occurred in and around the Bandera County planning area.

Figure 15-4: USGS Earthquake Map with Location and Magnitude



Source: https://earthquake.usgs.gov/earthquakes

Significant Events

March 28, 1982 – Comal County

At 6:00 AM on March 28, 1982, a magnitude 3.0 earthquake had its epicenter 11 kilometers North of Bulverde and a depth of 5 kilometers.

Probability of Future Events

Based on the USGS estimates in the seismic hazard risk map provided at the beginning of this section, the planning area has a 4-8% chance of experiencing an earthquake over the next 50 years. Over the 100-year period of USGS data there have been no occurrences of earthquakes in the Bandera County planning area. Based on most recent data, the probability of an earthquake occurring somewhere in the planning area in the next year is **unlikely**.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

Historical earthquake impacts for the area are 0 for number of deaths, injuries, property damage, and crop damage. This does not mean that there haven't been any impacts due to earthquakes in the planning area, only that there have not been any impacts recorded. All structures, assets, and populations within Bandera County, including participating jurisdictions and Water, are vulnerable to the impacts of earthquakes. The recent history of rapidly increasing earthquake activity in the area appears to overlay exactly with the distribution and proliferation of wastewater injection wells associated with oil and gas drilling.

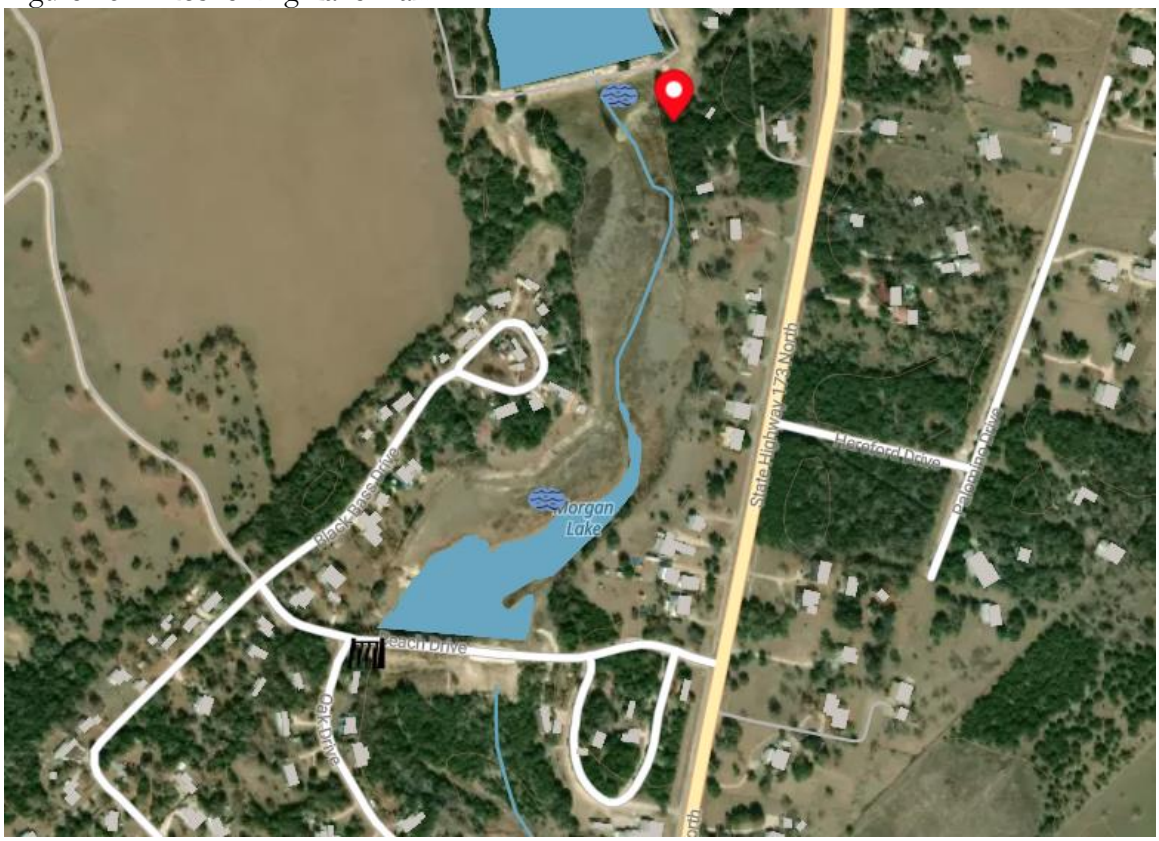
Aside from buildings, roads, and bridges, underground assets like utilities can also be severely affected by earthquakes, depending on their magnitude and epicenter. Subterranean utilities that can be impacted by earthquakes include underground sanitary sewer collection systems, which may rupture or backup, drinking water distribution pipes that can become contaminated if pressure gaps occur, allowing untreated groundwater to enter, and gas and underground power lines that can also be damaged, generating hazardous conditions.

SECTION 16: DAMS

Description

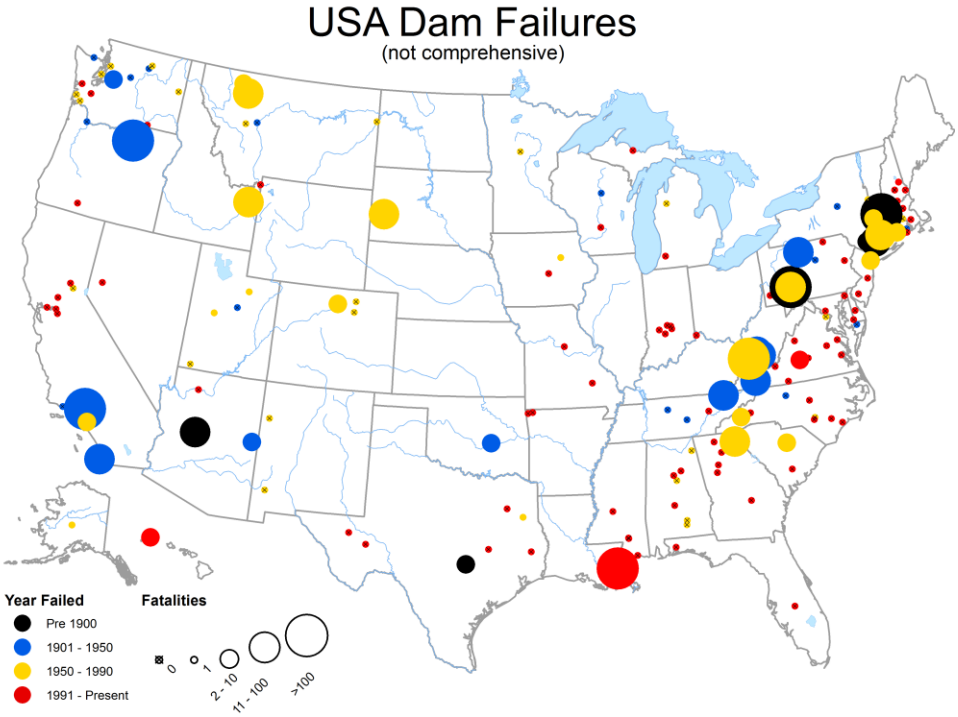
Dams are water storage, control, or diversion structures that impound water upstream in reservoirs. Benefits provided by dams include water supplies for drinking, irrigation, and industrial uses. Dams also provide flood control, hydroelectric power, recreation, and navigation. At the same time, dams also represent a risk to public safety. Dams require ongoing maintenance, monitoring, safety inspections, and sometimes even rehabilitation to continue safe service.

Figure 16-1 Mosher Big Lake Dam



Dam failure can take several forms, including a collapse of or breach in the structure. Hundreds of dam failures have occurred throughout U.S. history. These failures have caused immense property and environmental damages and have taken thousands of lives. As the nation's dams age and population increases, the potential for deadly dam failures grows. No one knows precisely how many dam failures have occurred in the U.S., but they have been documented in every state. From January 2005 through June 2013, state dam safety programs reported 173 dam failures and 587 "incidents" - episodes that, without intervention, would likely have resulted in dam failure. The graphic below depicts the history of dam failures throughout the United States.

Figure 16-2: USA Dam Failures



Source: damsafety.org/dam-failures

In the event of a dam failure, the energy of the water stored behind the dam is capable of causing rapid and unexpected flooding downstream, resulting in loss of life and substantial property damage. A devastating effect on water supply and power generation could be expected as well. The causes of dam failures are many but they are most likely to happen for one of five reasons.

1. **Overtopping** caused by water spilling over the top of a dam. Overtopping of a dam is often a precursor of dam failure. National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for approximately 34% of all U.S. dam failures. Overtopping can happen after periods of prolonged rainfall and flooding for which the dam was not designed or failure of upstream dams in the same drainage basin.
2. **Foundation Defects**, including settlement and slope instability, cause about 30% of all dam failures.
3. **Cracking** caused by movements like the natural settling of a dam.
4. **Inadequate maintenance and upkeep.**
5. **Piping** is when seepage through a dam is not properly filtered and soil particles continue to progress and form sink holes in the dam. [See an animation of a piping failure.] Another 20% of U.S. dam failures have been caused by piping (internal erosion caused by seepage). Seepage often occurs around hydraulic structures, such as pipes and spillways; through animal burrows; around roots of woody vegetation; and through cracks in dams, dam appurtenances, and dam foundations.

Location

Figures 16-3 and 16-4, provide a summary and illustrate general locations for each dam in the planning area. Currently, there are seven dams located in the Bandera County planning area:

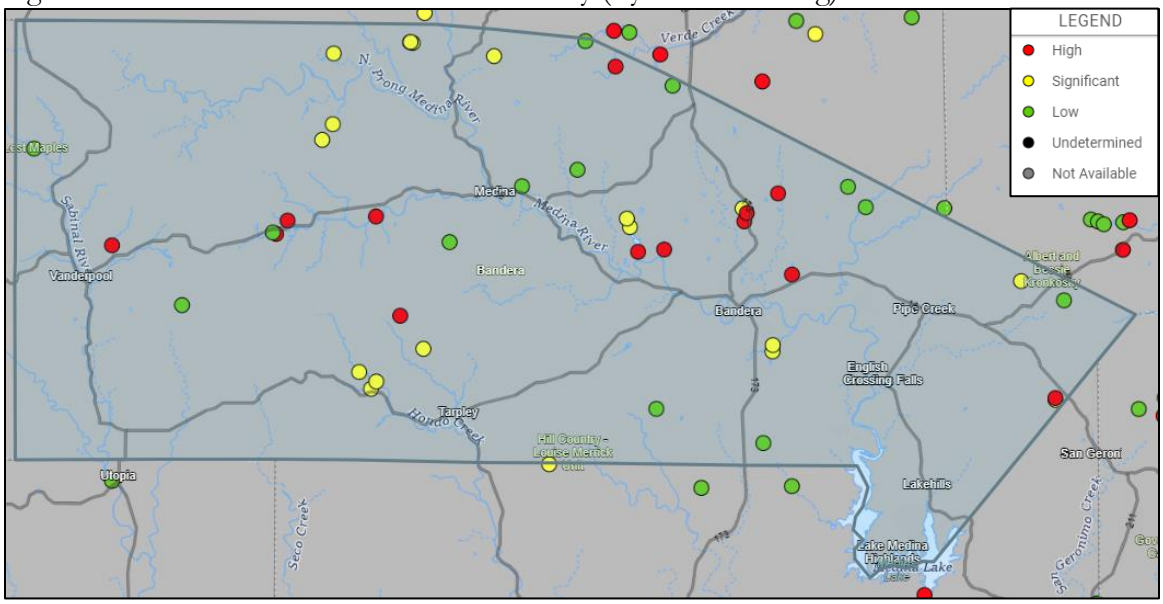
two are classified as "high-hazard", zero as "significant-hazard", five as "low-hazard" dams, zero as "undetermined," and zero as "not available."

Figure 16-3: Dam Summary for Bandera County, Texas

44 Total Dams	**63 years** Average Dam Age	**77%** High Hazard Potential Dams with an EAP	**0%** Federally Regulated Dams
		0% Dams with Hydropower	**32%** State-Regulated Dams

Source: https://nid.sec.usace.army.mil

Figure 16-4: Dam Locations in Bandera County (By Hazard Rating)



Source: https://nid.sec.usace.army.mil, NID

The survey of dams within the Bandera County planning area is presented in Table 16-1 below. The survey provides the dam's name, the year built, height of dam, normal storage in acre feet of the impoundment, max storage, and the hazard potential.

Table 16-1: Bandera County Dam Survey

Dam Name	Year Completed	Height (Ft.)	Normal Storage (Acre Ft.)	Max Storage (Acre Ft.)	Hazard Potential
Mosher Big Lake Dam	1942	26	259	342	High
Twin Lakes Dam No 1	1948	21	5	121	High
Mosher Little Lake Dam	1942	17.3	59	220	Significant
Lost Maples State Park Dam No 2		28	14	30	Low
Shadow Dance Ranch Dam	1978	35	153	377	High
Armstrong Lake Dam	1964	26	95	220	High

Rock Cliff Dam	1956	50.7	1743	2508	High
H and K Lake Dam	1964	35	106	140	High
Robert L Parker Dam	1977	36	277	518	High
Love Creek Dam		32	35	65	High
Pelaez Lake Dam	1956	27	66	150	High
Walton Lake Dam	1940	49.6	189.1	627	High
Montague Lake Dam	1947	41	500	900	High
Garrison Ranch Lake Dam	1957	38	162	680	High
Purple Sage Ranch Lake Dam	1947	22	167	342	High
Johnson Lake Dam	1961	37.8	81.7	159	Significant
Duke Dam	1967	28	71	111	Low
Mcclennahan Lake No 1 Dam	1964	27	103	230	Significant
Boazman Lake Dam	1958	23	50	110	Low
Schoenfeld Dam	1982	21	90	180	Low
Voss Lake Dam	1962	37	226	340	Significant
Berry Lake Dam	1964	30	115	200	Low
Mcclennahan Lake No 2 Dam	1964	35	73	150	Significant
Old Langford Lake Dam	1944	34	54	136	Low
Walters Lake Dam	1955	18	41	85	Low
Kelso Dam		27	32	100	Low
Rio Hondo Lake 1 Dam	1969	18	28	28	Significant
Dawson Ranch Dam No 4		15	5.6	6.7	Significant
Gallant Lake Dam	1964	24	108	240	Low
Thompson Lake Dam	1964	25	67	263	Significant
Middle Verde Ranch Lake Dam	1956	24	58	90	Low
Madrona Ranch Lake Dam	1968	30	20	140	Significant

Gutierrez Ranch Dam	2003	34	73	133	Significant
Hadfield Lake Dam	1950	10	28	60	Low
Dawson Ranch Dam No1		21	5.8	6.6	Significant
Brewington Creek Ranch Dam	1964	37.2	190	243	Significant
Ikins Lake Dam No 1	1938	24	197	420	Significant
Silver Spring Dam		12	6	7.5	Significant
Alkek Lake No 1 Dam	1960	36	274	423	Significant
Falls Lake Dam	1964	32	48	77	Low
Youngblood Lake Dam	1964	27	91	225	Low
Alkek Lake No 2 Dam	1940	27	63	192	Significant
Ikins Lake Dam No 2	1980	27	115	248	Significant
Dawson Ranch Dam No 2		16	3.2	3.8	Significant

Source: https://nid.sec.usace.army.mil, NID

All census blocks within five miles of a dam with a maximum storage capacity of 100,000 acre-feet or more are considered at risk of potential dam failure hazards. For dams with a maximum storage capacity between 10,000- and 100,000-acre feet, all census blocks within three miles are considered to be at risk to potential dam failure hazards. For dams with a maximum storage capacity of less than 10,000 acre-feet, all census blocks within one mile are considered to be at risk from potential dam failure hazards.

With residential and commercial developments located downstream of the dams, all populations are considered to be at if/when a dam failure occurs. The number of census blocks at risk as they relate to dam size is to be used only as a rough guide. Inundation maps based on hydraulic and hydrologic modeling can be used to provide precise risk from dam failure. The owners of high hazard dams in Bandera County are in possession of this sensitive data for dams in the planning area.

Extent

The extent or magnitude of a dam failure event is described in terms of the classification of damages that could result from a dam's failure; not the probability of failure. The National Interagency Committee on Dam Safety defines high hazard dams as those where failure or mis-operation would cause loss of human life. Low hazard potential dams are those at which failure or mis-operation probably would not result in loss of human life but would cause limited economic and/or environmental losses. Losses would be limited mainly to the owner's property. Classifications for dam failure extent are found in Table 16-2 below.

Table 16-2: Extent Classifications

Hazard Potential Classification	Loss of Human Life	Dam Storage Capacity
Low	None Expected	Less than 10,000 acre-feet
Significant	Probable (1 to 6)	Between 10,000 and 100,000 acre-feet

High	Loss of Life Expected (7 or More)	100,000 acre-feet or more

Table 16-3 represents the extent or magnitude of a dam failure event that could be expected for the Bandera County planning area as well as participating jurisdictions. The 'Extent Classification' column was determined by assessing max volume storage capacity, elevation, history of failure, classification information, condition, and potential severity based on population downstream.

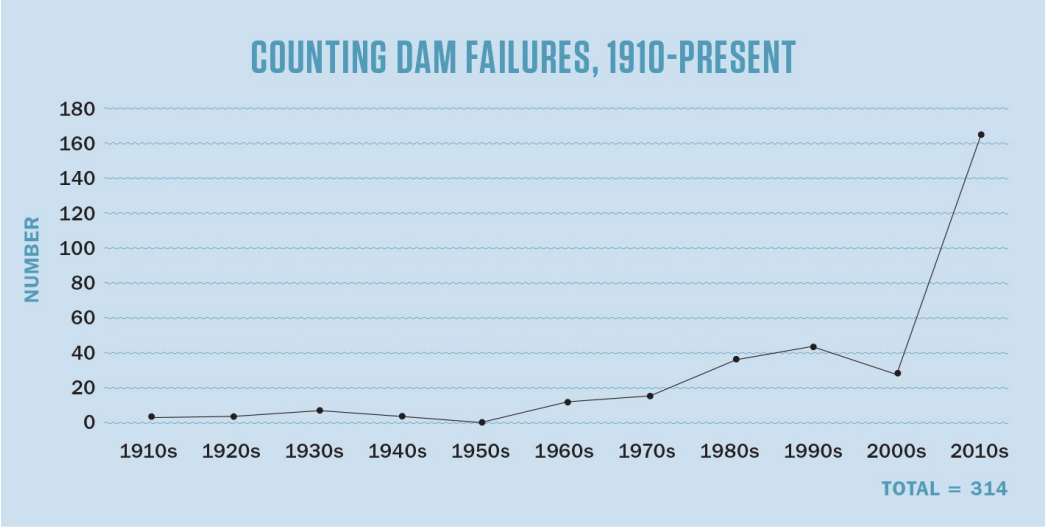
Table 16-3: Extent for Bandera County and Participating Jurisdictions

Jurisdiction	Dams and Classification	Extent Classification	Level of Intensity to Mitigate
Bandera County	9 - High 14 – Significant 13 - Low	High	Dam failure presents a high threat for Bandera County as 9 Dams represent a large impoundment upstream of developed areas. Loss of life is expected and economic loss is significant in the event of a catastrophic dam failure. These are Mosher Big Lake Dam, Shadow Dance Ranch Dam, Armstrong Lake Dam, Robert L Parker Dam, Love Creek Dam, Pelaez Lake Dam, Walton Lake Dam, Garrison Ranch Lake Dam, and Purple Sage Ranch Lake Dam.
City of Bandera	4 – High 4 - Significant	High	Dam failure presents a high threat for Bandera as 4 Dams represent a large impoundment just upstream of developed areas. Loss of life is expected and economic loss is significant in the event of a catastrophic dam failure. These are Town Lakes Dam No 1, Rock Cliff Dam, H and K Lake Dam, and Montague Lake Dam.

Historical Occurrences

Texas dams earn a "D" grade from the American Society of Civil Engineers. Of the approximately 300 dam failures in Texas since 1910, half have occurred in the last nine years.

Figure 16-5: Texas Dam Failures, 1910-Present



Source: Texas Observer

Many of the dams in the planning area are classified as small dams and their failure has the capacity to cause physical and economic harm. A federal study found that from 1960-1998 dam failures accounted for 300 fatalities that occurred nationally and more than 85 percent were caused by dams less than 50 feet in height. In Texas, almost half of all dams are considered too small to regulate, and they are exempt from inspections and oversight.

Based on an investigation by the Texas Observer,

> "This investigation found that the vast majority of failures in Texas involve dams that impound less than 1,000 acre-feet. Despite their size, many small dams are ticking time bombs, according to safety experts. Big dams are usually owned by government agencies such as river authorities, which have money for upgrades and are regulated by TCEQ. Small dams are typically owned by individuals, homeowners' associations and cash-strapped counties that can't afford expensive improvements." [11]

Significant Events

There have been no significant dam failure events in the Bandera County planning area.

Table 16-4: Dam Inspections, Condition Assessments, and EAP Revisions

Dam Name	Last Inspection Date	Conditions Assessment	Condition Assessment Date	EAP Prepared	Date of Last EAP Revision
Mosher Big Lake Dam	3/24/21	Unsatisfactory	5/23/2022	No	
Twin Lakes Dam No 1	1/30/19	Fair	6/3/2019	Yes	9/29/17
Mosher Little Lake Dam	7/1/10	Not Rated	7/1/2015	Not Required	
Lost Maples State Park Dam No 2	8/17/77	Not Rated	6/18/2014	Not Required	
Shadow Dance Ranch Dam	1/30/19	Fair	2/9/2016	Yes	9/7/12
Armstrong Lake Dam	1/30/19	Fair	2/29/2016	Yes	5/22/13
Rock Cliff Dam	1/30/19	Fair	2/16/2016	Yes	5/11/16
H and K Lake Dam		Not Rated	6/18/2014	No	
Robert L Parker Dam	1/31/19	Fair	2/26/2016	Yes	10/15/09
Love Creek Dam	3/24/21	Fair	10/14/2021	Yes	10/26/12
Pelaez Lake Dam	3/24/21	Fair	5/28/2021	Yes	3/21/12
Walton Lake Dam	1/31/19	Fair	5/31/2019	No	
Montague Lake Dam	2/21/19	Fair	2/29/2016	Yes	8/29/16
Garrison Ranch Lake Dam	2/21/19	Fair	2/9/2016	Yes	9/1/16

[11] Sadasivam, Naveena. *Dammed to Fail.* The Texas Observer. **April, 1 2019.**

Purple Sage Ranch Lake Dam	1/31/19	Fair	12/29/2015	Yes	1/22/21
Johnson Lake Dam	6/30/10	Not Rated	6/30/2015	Not Required	
Duke Dam		Not Rated	6/18/2014	Not Required	
Mcclennahan Lake No 1 Dam	4/13/09	Not Rated	6/18/2014	Yes	2/18/11
Boazman Lake Dam		Not Rated	6/18/2014	Not Required	
Schoenfeld Dam	3/11/82	Not Rated	6/18/2014	Not Required	
Voss Lake Dam	4/13/09	Not Rated	6/18/2014	Yes	6/3/10
Berry Lake Dam		Not Rated	6/18/2014	Not Required	
Mcclennahan Lake No 2 Dam	4/13/09	Not Rated	6/18/2014	Yes	2/18/11
Old Langford Lake Dam		Not Rated	6/18/2014	Not Required	
Walters Lake Dam		Not Rated	6/18/2014	Not Required	
Kelso Dam	8/22/83	Not Rated	6/18/2014	Not Required	
Rio Hondo Lake 1 Dam	10/30/12	Not Rated	10/30/2017	Not Required	
Dawson Ranch Dam No 4	8/18/09	Not Rated	8/18/2014	Yes	5/5/10
Gallant Lake Dam		Not Rated	6/18/2014	Not Required	
Thompson Lake Dam	6/30/10	Not Rated	6/18/2014	Yes	1/18/11
Middle Verde Ranch Lake Dam		Not Rated	6/18/2014	Not Required	
Madrona Ranch Lake Dam	8/24/09	Not Rated	8/24/2014	Not Required	
Gutierrez Ranch Dam	11/24/15	Not Rated	11/24/2020	Not Required	
Hadfield Lake Dam		Not Rated	6/18/2014	Not Required	
Dawson Ranch Dam No1	8/18/09	Not Rated	8/18/2014	Yes	5/5/10
Brewington Creek Ranch Dam	8/5/15	Not Rated	8/5/2020	Not Required	
Ikins Lake Dam No 1	3/4/09	Not Rated	6/18/2014	Not Required	
Silver Spring Dam	8/24/09	Not Rated	8/24/2014	Not Required	
Alkek Lake No 1 Dam	3/22/11	Not Rated	3/22/2016	Yes	6/3/11

Falls Lake Dam		Not Rated	6/18/2014	Not Required	
Youngblood Lake Dam		Not Rated	6/18/2014	Not Required	
Alkek Lake No 2 Dam	3/22/11	Not Rated	3/22/2016	Yes	6/3/11
Ikins Lake Dam No 2	3/4/09	Not Rated	6/18/2014	Not Required	
Dawson Ranch Dam No 2	8/18/09	Not Rated	8/18/2014	Yes	5/5/10

Probability of Future Events

According to historical records, from 1997-2023, the Bandera County planning area has experienced 0 dam failures. The probability of a dam failure event occurring in the planning area is **unlikely**, with a dam failure event possible in the next 10 years.

Frequency of Occurrence	
Highly likely:	Event probable in next year.
Likely:	Event probable in next 3 years.
Occasional:	Event possible in next 5 years.
Unlikely:	Event possible in next 10 years.

Vulnerability and Impact

All areas that are directly downstream of one of the 44 dams in the planning area are vulnerable to a breach. The impact of dam failure to the majority of the Bandera County planning area is **"Low,"** however, areas just downstream of significant or high hazard dams receive an impact rating of **"High"** due to their location. The extent of the impact is dependent on the severity of the dam failure, the size of the storage area, dam height, rain/flood conditions, and a host of other factors. 13 of the dams in the planning area are considered low hazard dams based on their size, but as discussed in this section, low hazard dam failures have caused extensive loss of life and significant economic impact in the past. There are 18 dams rated as a significant hazard and 13 dams rated as a high hazard. If a dam failure is extensive, a large amount of water would enter the downstream waterways forcing them out of their banks. There may be significant environmental effects, resulting in flooding that could disperse debris and hazardous materials downstream that can damage local ecosystems. If the event is severe, debris carried downstream can block traffic flow, cause power outages, disrupt local utilities, such as water and wastewater, and could result in school closures.

Mosher Big Lake dam is the dam of highest concern in the planning area due it high hazard potential coupled with an unsatisfactory conditions assessment last performed on May 23, 2022. A failure could have a high impact on the downstream community of Bandera, its infrastructure, riverine systems, and even downstream dams. Areas directly downstream and within the City of Bandera and the unincorporated areas of the county would be need to be immediately evacuated in the event of Mosher Big Lake Dam's failure or if failure were imminent. Annualized loss-estimates for dam failure are not available nor is there a breakdown of potential dollar losses for critical facilities, infrastructure and lifelines, or hazardous materials facilities. For the dams that are regulated, the State of Texas assigns a rating based on the condition of the dam during the last inspection.

Any individual dam has a very specific area that will be impacted by a catastrophic failure. The 44 dams identified can directly threaten the lives of people and animals in the inundation zone below the dam. The impact from any catastrophic failure would be like that of a flash flood with loss of life possible and injuries from debris carried by the flood. As the size of the dam increases and the proximity to the public and/or critical infrastructure increases, the probability of damage to the economy increases as well. For these reasons, creating mitigation actions to remove or protect people and structures from the path of destruction is necessary in order to minimize impact from dam failure.

The following is an excerpt from the American Society of Civil Engineers' 2017 Infrastructure Report Card detailing the importance of public safety and proper maintenance:

> "In order to improve public safety and resilience, the risk and consequences of dam failure must be lowered. Progress requires better planning for mitigating the effects of failures; increased regulatory oversight of the safety of dams; improving coordination and communication across governing agencies; and the development of tools, training, and technology. Dam failures not only risk public safety, they also can cost our economy millions of dollars in damages. Failure is not just limited to damage to the dam itself. It can result in the impairment of many other infrastructure systems, such as roads, bridges, and water systems. When a dam fails, resources must be devoted to the prevention and treatment of public health risks as well as the resulting structural consequences."

Dam safety inspections fall to the Dam Safety Program managed by the Texas Commission on Environmental Quality (TCEQ). The Commission currently focuses its inspection program of existing dams primarily on high and significant hazard dams as required by rule in 30 TAC §299.42(a)(2). According to the rule, high and significant hazard dams and large, low hazard dams are scheduled to be inspected every five years, while small and intermediate dams, and low hazard dams, are only to be inspected at the request of an owner, as a result of a complaint, at the request of someone other than the owner, following an emergency such as a flooding event, or, for determining the hazard classification.

SECTION 17: MITIGATION STRATEGY

The overall mitigation strategy is to reduce and eliminate the long-term risk of loss of life and property damage from the full range of disasters affecting the planning area. The success of this strategy is dependent on three main components: mitigation goals, mitigation actions, and an action plan for implementation. These building blocks provide the framework to identify, prioritize, and implement actions to reduce risk to hazards. The goals describe long term outcomes the communities want to achieve. Objectives are broad but more measurable and connect goals with the actual mitigation actions. The actions are specific actions that the local government will take to reduce risk to hazards, and the action plan describes how the action items will be prioritized and implemented. Each jurisdiction involved in this multi-jurisdictional plan update had the opportunity to prioritize and implement action plans based on their priorities and vulnerabilities.

Because the State Hazard Mitigation Plan provides the State's overall strategy for reducing risk and allocating resources, the team chose to align the plan's goals to the State plan's vision, objectives and plan goal to better integrate the two. An excerpt from the 2018 State of Texas Hazard Mitigation states that,

> The successful implementation of the Texas Hazard Mitigation Strategy requires a strong partnership between many partners at all levels of government, public, private-sector, and non-governmental organizations. Effective hazard mitigation begins with individual citizens who are ultimately responsible for making risk-informed decisions regarding their personal safety and the safety of their family and home. Local governments work to identify hazards and understand the vulnerabilities and risk associated with these hazards. This work by local governments informs the citizenry and local officials so that they may develop effective strategies and policies to reduce or eliminate the long-term risk these hazards present to their communities. The state must also work to identify hazards and understand the collective vulnerability and risk these hazards present to Texas communities in order to craft effective strategies, public policy, and programs that support local government in risk management. Ultimately, the state's success at implementing an effective hazard mitigation program that reduces the long-term risk for natural hazards in Texas depends on the success of local government, as this is where the impacts of hazards are most acutely experienced. Therefore, helping local governments achieve success with their mitigation strategies is the primary focus of the Texas Hazard Mitigation Program.[12]

The following objectives and plan goal from the Texas State Hazard Mitigation Plan were also considered.

Objectives

- Implement an effective comprehensive statewide hazard mitigation plan
- Support local and regional mitigation projects and priorities
- Increase public and private sector awareness to increase support for hazard mitigation in Texas
- Support mitigation initiatives and policies that protect the state's cultural, economic, and natural resources

Plan Goal

The objective of SHMP is to establish a framework for the state of Texas to administer an effective mitigation program to prevent catastrophic impact to people and property from natural hazards.

The Planning Team mitigation strategy also included a review of the goals and objectives from the 2016 Bandera County Hazard Mitigation Action Plan Update. This was an opportunity to evaluate the previous goals and reaffirm or change them based on current conditions and priorities in each community. Two Mitigation Workshops were held for the 2024 Bandera County Mitigation Action Plan Update. The first was held during the second Core Planning Team at the Bandera County Justice Center and the second was held virtually with each of the participating jurisdictional sub-teams. The goals and objectives from the 2016 Bandera County Hazard Mitigation Action Plan Update were reviewed and found to be still applicable for this plan update. The motion to adopt the following goals and objectives passed by unanimous consent at these workshops.

Mitigation Goals

Hazard mitigation goals and objectives for the Bandera County Hazard Mitigation Action Plan update are presented below.

[12] State of Texas Hazard Mitigation Plan 2018, Texas Division of Emergency Management (TDEM)

Goal #1: Increase regional emergency preparedness, response and recovery capability.

- Objective 1.1 - Ensure that emergency services organizations are prepared and have the capability to detect and promptly respond to emergency situations.

- Objective 1.2 - Maximize intergovernmental coordination on the effective use of emergency response resources during response, including vital communications between multiple agencies in emergency situations.

- Objective 1.3 – Ensure that infrastructure, equipment and support systems are maintained and/or upgraded to support emergency services response and recovery operations.

Goal #2: Build capacity for hazard mitigation at the county and municipal level through technical and financial assistance programs.

- Objective 2.1 - Promote partnerships between The County, the City of Bandera, and unincorporated communities to identify federal and state programs that provide financial assistance to help attract funds for mitigation projects and programs.

- Objective 2.2 - Promote partnerships between The County, the City of Bandera, and unincorporated communities to identify federal and state programs that provide technical assistance, such as training funds and training services for mitigation projects and programs.

- Objective 2.3 - Maximize the use of available hazard mitigation grant programs to protect vulnerable populations and structures in participating jurisdictions.

Goal #3: Reduce the impact of natural disasters on populations and private property.

- Objective 3.1 - Promote partnerships between The County, the City of Bandera, and unincorporated communities to encourage and facilitate coordination of planning and development initiatives, particularly on developments of regional impact.

- Objective 3.2 - Increase the county and municipal control over development, especially in high hazard areas.

- Objective 3.3 - Implement programs that seek to remove residential structures from high hazard areas.

- Objective 3.4 - Develop adequate and consistent development review boards to provide enforcement of ordinances and codes within and between jurisdictions to ensure that all new construction is completed using hazard resistant design techniques.

- Objective 3.5 - Implement natural resource protection projects that, in addition to minimizing hazard losses, also preserve, restore or otherwise benefit and/or properly manage the functions of natural systems.

- Objective 3.6 - Implement projects that involve the construction of structures designed to reduce the impact of a hazard, such as dams, levees, floodwalls, retaining walls, safe rooms, etc., or such structural modifications as the elevation or relocation of bridges, the anchoring of manufactured housing, or a retrofit of an existing building.

Goal #4: Identify, introduce, and implement programs designed to raise awareness of and acceptance of the principles of hazard mitigation.

- Objective 4.1 – Develop outreach programs focused on increasing public education to increase awareness of hazards and their associated risks.

- Objective 4.2 – Promote partnerships between The County, the City of Bandera, and unincorporated communities to continue to develop a regional approach to identifying and implementing mitigation actions.
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- Objective 4.3 – Promote partnerships between The County, the City of Bandera, and unincorporated communities to monitor and publicize the effectiveness of mitigation initiatives implemented in the community.

- Objective 4.4 – Develop outreach programs focused on increasing participation in mitigation programs by business, industry, institutions and community groups.

Goal #5: Reduce the potential impact of natural disasters on critical facilities and infrastructure.

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- Objective 5.1 – Reduce the vulnerability of critical facilities (schools, shelters, police, fire stations, and other institutions) that are important to the community.

- Objective 5.2 – Reduce the vulnerability of buildings and facilities used for routine government operations.

- Objective 5.3 – Reduce the vulnerability of public and private medical and health care facilities in the community.

- Objective 5.4 – Reduce the vulnerability of lifelines (transportation facilities and systems, water and sewer systems, telecommunication systems and facilities) serving the community.

- Objective 5.5 – Ensure that critical facilities and lifelines will be constructed and/or retrofitted to minimize the potential for disruption during a disaster.

- Objective 5.6 – Local governments will strive to involve the private sector, especially utility companies, in participating in hazard mitigation planning efforts.

Goal #6: Increase regional capabilities to mitigate the effects of natural hazards.

- Objective 6.1 - Enhance the local governments' capability to conduct hazard risk assessments, demonstrate funding needs, and track mitigation activities.

- Objective 6.2 - Enhance the local governments' ability to notify the public at risk and provide emergency instruction during a disaster.

- Objective 6.3 - Address data limitations needed for hazard identification and risk assessment (definition of hazards, identification of hazard areas, and vulnerabilities).

- Objective 6.4 - Promote natural hazard studies and the development of data to support mitigation strategies for those hazards that are a threat throughout the region.

SECTION 18: MITIGATION ACTIONS

The mitigation actions developed by Core Team, Jurisdictional sub-teams, and community stakeholders are presented in this section for Bandera County and all participating jurisdictions. Core Team members and Jurisdictional sub-team members met for two mitigation workshops in February 2024 and April 2024 to develop mitigation actions for each of the natural hazards described in the Plan; Sections 5-16.

This began with a review of mitigation actions from the prior 2017 AACOG Hazard Mitigation Plan to assess whether they had been completed and if not, whether they were still relevant. The Action items with a "N" in the New Action column are those that have been carried over from the previous plan. New actions were developed with unique insight from planning team members, community and regional plans, capital improvement plans, and mitigation ideas developed by FEMA and the Texas Department of Emergency Management (TDEM).

Based on local input, the following action items from the previous 2017 plan were completed and those that were not carried forward from that plan were discarded due to lack of continued relevance. The actions below were listed in the prior 2017 AACOG Hazard Mitigation Plan and are listed as completed or no longer applicable. On-going actions or those that have not been completed but that have been considered applicable to this current planning effort are listed in the tables in the following pages and included with any new actions adopted for this hazard mitigation planning effort.

Bandera County	
ACTION: Bandera 9, Establish, maintain and publicize a library section on hazard mitigation and awareness, for use by residents county-wide	
Action No Longer Applicable	Merged with Bandera 9, action items duplicated
City of Bandera	
ACTION: (All actions targeted to the City of Bandera specifically have been brought forward to the new plan.)	

The Core Planning Team then took the draft mitigation actions back to their respective departments to get feedback and develop them further with input from local staff and officials responsible for their implementation. The goals listed in Section 17 were used as guidance while considering such factors as existing and future growth, the hazard risk assessments, individual community priorities, critical facilities, and unique community vulnerabilities. Mitigation action types include *Local plans and regulations, Structural projects, Natural systems protection, and Education programs.* Additional information provided for each mitigation action includes the jurisdictional department responsible for implementation, estimated cost, potential funding sources, timeline for implementation, and benefit to the community based on the cost and resources to implement the action.

An action that is ranked as "High" indicates that it will be implemented as soon as funding is made available from both local budgets and through grants. A "Medium" action is one that may not be implemented right away depending on the cost and how well or how many community members are served. A "Low" action is one whose benefit is hard to quantify in relation to the cost but is still considered of value to the community and is to be implemented when funds and resources are available.

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Bandera County											
1	Update the county wide emergency action plan annually	Update the emergency action plan that addresses Critical Infrastructure and Key Resources (CIKR) failure, interruption, Potable water supply failure/ contamination, and water treatment plant failure	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G4	Y	Emergency Management	$50,000	Local, Homeland Security	24	Medium
2	Installation of emergency power generators at critical infrastructure/key resource locations	Install emergency generators at critical facilities to provide back-up power from hazard events.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3, G5	Y	Emergency Management	$250,000	Local	36	High
3	Post burn ban signs	Post burn ban signs on roads and articles in local newspapers.	Drought, Extreme Heat, Wildfire		G1, G3	Y	Emergency Management	<$10,000	Local: Road and Bridge, PDM, HMGP	24	Medium
4	Implement the identified interoperable communications system for all identified users	The P25 5-channel simulcast system was identified as the preferred emergency communication system and will need to be implemented.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G6	N	Emergency Management	$500,000	*Local Budget, HMGP, PDM, HMA, Firefighter Assistance*	48	High
5	Lighting Protection for communication towers	Lightning strikes commonly impair communication towers within the county, harden towers to mitigate against future lightning strikes.	Lightning		G5, G6	Y	Public Works	$150,000	*Local Budget, HMGP, PDM, HMA Grants*	24	High
6	Study existing shelter needs and modify as necessary	The County currently uses Red Cross approved shelters as well as Silver Sage and Bandera ISD High School. The ability of these locations to function as short or long term shelters will be determined with the appropriate upgrades made. Lakehills and Pipecreek communities also use communities centers as shelters.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3, G6	N	Emergency Management	$50,000	*Local Budget, HMGP, PDM, HMA Grants*	36	Low
7	Adopt codes to control location of and standards for development, especially in high flood hazard areas.	Study heightened regulatory requirements with regard to development in hazard areas, floodplain management, and RV developments.	Flood, Hurricane, Wildfire, Dam Failure		G3, G5, G6	Y	Planning Department	$45,000	*Local Budget*	24	High

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Bandera County											
8	CWRP Wildfire Protection Plan	Develop a community wildfire protection plan that focuses on site and neighborhood level wildfire protection and evacuation strategies.	Lightning, Wildfire		G1, G3, G5	Y	Emergency Management	$200,000	*Local Budget, HMGP, PDM, HMA Grants*	36	High
9	Develop a hazard awarenes week for implementation countywide in cooperation with local schools and school districts.	This awareness campaign is linked to the National Weather Service education program and will coordinate with National Weather Week. Fire prevention week is currently practiced by the County.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G2, G4	N	Emergency Management	$10,000	*Local Budget, HMGP, PDM, HMA Grants*	12	Low
10	Study and implementation of SH 16 Bridge @ the Medina River preferred flood mitigation alternative.	Work with TxDot to perform studies and ultimately upgrade the SH 16 bridge over the Medina River. This crossing can remain flooded for long periods of time and prevent access in case of emergency.	Flood, Hurricane, Dam Failure		G3, G5	Y	Public Works	$200,000	*Local Budget, TXDOT, HMGP, PDM, HMA Grants*	60	High
11	Study and implementation of SH 16@ Lower Mason Creek and @ Bandera Creek preferred flood mitigation alternative.	Work with TxDot to perform studies and ultimately upgrade SH 16 crossings at Lower Mason Creek and Bandera Creek. These crossings can remain flooded for long periods of time and prevent access in case of emergency.	Flood, Hurricane, Dam Failure		G3, G5	Y	Public Works	$50,000	*Local Budget, TXDOT, HMGP, PDM, HMA Grants*	60	High
12	Study and implementation of SH 173 @ the Medina River preferred flood mitigation alternative.	Work with TxDot to perform studies and ultimately upgrade the SH 173 crossing at the Medina River. This crossing can remain flooded for long periods of time and prevent access in case of emergency.	Flood, Hurricane, Dam Failure		G3, G5	Y	Public Works	$50,000	*Local Budget, TXDOT, HMGP, PDM, HMA Grants*	60	High
13	Study and implementation of Patterson St. @ Medina River preferred flood mitigation alternative.	Study and implementation of structural alternatives to existing low water crossing at Patterson St. and the Medina River.	Flood, Hurricane, Dam Failure		G3, G5	Y	Public Works	$50,000	*Local Budget, HMGP, PDM, HMA Grants*	48	High
14	Study and implementation of FM 470 @ Medina River preferred flood mitigation alternative.	Study and implementation of structural alternatives to existing low water crossing at FM 470 and the Medina River.	Flood, Hurricane, Dam Failure		G3, G5	Y	Public Works	$50,000	*Local Budget, HMGP, PDM, HMA Grants*	48	High

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Bandera County											
15	Study and implementation of FM 470 @ Indian Creek preferred flood mitigation alternative.	Study and implementation of structural alternatives to existing low water crossing at FM 470 and Indian Creek.	Flood, Hurricane, Dam Failure		G3, G5	Y	Public Works	$50,000	*Local Budget, HMGP, PDM, HMA Grants*	48	High
16	Study and implementation of FM 2107 @ Medina River preferred flood mitigation alternative.	Study and implementation of structural alternatives to existing low water crossing at FM 2107 and the Medina River.	Flood, Hurricane, Dam Failure		G3, G5	Y	Public Works	$300,000	*Local Budget, HMGP, PDM, HMA Grants*	48	High
17	Maintain a program for clearing debris	Implement a program for clearing debris from drains and culverts and enact driveway permits. Periodic checks by road crews to ascertain that drains are open.	Hurricane, Flood, Dam Failure		G1	Y	Public Works	$50,000	Local	24	Medium
18	Publish, distribute, and disseminate (countywide) hazard information brochures.	This is a program to publish, distribute and disseminate hazard information brochures. This will include bill stuffers, pamphlets, and an online library section on preparedness and severe weather mitigation for homeowners and businesses.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G4	N	Emergency Management	$10,000	*Local Budget, HMGP, PDM, HMA Grants*	12	Low
19	Investigate availability of funding and/or TA from TDEM and TCEQ for development of dam inundation data (countywide)	Investigate availability of funding and/or TA from TDEM and TCEQ for development of countywide dam inundation data. This would include both upstream and downstream effects of a catostrophic dam failure at Medina Lake.	Dam Failure		G1, G2, G3, G5	N	Engineering	$200,00	*Local Budget, HMGP, PDM, HMA Grants*	36	High
20	Implement Community Emergency Response Teams (CERTs)	Implement Community Emergency Response Teams (CERTs) in the county and in all communities.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G2, G4	N	Emergency Management	$10,000	*Local Budget, HMGP, PDM, HMA Grants*	36	Low

Legend:

Structure and Infrastructure
Natural System Protection
Local Plans and Regulations
Education and Awareness Programs
Emergency Preparation and Response

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
City of Bandera											
1	Relocate wastewater treatment plant outside of the floodplain.	Relocate the wastewater treatmant plant out of the floodplain to mitigate the repeated impacts from flooding to citywide wastewater treatment.	Flood, Hurricane, Dam Failure		G1, G3, G5	N	City Manager/ Public Works Director	$25 Million	*Local Budget, TWDB, HMGP, PDM, HMA Grants*	24	High
2	Drill two new Trinity Acquifer Wells	Drill two new middle Trinity aquifer wells with a total yield of 161 acre-foot per year.	Extreme Heat, Drought		G1, G3	Y	City Manager/ Public Works Director	$1.5 Million	*Local Budget, TWDB, HMGP, PDM, HMA Grants*	60	High
3	Diversity Water Resources and improve management of the lower Trinity Acquifer. (Surface water acquisition, treatment, and ASR project)	Per the 2022 State Water Plan, construct a new surface water treatment facility and associated conveyance pipelines to provide 1,000 acre-feet of treated water per year through the 2040 decade. The planned source water is surface water diverted from the Medina River and the construction of a new diversions and control structure will be needed upstream of the Medina River. When the direct demands are fully met, the excess will be injected into the lower Trinity aquifer through the ASR system. The stored water will be recovered and used in conjunction with treated surface water during peak demand.	Extreme Heat, Drought		G1, G3, G5	Y	Emergency Management	$34.2 Million	Local Budget, TWDB, HMGP, PDM, HMA Grants	60	Medium
4	Contaminated Water Source	Incident plan for contaminated City water system.			G1	Y	City Manager/ Emergency Management	$50,000	Local Budget, TDEM	48	Low
5	Develop and promote hazard awareness campaigns	Implement education and awareness program utilizing media, social media, bulletins, flyers, etc. to educate citizens of hazards that can threaten the area and mitigation measures to reduce injuries, fatalities, and property damages within the district. Make water conservation a key theme of Bandera to educate children, citizens, and tourists about the regional water availability challenges and the need to reduce overall water demands. The community should preserve its water capacity for drinking and living. Reducing water demands can be accomplished through changing habits, installing xeriscaping landscaping, or other creative ways. Programs can include water reclamation and rainwater harvesting. A water conservation campaign should be implemented to educate tourists on this regional challenge and keep conservation at the forefront of citizens' minds and actions.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G2, G3, G4	Y	Emergency Management	$5,000	*Local Budget, TWDB, HMGP, PDM, HMA Grants*	24	Medium

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
City of Bandera											
6	Animal Control	Creation of a State certified animal control department to maintain public health standards within the City of Bandera.			G1	Y	City Administrator	$50,000	Local Budget, TDEM	48	Low
7	Chlorine Response	Incident response plan for the accidental release of chlorine gas from the Bandera Water System's Towers			G1	Y	City Administrator	$50,000	Local Budget, TDEM	24	Low
8	Acts of Terrorism	Incident plan for acts of terrorism on City businesses and schools.			G1	Y	City Administrator	$50,000	Local Budget, TDEM	24	Low
9	Develop and implement low impact Development Standards for its stormwater management best management practices (BMP's).	Signage is posted at the entrance of the City Park alerting visitors to not swim or fish in the Medina River. Low impact Development Standards utilize existing natural systems, alternative pavement materials, design, and locally appropriate solutions, which are better fits than conventional practices. These natural systems could aid in improving the water quality of the river. Bandera's topography, shallow bedrock, existing built environment, community goals make adopting stormwater BMP's a great long-term investment and community strategy.	Hurricane, Flood, Drought, Extreme Heat, Dam Failure		G3, G5	Y	City Manager/ Planning Director	$50,000	*Local Budget, TWDB, HMGP, PDM, HMA Grants*	36	Medium

Legend:

- Structure and Infrastructure
- Natural System Protection
- Local Plans and Regulations
- Education and Awareness Programs
- Emergency Preparation and Response

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Bandera ISD											
1	Harden facilities and assets	Harden facilities and assets against the full range of natural hazards	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G5	Y	Superintendent	$100,000	*Annual budget, HMGP, PDM, HMA Grants*	36	Moderate
2	Create, Fund and Staff a School Resource Officer Position	The School Resource Officer (SRO) is a sworn law enforcement officer responsible for providing security and police services to a school or group of schools. The SRO is a visible presence in the school community and works to build relationships with students, staff, and families.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G6	Y	School Board	$80,000/year	*Annual budget, State and Local Grants*	12	High
3	Develop a hazard awarenes week for implementation countywide in cooperation with the county.	This awareness campaign is linked to the National Weather Service education program, including a library section on preparedness and information on County's website with links to preparedness programs. Publish, distribute and disseminate hazard information brochures.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G4	Y	Superintendent	$10,000	*Annual budget, HMGP, PDM, HMA Grants*	24	Moderate
4	Study existing shelter needs and modify and upgrade as necessary	The County currently uses Bandera ISD High School as a shelter. The ability of this location to function as short or long term shelters will be determined with the appropriate upgrades made.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3, G6	Y	ISD Board	$50,000	*Annual budget, HMGP, PDM, HMA Grants*	48	Low
5	Generator needed for shelter	The ISD requires backup power for the shelter that is designated for use by the community in the event of an emergency.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3	Y	Operations Manager	$50,000	*Annual budget, HMGP, PDM, HMA Grants*	36	High

Legend:

Structure and Infrastructure
Natural System Protection
Local Plans and Regulations
Education and Awareness Programs
Emergency Preparation and Response

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Flying L PUD											
1	Harden facilities and assets	Harden facilities and assets against the full range of natural hazards	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G5	Y	Manager	$100,000	*Annual budget, HMGP, PDM, HMA Grants*	36	Moderate
2	Implement Education and Awareness Program	Implement education and awareness program utilizing classrooms, social media, bulletins, flyers, etc. to educate students, parents and area residents of hazards that can threaten the area and mitigation measures to reduce injuries, fatalities, and property damages.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G4, G5	Y	Curriculum Developer, Superintendent	$5,000	*Annual budget, HMGP, PDM, HMA Grants*	36	High
3	Acquire and install generators at all critical facilities	Aquire and install generators with hard wired quick connections at all critical facilities	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G2, G6	Y	Facilities Department	>$100,000	*Annual budget, HMGP, PDM, HMA Grants*	36	Medium

Legend:

Structure and Infrastructure
Natural System Protection
Local Plans and Regulations
Education and Awareness Programs
Emergency Preparation and Response

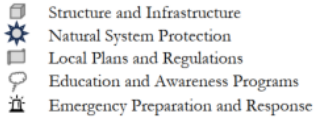
Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Bandera FWSD #1											
1	Acquire and install generators at all critical facilities	Aquire and install generators with hard wired quick connections at all critical facilities	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G2, G6	Y	General Manager	>$100,000	*Annual budget, HMGP, PDM, HMA Grants*	36	High
2	Harden facilities against hazards	Upgrade maintenance facilities and offices to include drought mitigation measures such as greywater reuse systems, drought tolerant landscaping, installation of a sprinkler system with regular watering schedule and installation of French drains.	Drought, Extreme Heat, Wildfire		G1, G2, G6	Y	General Manager	$100,000	*Annual budget, HMGP, PDM, HMA Grants*	36	Medium
3	Water Conservation Education Program	Implement education and awareness program utilizing media, social media, bulletins, flyers, etc. to educate citizens of hazards that can threaten the area and mitigation measures to reduce injuries, fatalities, and property damages within the district.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3, G4	Y	General Manager, BPWD	$50,000	*Annual budget, HMGP, PDM, HMA Grants*	24	High
4	Asset Mapping and Documentation Program	Develop a program to map and document the condition, vulnerability, description, and age of all assets that are within the district's responsibility to protect, upgrade, maintain, and replace.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G4, G5	Y	General Manager	$80,000	*Annual budget, HMGP, PDM, HMA Grants*	36	High

Legend:

- Structure and Infrastructure
- Natural System Protection
- Local Plans and Regulations
- Education and Awareness Programs
- Emergency Preparation and Response

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Medina ISD											
1	Harden facilities and assets	Harden facilities and assets against the full range of natural hazards	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G5	Y	Superintendent	$100,000	*Annual budget, HMGP, PDM, HMA Grants*	36	Moderate
2	Create, Fund and Staff a School Resource Officer Position	The School Resource Officer (SRO) is a sworn law enforcement officer responsible for providing security and police services to a school or group of schools. The SRO is a visible presence in the school community and works to build relationships with students, staff, and families.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G6	Y	School Board	$80,000/year	*Annual budget, HMGP, PDM, HMA Grants*	12	High
3	Generator needed for shelter	The ISD requires backup power for the shelter that is designated for use by the community in the event of an emergency.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G5	Y	Operations Manager	$50,000	*Annual budget, HMGP, PDM, HMA Grants*	36	High
4	Develop a hazard awarenes week for implementation countywide in cooperation with the county.	This awareness campaign is linked to the National Weather Service education program, including a library section on preparedness and information on County's website with links to preparedness programs. Publish, distribute and disseminate hazard information brochures.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G4	Y	Supterintendent	$10,000	*Annual budget, HMGP, PDM, HMA Grants*	24	Moderate

Legend:



Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Medina Water Supply Corporation											
1	Harden facilities against hazards	Upgrade maintenance facilities and offices to include drought mitigation measures such as greywater reuse systems, drought tolerant landscaping, installation of a sprinkler system with regular watering schedule and installation of French drains.	Drought, Extreme Heat, Wildfire		G1, G2, G6	Y	General Manager	$100,000	*Annual budget, HMGP, PDM, HMA Grants*	36	High
2	Water Conservation Education Program	Implement education and awareness program utilizing media, social media, bulletins, flyers, etc. to educate citizens of hazards that can threaten the area and mitigation measures to reduce injuries, fatalities, and property damages within the district.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3, G4	Y	General Manager, BPWD	$50,000	*Annual budget, HMGP, PDM, HMA Grants*	24	Medium
3	Asset Mapping and Documentation Program	Develop a program to map and document the condition, vulnerability, description, and age of all assets that are within the district's responsibility to protect, upgrade, maintain, and replace.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G4, G5	Y	General Manager	$80,000	*Annual budget, HMGP, PDM, HMA Grants*	36	High

Legend:

- Structure and Infrastructure
- Natural System Protection
- Local Plans and Regulations
- Education and Awareness Programs
- Emergency Preparation and Response

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Utopia ISD											
1	Generator needed for shelter	The ISD requires backup power for the shelter that is designated for use by the community in the event of an emergency.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G5	Y	Operations Manager	$50,000	*Annual budget, HMGP, PDM, HMA Grants*	36	High
2	Develop a hazard awarenes week for implementation countywide in cooperation with the county.	This awareness campaign is linked to the National Weather Service education program, including a library section on preparedness and information on County's website with links to preparedness programs. Publish, distribute and disseminate hazard information brochures.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G4	Y	Supterintendent	$10,000	*Annual budget, HMGP, PDM, HMA Grants*	24	Moderate
3	Harden facilities and assets	Harden facilities and assets against the full range of natural hazards	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G5	Y	Superintendent	$100,000	*Annual budget, HMGP, PDM, HMA Grants*	36	Moderate
4	Acquire and install generators at all critical facilities	Aquire and install generators with hard wired quick connections at all critical facilities	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G2, G6	Y	Operations Manager	>$100,000	*Annual budget, HMGP, PDM, HMA Grants*	36	Medium
5	Implement Education and Awareness Program	Implement education and awareness program utilizing classrooms, social media, bulletins, flyers, etc. to educate students, parents and area residents of hazards that can threaten the area and mitigation measures to reduce injuries, fatalities, and property damages.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G4, G5	Y	Curriculum Developer, Superintendent	$5,000	*Annual budget, HMGP, PDM, HMA Grants*	36	High

Ranking	Mitigation Action Title	Description	Hazards Mitigated	Action Type	Applicable Goals	New Action	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline (Months)	Benefit
Utopia ISD											
6	Create, Fund and Staff a School Resource Officer Position	The School Resource Officer (SRO) is a sworn law enforcement officer responsible for providing security and police services to a school or group of schools. The SRO is a visible presence in the school community and works to build relationships with students, staff, and families.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G6	Y	School Board	$80,000/year	*Annual budget, HMGP, PDM, HMA Grants*	12	High

Legend:

- Structure and Infrastructure
- Natural System Protection
- Local Plans and Regulations
- Education and Awareness Programs
- Emergency Preparation and Response

Mitigation Action Plan

The mitigation action plan is a method to prioritize mitigation actions and assign departmental responsibility, ensuring a higher rate of successful action implementation and administration. Each jurisdiction has multiple authorities to implement the mitigation strategy including, but also limited to, local planning and zoning, public works efforts, emergency management, tax authority, building codes and ordinances, and legislative and managerial.

All of the mitigation actions, both new and old, in this section were prioritized primarily based on FEMA's Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLE+E) criteria. These criteria are considered necessary for successful and enduring implementation of each action. Each participating jurisdiction in the plan had an opportunity to discuss and consider each of the criteria as they related to each individual action and rate them from 1 to 5. The total scores from the STAPLE+E exercises were then used to assign an overall priority to each mitigation action for each of the participating jurisdictions. In addition to the STAPLE+E exercise, jurisdictions analyzed each action in terms of which department or agency will be responsible for administration of the action, action timeline, potential funding sources, and the overall costs, measuring whether the potential benefit to be gained from the action outweighed the costs associated with it.

SECTION 19: PLAN MAINTENANCE

This section describes how Bandera County, including participating jurisdictions, will implement the Plan and continue to evaluate and enhance it over time. As indicated in the previous section, each action has been assigned to a specific department within the jurisdiction. In order to ensure that the Plan remains current and relevant, the following plan maintenance procedures will be addressed:

1. Ensure the mitigation strategy remains current and that actions are implemented according to the timeline.

2. Develop an ongoing mitigation program throughout the community for each participating jurisdiction and work together at the county level to update and review the plan.

3. Integrate short and long-term mitigation objectives into community officials' daily roles and responsibilities.

4. Continue public involvement and maintain momentum with education programs and materials, routine publication of accomplishments, and briefings to decision-makers of the Plan's progress.

Table 20-1 indicates the department or title responsible for this action. Each participating jurisdiction determines the department or title of personnel responsible for implementation of mitigation strategies and the development of procedures.

Table 20-1: Team Members Responsible for Plan Maintenance

Jurisdiction/Entity	Title
Bandera County	Emergency Management Coordinator
Bandera FWSD #1	General Manager
City of Bandera	Public Works Director
Bandera ISD	Superintendent
Flying L PUD	General Manager
Medina ISD	Superintendent
Medina WSC	General Manager
Utopia ISD	Superintendent

Incorporation

Following adoption and approval of the Plan, Bandera County, including participating jurisdictions, will implement actions they have developed and prioritized in the plan based on funding availability and continuing public input. A timeline is provided with each action and is used to assess whether actions are being completed on time based on the date of plan adoption. Potential funding sources are also listed for each action in Section 18, and described in more detail below. Additional funding sources can include federal disaster declarations and other non-federal grant sources.

Local Funding: This is funding that the community can allocate in the budget process and with other local funding mechanisms such as impact fees and drainage utility fees. This funding can be used entirely for specific hazard mitigation activities and projects or can be used as a match to leverage federal and state funding.

BRIC: The Building Resilient Infrastructure and Communities (BRIC) grant program supports states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. The program's guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large infrastructure projects; maintaining flexibility; and providing consistency.

CWDG: The Community Wildfire Defense Grant Program, or CWDG, is intended to help at-risk local communities and Tribes plan for and reduce the risk of wildfire. This program, which was authorized by the Bipartisan Infrastructure Law, prioritizes at-risk communities in an area identified as having high or very high wildfire hazard potential, are low-income, or have been impacted by a severe disaster that affects the risk of wildfire. More details on these three priorities can be found in the Notices of Funding Opportunity (NOFOs) below. The program provides funding to communities for two primary purposes:

- Develop and revise Community Wildfire Protection Plans (CWPP).
- Implement projects described in a Community Wildfire Protection Plan that is less than ten years old.

The CWDG Grant Program also helps communities in the wildland urban interface (WUI) implement the three goals of the National Cohesive Wildland Fire Management Strategy.

HMGP: The purpose of Hazard Mitigation Grant Programs is to help communities implement hazard mitigation measures following a Presidential Major Disaster Declaration in the areas of the state, tribe, or territory requested by the Governor or Tribal Executive. The key purpose of this grant program is to enact mitigation measures that reduce the risk of loss of life and property from future disasters.

PDM: The Pre-Disaster Mitigation Grant Program is designed to provide technical and financial assistants to States and local governments for cost-effective pre-disaster hazard mitigation activities that complement a comprehensive mitigation program. The goal is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters. This program awards planning and project grants and provides opportunities for raising public awareness about reducing future losses before disaster strikes. Mitigation planning is a key process used to break the cycle of disaster damage, reconstruction, and repeated damage.

Methods of Incorporation of the Plan

Once per year at a minimum, participating Core team members will conduct a review of plans and policies in place and analyze the need for amendments based on the approved plan. Team members will incorporate any mitigation policies and actions into these plans and policies as appropriate, then seek approval from Commissioners Court and/or City Councils, as appropriate. The plans and policies that will require review include emergency operations or management plans, capital improvement plans, comprehensive land use and future growth plans, transportation plans, annual budgeting, and any building codes that guide and control development in a way that will contribute to the goals of this mitigation plan to reduce long-term risk to life and property from all hazards.

A list of regulatory and planning capabilities currently available to the jurisdictions can be found in **Appendix A**. In the process of integrating the mitigation actions into new and existing planning mechanisms, the participating jurisdictions will do the following:

- Bandera County – Actions will be presented to Commissioner's Court by the responsible department. Upon approval by Commissioner's Court, approved actions will be acted upon and/or integrated into existing planning mechanisms.
- Municipalities and ISDs – Actions will be presented to City Councils and School Boards by the responsible department. Upon approval by City Council, approved actions will be acted upon and/or integrated into existing planning mechanisms.

Grant Applications	Hazard mitigation grant funding will be sought as a way to fund eligible action items as the funding is awarded. If a need for additional action items is presented, an amendment will be necessary to include the action in the plan.
Annual Budget Review	The Plan and mitigation actions will be reviewed annually to determine any funding needs to be included during the budget process and will involve various departments and team members that participated in the planning process. Local funds match requirements for grants will be considered by the appropriate department such as engineering, planning, code enforcement, and others to achieve the mitigation action based on the timeline.
Floodplain Management Plans and Watershed Studies	These types of plans include preventative and corrective actions to address the flood hazard.
Regulatory Plans and Future Growth Plans	Bandera County, including participating jurisdictions, have regulatory plans in place that are in need of updating from time to time. This Hazard Mitigation Action Plan Update will be consulted when County and City departments review or revise their current regulatory planning mechanisms and growth plans such as land development and building codes, comprehensive plans, and capital improvement plans.

Periodic annual tracking of the Plan is required to ensure that the mitigation actions are implemented over the 5-year cycle and that the Plan is kept current based on the latest information about hazards and their impacts. The team members designated by department and jurisdiction in Table 18-1 are responsible for monitoring, evaluating, and updating the Plan for their participating jurisdiction. The planning team will convene on an annual basis or when other plans are being developed, reviewed or updated. In addition to annual monitoring, the Plan will be similarly reviewed immediately after extreme weather events including but not limited to state and federally declared disasters.

Monitoring

The Plan in its entirety, will be monitored, including but not limited to continued public participation, plan evaluation method, plan update methods, action prioritization, administration of identified mitigation actions, risk assessment, and incorporation into other planning mechanisms. Responsibilities of annual monitoring include working with various city and county departments to ensure that the identified mitigation actions get incorporated into existing plans and policies and that mitigations actions that are funded by City Councils and the County Commissioners' Court get implemented. These mitigation action status updates will include a feasibility assessment for implementation and funding for the remaining time left in the 5-year mitigation action planning cycle.

Planning team meetings for *monitoring* the plan will include a **sign-in sheet** to record attendance and a **brief report** that identifies policies and actions in the plan that have been successfully implemented since its adoption. The report will also document the steps to be

followed to develop action items into a policy or project that have not yet been completed and how the plan has been incorporated into other planning mechanisms.

Evaluation

As part of the annual tracking of the Plan, Core Planning Team members will evaluate changes in risk and hazard data associated with the planning area to determine if there are any needed changes to mitigation action timelines, prioritization, or if any action needs to be amended, added, or deleted. This is an opportunity to detect if there are any new obstacles to the implementation of actions such as funding, political, legal, or coordination within departments such as changes in departmental programs and goals that may affect mitigation priorities.

The Plan evaluation is also an opportunity to review the effectiveness of public participation and outreach efforts and to update or expand upon those efforts. The effectiveness of public participation can be measured with surveys, number of website hits, number of people in attendance, and number of materials printed. The annual evaluation process is necessary to make any necessary amendments to the plan to keep the plan relevant and most effective in mitigating the identified hazards in the Plan. Team meetings for *evaluating* the plan will include a **sign-in sheet** to record attendance and a **brief report** that identifies any changes to the Plan or to the local jurisdiction's implementation process needed for continued success.

Updating

The designated Core Planning Team member from each community evaluating the Plan will prepare annual reports that will be used to keep the Plan updated and keep them on file. Major changes to mitigation actions or the overall direction of the Plan or the policies contained within the Plan are subject to formal adoption by each city and the amendment will be submitted to TDEM. To determine whether to recommend approval or denial of a Plan amendment request, each County, City, or School District will consider the following factors:

- Changes in information, data, or assumptions from those on which the Plan was based.
- New issues or needs that were not adequately addressed in the Plan.
- Errors or omissions made in the identification of issues or needs during the preparation of the Plan.

This annual Plan Maintenance process enables Bandera County, including participating jurisdictions, to keep their Hazard Mitigation Plan relevant based on the latest information, capabilities, needs, and community input. The process also provides an opportunity to ensure that mitigation actions are meeting the goals in this Plan and that they are implemented in the manner they were intended. This is a valuable opportunity to identify mitigation actions in the annual report that were not successful and to recommend removal of those that are no longer needed.

Five Year Review and Update

The Plan will be thoroughly reviewed by Planning Team members at the end of three years from the approval date to determine whether there have been any significant changes in the area that may require updating, amending, or deleting parts of the Plan. It is wise to begin considering plan updates in advance of the five-year deadline due to the timelines for grant funding, Plan reviews, and to ensure eligibility. Oftentimes, the timelines for grant and planning cycles can be in excess of a year to apply and receive funding.

The 5-year Plan review allows for evaluating successful and unsuccessful mitigation actions, documenting losses avoided, and considering factors affecting the Plan. Necessary revisions will be summarized and integrated into the existing plan or reserved for the 5-year plan update. The revised or new Plan will be submitted to TDEM and FEMA for final review and approval.

Continued Public Involvement

Input from the stakeholders and public was an integral part of the preparation of this Plan and will continue as the Plan is reviewed, revised, and updated. This Plan will be posted on the websites of Bandera County, and participating jurisdictions, where the public will be invited to review and provide feedback via e-mail. Core Planning Team members are tasked with notifying stakeholders and community members when the annual review of the plan is undertaken.

The Planning team may also develop a voluntary citizen/stakeholder advisory group comprised of members from throughout the planning area to provide feedback on an annual basis. It is vital that the public and stakeholders maintain a vested interest in the Plan in order to keep the Plan relevant as it relates to the broader community's sustained health, safety, and welfare. Media such as websites, social media, local newspaper, and radio stations will be used to notify the public of any maintenance or periodic review activities taking place.

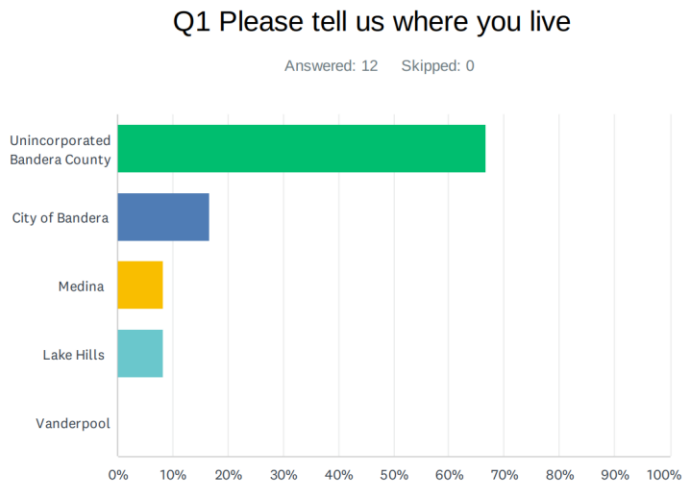
Public participation is critical to creating a plan that is enduring and one that has meaning to the community. The direct involvement of local officials and the public has been and will continue to be sought during the development, implementation, and maintenance phases of this Bandera County Hazard Mitigation Plan Update.

APPENDIX A: CAPABILITY ASSESSMENT

	Capabilities	Bandera County	Bandera County FWSD 1	City of Bandera	Medina WSC	City of Bandera ISD	City of Medina ISD	Utopia ISD	Flying L PUD	
Planning and Regulatory	Comprehensive Plan			X		X				The planning and regulatory mechanisms that guide growth and development and emergency plans
	Economic Development Plan			X						
	Transportation Plans					X				
	Emergency Operation Plans	X	X	X		X	X	X		
	Continuity of Operations Plan		X	X		X				
	Stormwater Management Plan									
	Zoning ordinances			X						
	Building Codes	X		X						
	Subdivision Ordinance	X	X	X						
	Floodplain Ordinance	X	X	X						
Administrative and Technical	Engineers	X		X						This refers to staff, skills, and tools a community has. So provide staff numbers and any credentials or certificate trainings in reference to hazard mitigation
	Planners									
	GIS Analysts	X								
	Building inspectors			X						
	Emergency managers	X		X		X				
	Grant writers			X						
	Chief Building Official					X				
	Floodplain Administrator	X		X						
Financial	CDBG	X		X						The resources that a jurisdiction has access to or is eligible to use to fund mitigation efforts
	Capital Improvement Program			X						
	Stormwater utility fees			X						
	Development impact fees								X	
Education and Outreach	School programs					X	X	X		The programs and methods already in place that could be used to implement mitigation activities
	Firewise communities									
	Storm Ready communities									
	Hazard awareness campaigns									
	Public Information Officer	X		X						
	Community newsletter			X		X		X	X	

Planning and regulatory capabilities are identified as the most impactful to how a municipality or utility can plan and develop in a way that is disaster resilient. The most critical capabilities related to planning and development such as Capital Improvement Programs, subdivision ordinances, comprehensive plans, transportation plans and zoning codes are already in place for the City of Bandera. As is typical of smaller communities, many critical municipal functions and roles are carried out by people that are required to wear "many hats" as part of their job description. This strategy can be cost-effective for cash strapped municipalities but it often leads to roles being carried out by those that may be experts in one area or field and not necessarily the secondary and tertiary roles they are needed for. This also leads to the requirement to contract with outside consultants who may be experts in specific areas but don't always have the local knowledge and background that can be critical to success. This would require local focus on these items such as hiring planning, GIS, and building official personnel or developing these capabilities with grants and other means. Studies also need to be conducted to thoroughly identify gaps in capabilities and comparisons made with other communities of similar size and economy. The communities throughout the planning area currently utilize engineering and grant writing consultants that are meeting these capability needs. Fiscal mechanisms to fund growth also need to be explored throughout the planning area such as drainage utility fees and impact fees. Lastly, educational programs and literature related to hazard mitigation should be strengthened within all municipalities which includes close coordination with the local school districts.

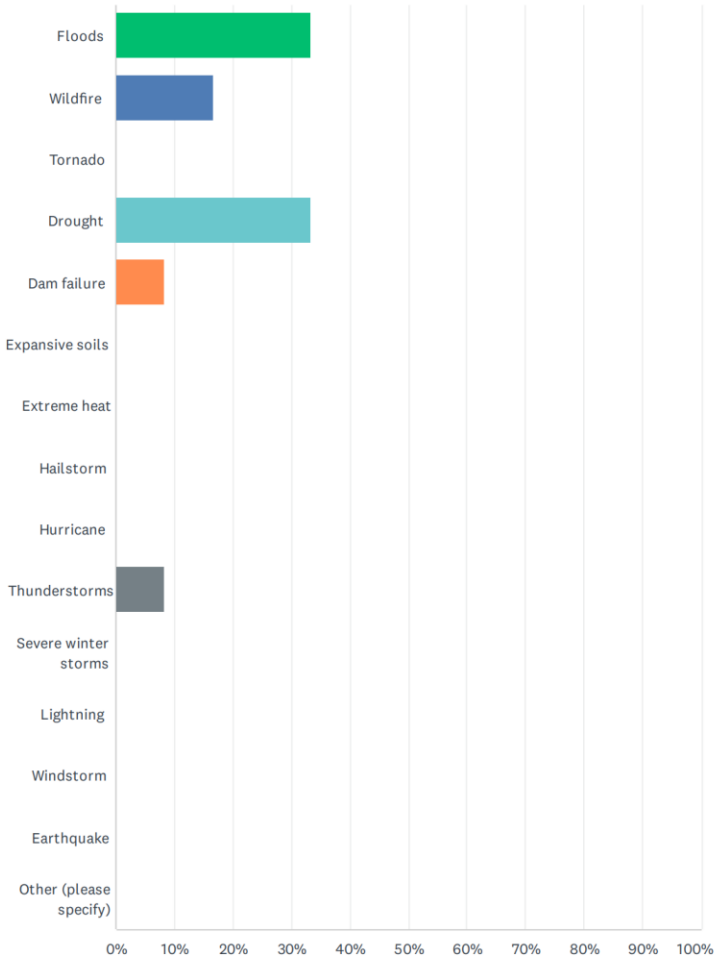
APPENDIX B: PUBLIC SURVEY



ANSWER CHOICES	RESPONSES	
Unincorporated Bandera County	66.67%	8
City of Bandera	16.67%	2
Medina	8.33%	1
Lake Hills	8.33%	1
Vanderpool	0.00%	0
TOTAL		12

Q2 Please select the hazard you think is the highest threat to you, your business and/or your community. (Please check only one)

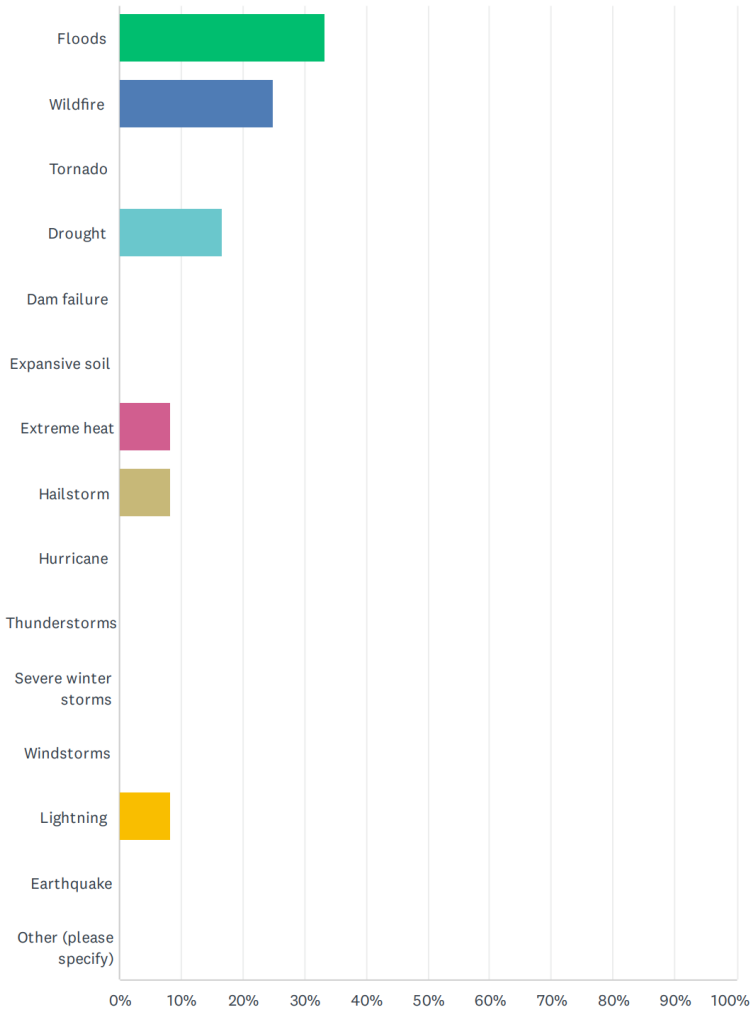
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Floods	33.33%	4
Wildfire	16.67%	2
Tornado	0.00%	0
Drought	33.33%	4
Dam failure	8.33%	1
Expansive soils	0.00%	0
Extreme heat	0.00%	0
Hailstorm	0.00%	0
Hurricane	0.00%	0
Thunderstorms	8.33%	1
Severe winter storms	0.00%	0
Lightning	0.00%	0
Windstorm	0.00%	0
Earthquake	0.00%	0
Other (please specify)	0.00%	0
TOTAL		12

Q3 Please select the hazard you think is the second highest threat to you, your business and/or your community. (Please check only one)

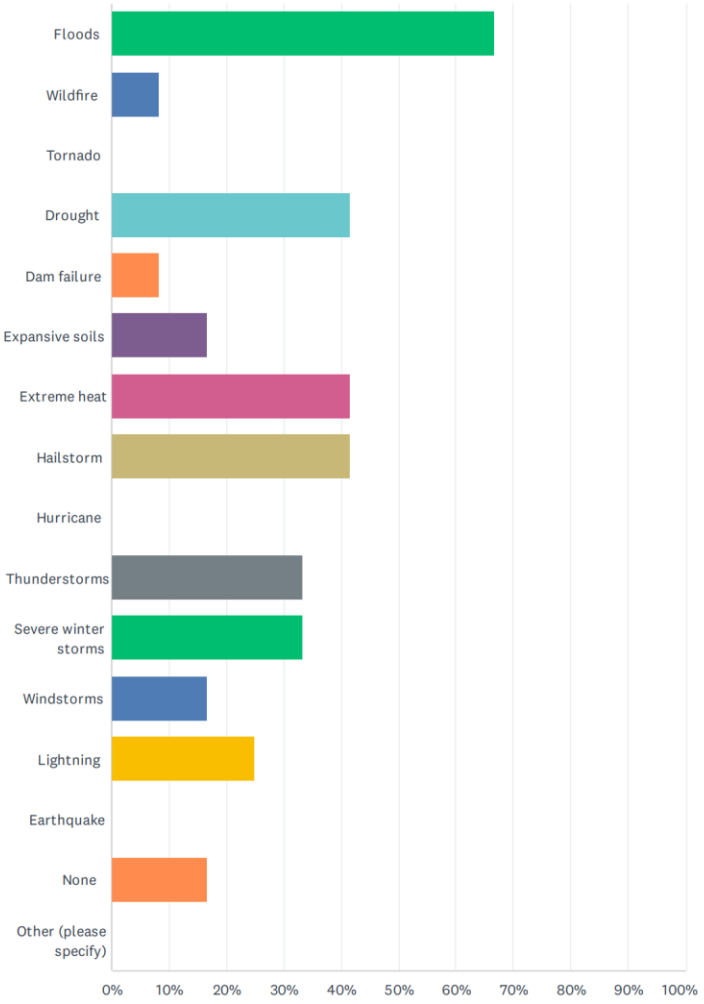
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Floods	33.33%	4
Wildfire	25.00%	3
Tornado	0.00%	0
Drought	16.67%	2
Dam failure	0.00%	0
Expansive soil	0.00%	0
Extreme heat	8.33%	1
Hailstorm	8.33%	1
Hurricane	0.00%	0
Thunderstorms	0.00%	0
Severe winter storms	0.00%	0
Windstorms	0.00%	0
Lightning	8.33%	1
Earthquake	0.00%	0
Other (please specify)	0.00%	0
TOTAL		12

Q4 While living here in Bandera County, have you experienced a disaster? (please check all that apply)

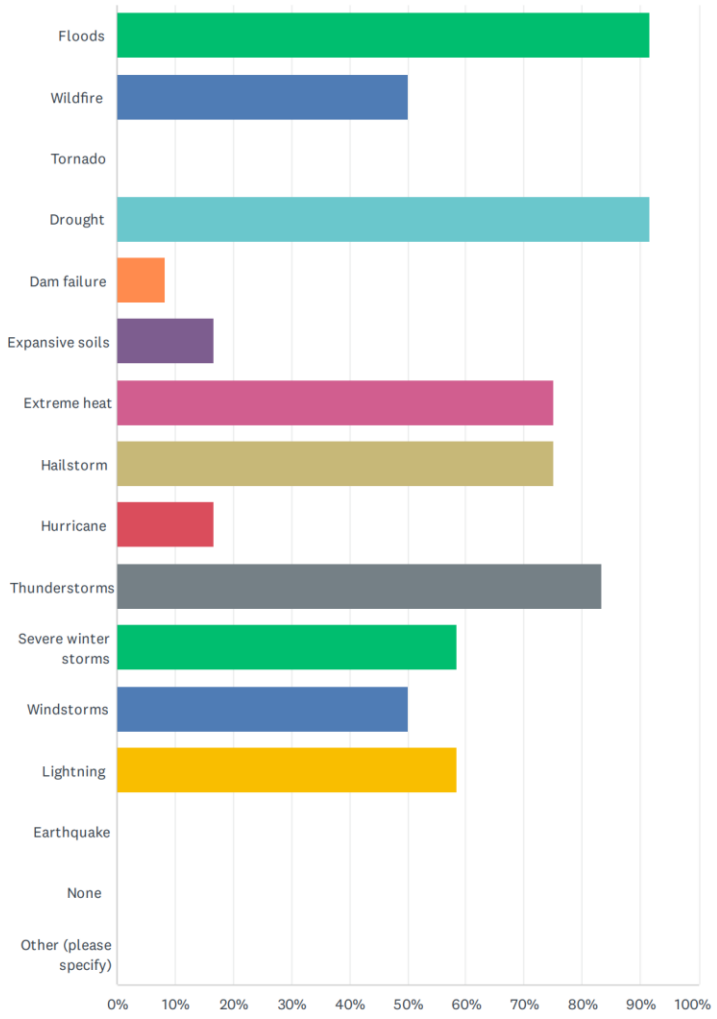
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Floods	66.67%	8
Wildfire	8.33%	1
Tornado	0.00%	0
Drought	41.67%	5
Dam failure	8.33%	1
Expansive soils	16.67%	2
Extreme heat	41.67%	5
Hailstorm	41.67%	5
Hurricane	0.00%	0
Thunderstorms	33.33%	4
Severe winter storms	33.33%	4
Windstorms	16.67%	2
Lightning	25.00%	3
Earthquake	0.00%	0
None	16.67%	2
Other (please specify)	0.00%	0
Total Respondents: 12		

Q5 Which of the following are likely to occur in your area at least once in your lifetime? (please check all that apply)

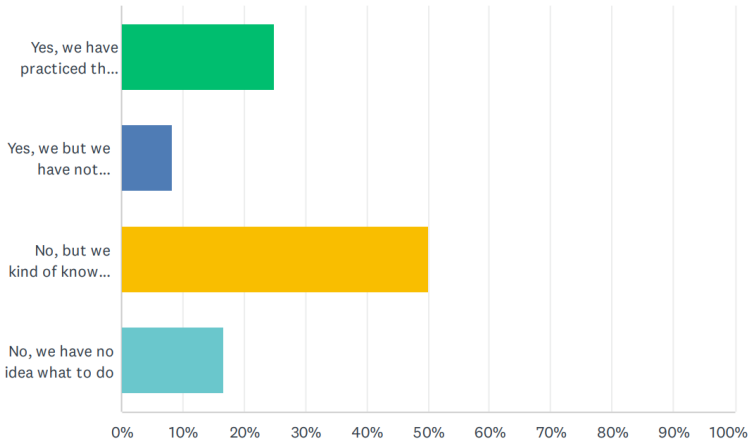
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Floods	91.67%	11
Wildfire	50.00%	6
Tornado	0.00%	0
Drought	91.67%	11
Dam failure	8.33%	1
Expansive soils	16.67%	2
Extreme heat	75.00%	9
Hailstorm	75.00%	9
Hurricane	16.67%	2
Thunderstorms	83.33%	10
Severe winter storms	58.33%	7
Windstorms	50.00%	6
Lightning	58.33%	7
Earthquake	0.00%	0
None	0.00%	0
Other (please specify)	0.00%	0
Total Respondents: 12		

Q6 My household has a plan in the event of a disaster such as a flood, tornado, etc.

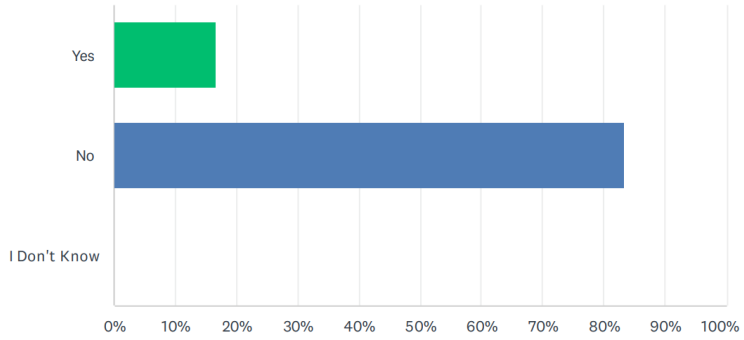
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes, we have practiced the plan	25.00%	3
Yes, we but we have not practiced the plan	8.33%	1
No, but we kind of know what to do	50.00%	6
No, we have no idea what to do	16.67%	2
TOTAL		12

Q7 Is your home located in a floodplain?

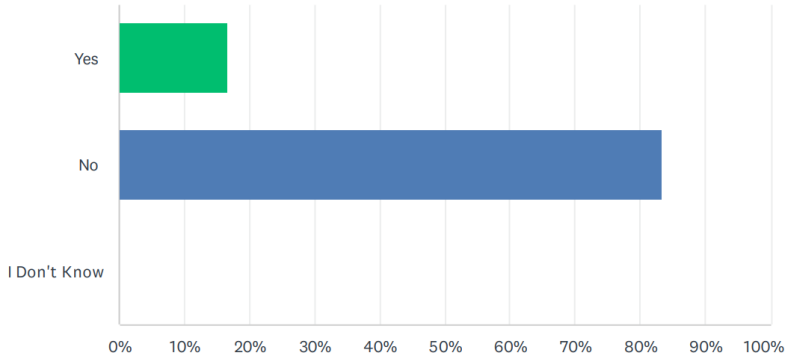
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	16.67%	2
No	83.33%	10
I Don't Know	0.00%	0
TOTAL		12

Q8 Do you have flood insurance?

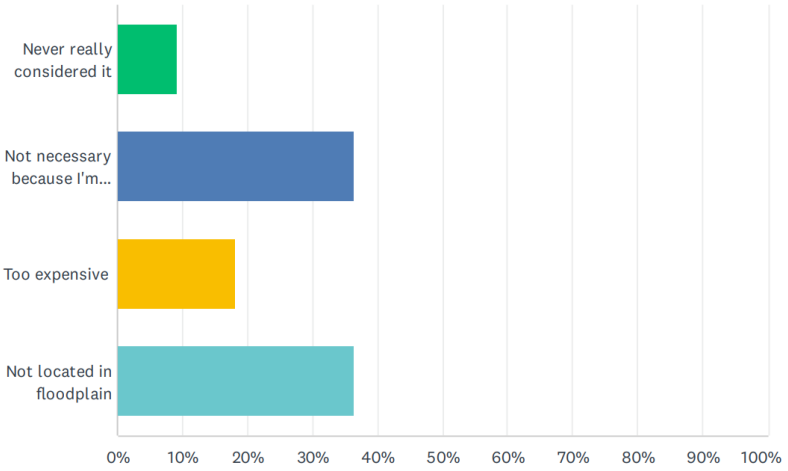
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	16.67%	2
No	83.33%	10
I Don't Know	0.00%	0
TOTAL		12

Q9 If you do not have flood insurance, why not?

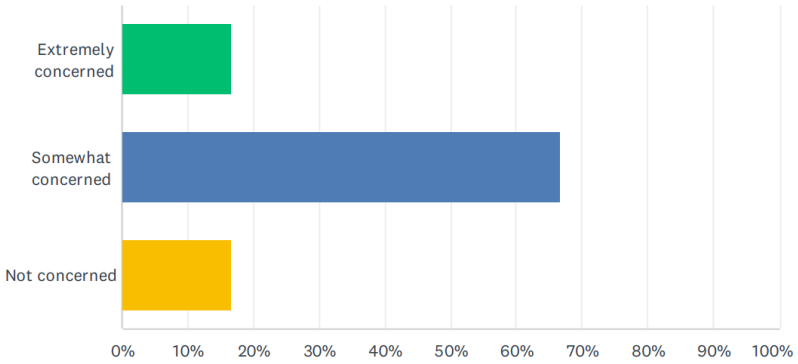
Answered: 11 Skipped: 1



ANSWER CHOICES	RESPONSES	
Never really considered it	9.09%	1
Not necessary because I'm elevated or otherwise protected	36.36%	4
Too expensive	18.18%	2
Not located in floodplain	36.36%	4
TOTAL		11

Q10 How concerned are you about the possibility of you or your community being impacted by a disaster?

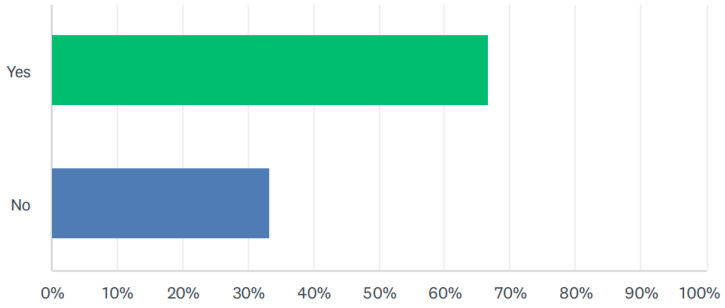
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Extremely concerned	16.67%	2
Somewhat concerned	66.67%	8
Not concerned	16.67%	2
TOTAL		12

Q11 Have you taken any actions to make your home, business and/or community more resistant to hazards?

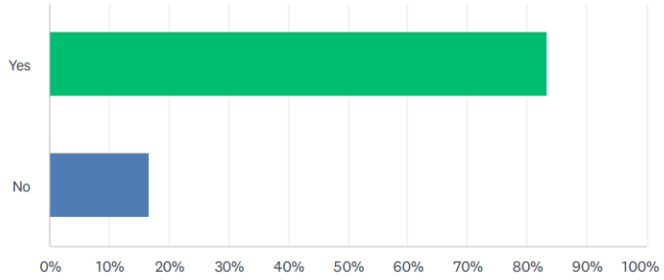
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	66.67%	8
No	33.33%	4
TOTAL		12

Q13 Are you interested in making your home, business and/or community more resistant to hazards?

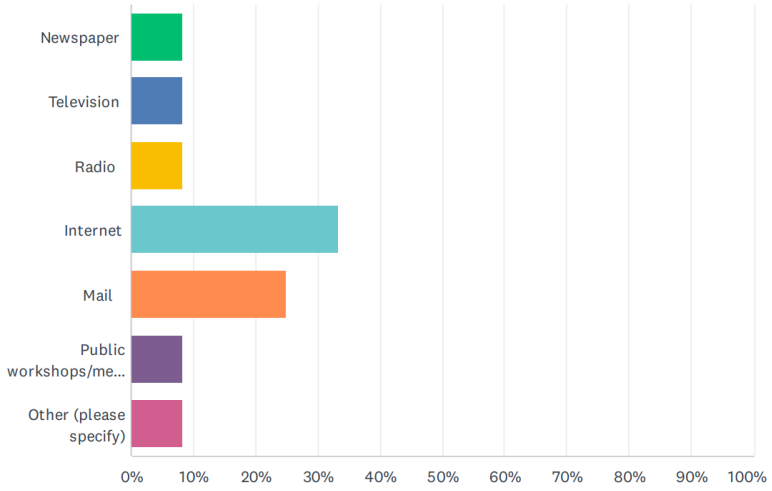
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	83.33%	10
No	16.67%	2
TOTAL		12

Q14 What is the most effective way for you to receive information about how to make your home, business and/or community more resistant to hazards?

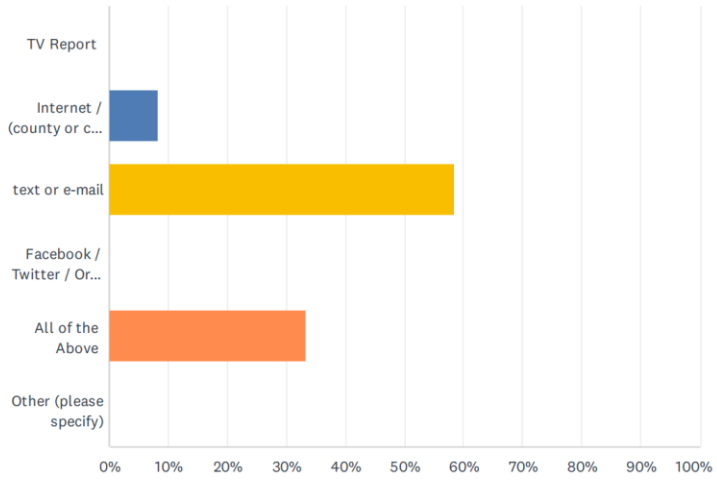
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Newspaper	8.33%	1
Television	8.33%	1
Radio	8.33%	1
Internet	33.33%	4
Mail	25.00%	3
Public workshops/meetings	8.33%	1
Other (please specify)	8.33%	1
TOTAL		12

Q15 Which of the following would be the best way to alert you and your household to an imminent disaster?

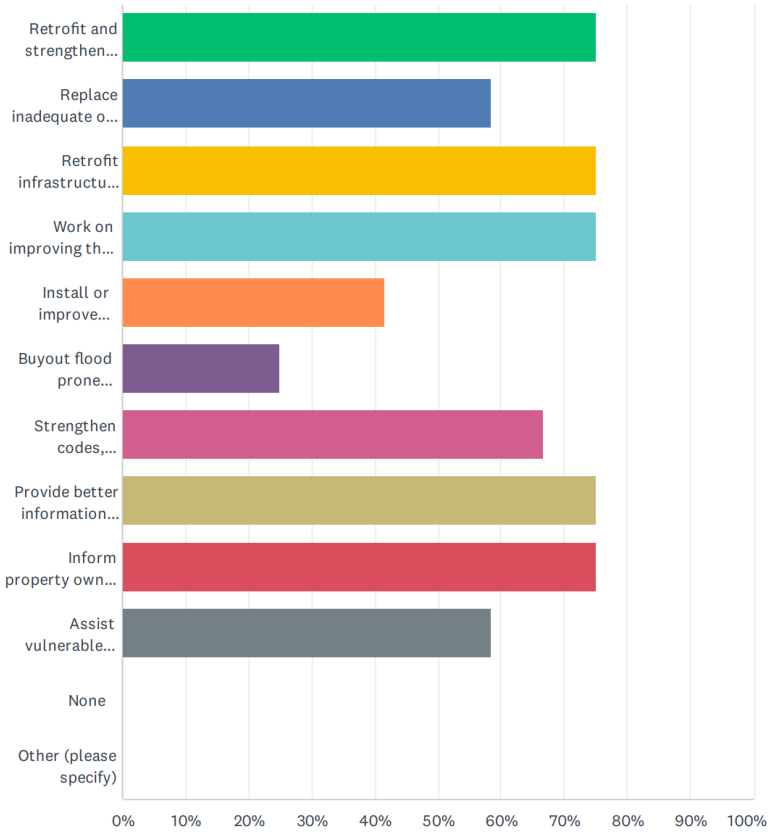
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
TV Report	0.00%	0
Internet / (county or city website)	8.33%	1
text or e-mail	58.33%	7
Facebook / Twitter / Or other social media	0.00%	0
All of the Above	33.33%	4
Other (please specify)	0.00%	0
TOTAL		12

Q16 Which of the following mitigation activities do you believe your local government should employ to reduce or eliminate the risk of future hazard damages in your neighborhood and/or community. (Please check all that apply)

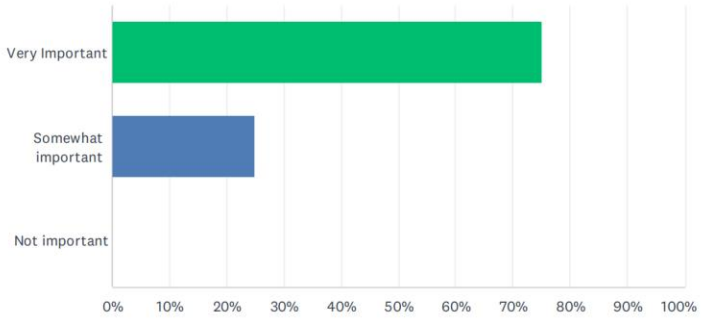
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Retrofit and strengthen essential facilities such as police, fire, emergency medical services, hospitals, schools, etc.	75.00%	9
Replace inadequate or vulnerable bridges and roads.	58.33%	7
Retrofit infrastructure, such as elevating roadways and improving drainage systems.	75.00%	9
Work on improving the damage resistance of utilities (electricity, communications, water / wastewater facilities, etc.).	75.00%	9
Install or improve protective structures, such as floodwalls and levees or individual/community saferooms.	41.67%	5
Buyout flood prone properties and maintain as open-space.	25.00%	3
Strengthen codes, ordinances, and plans to require higher hazard risk management standards.	66.67%	8
Provide better information about hazard risk and high-hazard areas.	75.00%	9
Inform property owners of ways they can mitigate damage to their properties.	75.00%	9
Assist vulnerable property owners with securing funding to mitigate impacts to their property(s).	58.33%	7
None	0.00%	0
Other (please specify)	0.00%	0
Total Respondents: 12		

Q18 Prevention of Hazards is any administrative or regulatory action that influences the way land is developed and buildings are built. Some examples include planning and zoning, building codes, open space prevention, and flood plain regulation. Please rank how important you believe it is for your community to pursue the prevention of hazards .

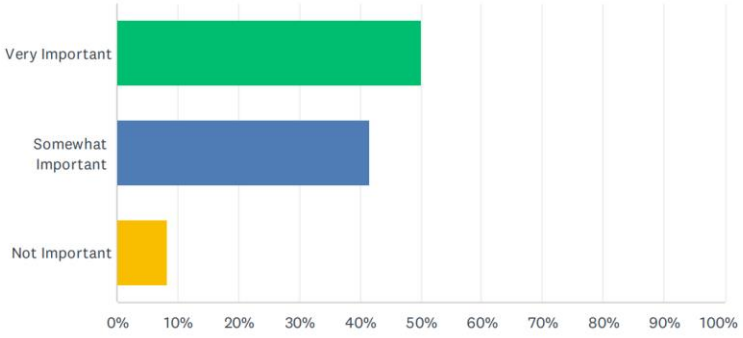
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very Important	75.00%	9
Somewhat important	25.00%	3
Not important	0.00%	0
TOTAL		12

Q19 Reducing community risks from hazards can also include property protection. This involves actions that involve the modification of existing buildings to protect them from a hazard or removal from the hazard area. Examples include acquisition, relocation, elevations, structural retrofits and storm shutters. How important is it to you that your community should pursue property protection?

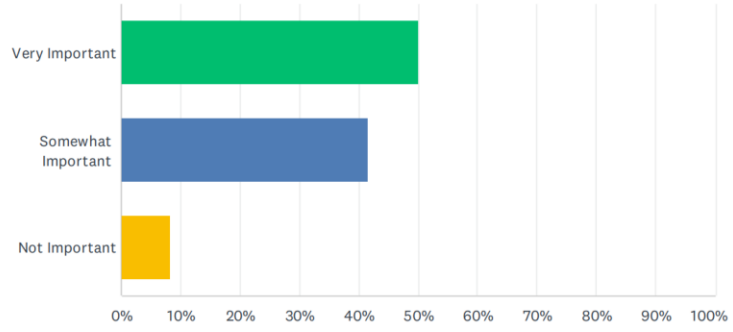
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very Important	50.00%	6
Somewhat Important	41.67%	5
Not Important	8.33%	1
TOTAL		12

Q20 Reducing community risks from hazards can also include natural resource protection. This kind of protection is in addition to minimizing hazard losses, preserve or restoring the functions of natural systems. Some examples include flood plain protection, habitat preservation, slope stabilization, riparian buffers and forest management. Do you believe this is important for your community to pursue? Please rank below.

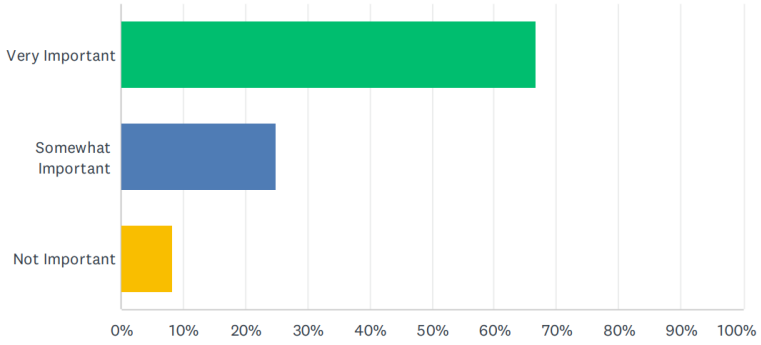
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very Important	50.00%	6
Somewhat Important	41.67%	5
Not Important	8.33%	1
TOTAL		12

Q21 Structural Projects can also help to reduce hazards.These actions are intended to lessen the impact of a hazard by modifying the natural progression of the hazard. Examples include dams, levees, seawalls, detention/retention basins, channel modifications, retaining walls and storm sewers. Do you believe this is important for your community to pursue? Please rank below.

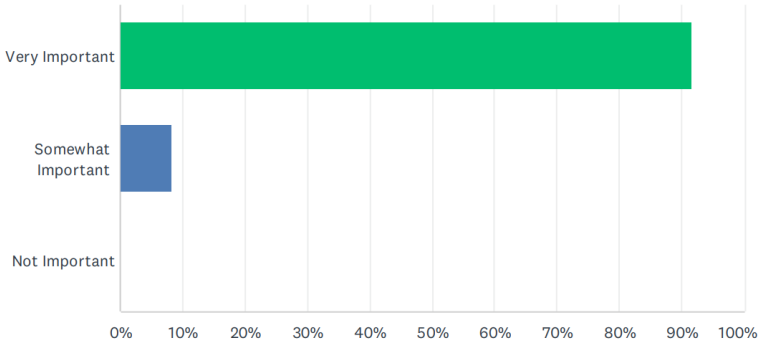
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very Important	66.67%	8
Somewhat Important	25.00%	3
Not Important	8.33%	1
TOTAL		12

Q22 Emergency Services are actions that protect people and property during and immediately after a hazard event . Some examples include warning systems, evacuation planning, emergency planning, emergency response training and protection of critical emergency facilities/system. Do you believe this is important for your community to pursue? Please rank below.

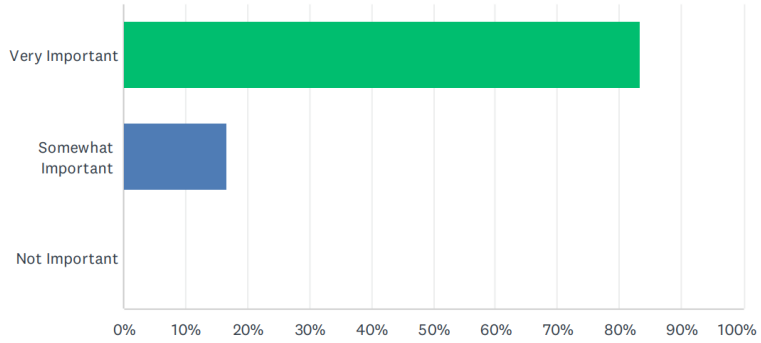
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very Important	91.67%	11
Somewhat Important	8.33%	1
Not Important	0.00%	0
TOTAL		12

Q23 Public Education and Awareness are actions to inform citizens about hazards and the techniques they can use to protect themselves and their property. Examples include outreach projects, school education programs, library materials and demonstration events. Do you believe this is important for your community to pursue? Please rank below.

Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very Important	83.33%	10
Somewhat Important	16.67%	2
Not Important	0.00%	0
TOTAL		12

APPENDIX C: PRIORITY RANKING FORMS

Bandera County

Bandera County Hazard Mitigation Plan
Prioritization Excercise

Bandera County

STAPLEE Ranking - Jurisdiction: Bandera County
The project was evaluated based on STAPLEE criteria on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration.
(1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)

Timeframe Values: Within next 2 years --> Immediate (I); 2-3 years --> Near (N); 3-5 years-->Short (S); More than 5 years-->Long (L)

ID	Mitigation Action	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	BONUS (5 pts): Addresses Multiple Hazards	BONUS (5 pts): Complements Another Entity's Efforts	TOTAL SCORE	TIMEFRAME	
1	Implement the identified interoperable communications system for all identified users	5	5	1	4	5	4	3	5		27	S	4
2	Develop a hazard awarenes week for implementation countywide in cooperation with local schools and school districts.	3	3	3	3	5	3	3	5		23	I	9
3	Study existing shelter needs and modify as necessary	4	3	2	3	5	3	5	5		25	I	6
4	Publish, distribute, and disseminate (countywide) hazard information brochures.	3	3	3	3	5	2	3	5		22	I	18
5	Implement Community Emergency Response Teams (CERTs)	3	3	2	2	5	3	3	5		21	N	20
6	Investigate availability of funding and/or TA from TDEM for development of dam inundation data (countywide)	3	4	1	3	5	3	3	—		22	L	19
7	Lighting Protection for communication towers	5	5	1	4	5	4	3	—		27	S	5
8	CWRP Wildfire Protection Plan	3	4	2	3	5	4	3	—		24	L	8
9	Study and implementation of SH 16 Bridge @ the Medina River preferred flood mitigation alternative.	3	4	1	4	5	3	3	—		23	S	10
10	Study and implementation of SH 16@ Lower Mason Creek and @ Bandera Creek preferred flood mitigation alternative.	3	4	1	4	5	3	3	—		23	S	11
11	Study and implementation of SH 173 @ the Medina River preferred flood mitigation alternative.	3	4	1	4	5	3	3	—		23	S	12
12	Study and implementation of Patterson St. @ Medina River preferred flood mitigation alternative.	3	4	1	4	5	3	3	—		23	S	13
13	Study and implementation of FM 470 @ Medina River preferred flood mitigation alternative.	3	4	1	4	5	3	3	—		23	S	14
14	Study and implementation of FM 470 @ Indian Creek preferred flood mitigation alternative.	3	4	1	4	5	3	3	—		23	S	15
15	Study and implementation of FM 2107 @ Medina River preferred flood mitigation alternative.	3	4	1	4	5	3	3	—		23	S	16
16	Update the county wide emergency action plan annually	3	4	3	3	5	5	5	5		28	I	1

Bandera FWSD #1

Bandera County Hazard Mitigation Plan
Prioritization Excercise

STAPLEE Ranking - Jurisdiction: FWSD #1
The project was evaluated based on STAPLEE criteria on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration.
(1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)

Timeframe Values: Within next 2 years --> Immediate (I); 2-3 years --> Near (N); 3-5 years-->Short (S); More than 5 years-->Long (L)

ID	Mitigation Action	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	BONUS (5 pts): Addresses Multiple Hazards	BONUS (5 pts): Complements Another Entity's Efforts	TOTAL SCORE	TIMEFRAME
1	Harden facilities against hazards	3 L	3 L	3 L	3 L	4 L	3 L	2 L			21	
2	Acquire and install generators at all critical facilities	4 I	4 I	4 I	4 I	5 I	4 I	4 I			29	
3	Water Conservation Education Program	3 N	3 N	3 N	3 N	3 N	3 N				18	

City of Bandera

Bandera County Hazard Mitigation Plan
Prioritization Excercise

STAPLEE Ranking - Jurisdiction: City of Bandera
The project was evaluated based on STAPLEE criteria on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration.
(1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)

Timeframe Values: Within next 2 years --> Immediate (I)
2-3 years --> Near (N)
3-5 years-->Short (S)
More than 5 years-->Long (L)

ID	Mitigation Action	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	BONUS (5 pts): Addresses Multiple Hazards	BONUS (5 pts): Complements Another Entity's Efforts	TOTAL SCORE	TIMEFRAME
1	Relocate wastewater treatment plant outside of the floodplain.	5	5	3	5	5	5	5	5	5	43	2 years
2	Adopt codes to control location of development, especially in high flood hazard areas.											
3	Chlorine Response	5	5	1	5	5	5	5			31	2 years
4	Acts of Terrorism	5	5	1	5	5	5	5			31	2 years
5	Contaminated Water Source	5	5	5	5	5	5	5			35	3-5 years
6	Animal Control	5	5	2	5	5	5	5			32	3-5 years
7	Diversity Water Resources and improve management of the lower Trinity Acquifer. (Surface water acquisition, treatment, and ASR project)	5	5	0	5	5	5	5	5	5	40	5+
8	Drill two new Trinity Acquifer Wells	5	5	1	5	5	5	5	5	5	41	3-5 years
9	Existing well study											
10	Develop and promote hazard awareness campaigns	5	5	5	5	5	5	5			35	2 years
11	Build Medina River Greenway improvements once funding is secured											
12	Create a two hundered (200) foot riparian zone along the City side of the Medina River											
13	Develop and implement low impact Development Standards for its stormwater management best management practices (BMP's).	5	5	1	5	5	5	5			31	2-3 yrs.
14	Install wayfinding signage along the SH 16 corridor.											
15	Develop Emergency Preparedness page on city website											
16	Wildfire Prevention Education											

Bandera County Hazard Mitigation Plan
Prioritization Excercise

STAPLEE Ranking - Jurisdiction: City of Bandera
The project was evaluated based on STAPLEE criteria on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration.
(1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)

Timeframe Values: Within next 2 years --> Immediate (I)
2-3 years --> Near (N)
3-5 years-->Short (S)
More than 5 years-->Long (L)

ID	Mitigation Action	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	BONUS (5 pts): Addresses Multiple Hazards	BONUS (5 pts): Complements Another Entity's Efforts	TOTAL SCORE	TIMEFRAME
17	Develop Critical Wildfire Protection Plan											
18	Install lightning protection devices											

Bandera ISD

Bandera County Hazard Mitigation Plan
Prioritization Excercise

STAPLEE Ranking - Jurisdiction: Bandera ISD
The project was evaluated based on STAPLEE criteria on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration.
(1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)

Timeframe Values: Within next 2 years --> Immediate (I)
2-3 years --> Near (N)
3-5 years-->Short (S)
More than 5 years-->Long (L)

ID	Mitigation Action	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	BONUS (5 pts): Addresses Multiple Hazards	BONUS (5 pts): Complements Another Entity's Efforts	TOTAL SCORE	TIMEFRAME
1	Generator needed for shelter	1	5	3	3	1	1	1			15	L
2	Develop a hazard awarenes week for implementation countywide in cooperation with the county.	3	5	3	3	3	3	3			23	S
3	Study existing shelter needs and modify and upgrade as necessary	5	3	3	3	3	3	3			23	N
4	Harden facilities and assets	5	5	5	5	5	5	5	5		40	N
5	Create, Fund and Staff a School Resource Officer Position	5	5	5	5	5	5	5	5		40	N

Flying L PUD

Medina ISD

Bandera County Hazard Mitigation Plan
Prioritization Excercise

STAPLEE Ranking - Jurisdiction: Medina ISD
The project was evaluated based on STAPLEE criteria on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration.
(1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)

Timeframe Values:
Within next 2 years --> Immediate (I)
2-3 years --> Near (N)
3-5 years-->Short (S)
More than 5 years-->Long (L)

ID	Mitigation Action	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	BONUS (5 pts): Addresses Multiple Hazards	BONUS (5 pts): Complements Another Entity's Efforts	TOTAL SCORE	TIMEFRAME
1	Generator needed for shelter	3	3	1	5	3	2	5			23	S
2	Develop a hazard awarenes week for implementation countywide in cooperation with the county.	3	4	3	5	2	3	5			20	N
3	Harden facilities and assets	5	5	5	5	5	5	5			35	I
4	Create, Fund and Staff a School Resource Officer Position	5	5	5	5	5	5	5			35	I

Medina WSC

Bandera County Hazard Mitigation Plan
Prioritization Excercise

STAPLEE Ranking - Jurisdiction: Medina WSC
The project was evaluated based on STAPLEE criteria on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration.
(1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)

Timeframe Values:
Within next 2 years --> Immediate (I)
2-3 years --> Near (N)
3-5 years-->Short (S)
More than 5 years-->Long (L)

ID	Mitigation Action	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	BONUS (5 pts): Addresses Multiple Hazards	BONUS (5 pts): Complements Another Entity's Efforts	TOTAL SCORE	TIMEFRAME
1	Acquire and install generators at all critical facilities									COMPLETED 03/01/24		
2	Harden facilities against hazards	5	4	4	5	5	4	5			32	
3	Water Conservation Education Program	5	4	3	5	5	3	5			30	

Utopia ISD

APPENDIX D: CRITICAL FACILITIES

The list and location of critical and vulnerable facilities will be kept and maintained by the Emergency Management Coordinators for Bandera County. This list is provided in the form of an ArcGIS geodatabase and a Microsoft Excel spreadsheet with location and contact information. The table below is a summary of critical facilities subject that are vulnerable to hazards based on location and magnitude.

Bandera County
7 VFDs, 1 Sheriff's Office, 3 Private Schools, 2 day care centers, 1 Constable's Office, 1 Courthouse, 1 Justice Center (EOC), 1 JP's Office, 1 Lakehills Annex (Government Building), 1 Tax Office, 1 County Attorney's Office, 1 Road and Bridge Department, 1 County Jail, 1 EMS Station, 7 Communication Towers, 2 Community Centers (Shelters), 1 Nursing Home
Bandera FWSD #1
1 Headquarter Building, 3 Water Plants, 1 Lift Station
City of Bandera
1 City Hall, 1 VFD, 1 American Legion Bldg. (Shelter), 1 Nursing Home, 1 Day Care
Bandera ISD
2 Elementary Schools, 1 Middle School, 1 High School
Flying L PUD
2 Wells and Storage, 2 Lift Station, 1 Wastewater Plant
Medina ISD
1 Elementary School, 1 Secondary School
Medina WSC
2 Wells, 1 Storage Tank, 1 Pump Station
Utopia ISD

APPENDIX E: MEETING DOCUMENTATION

Thank you for Coming

Please Sign In

Name	Representing	Email	Phone
Dayle S. Heiner	Bandera ISD	dheiner@banderaisd.net	830 460 3895
Harvey Young	Medina Water Co.	hyoungPfarmagmile	617-801-3404
DAN POSTON	Medina Water Co	dposton401@aol.com	512 779-0556
Susan Darst	City of Bandera	specialist@cityofbandera.org	210-268-6226
Gary OLIVER	medina ISD	gary.oliver@medinaISD.org	830 [illegible]-2855
Steve Childers	Flying L PUD	steve@SAchilders.com	361-658-8082
JUDY LEFEVERS	BANDERA COUNTY	emc@banderacounty.org	830-460-8299
Patty Swords	Lanaford		
Gabe Rojas	Lanaford		
Mike Baker	BCSO/BISD	SROBaker@banderaisd.net	830-688-2030

Thank you for Coming

Please Sign In

BANDERA CO. - Core Team 2 Meeting
February 27, 2024, 2 pm - 4pm
Bandera County Justice Center

Name	Representing	Email	Phone
Harvey Young	Medina Water CO,	HYoungPfarmgmail	617-801-3404
JON Henry Miller	Self	Janm128@Prodigy.net	830-246-2007
Dayle Heiner	Bandera ISD	dheiner@banderaisd	830 460 3895
JUDY LEFEVERS	BANDERA Co.	emc@banderacounty.org	
Patty Swords	Lanaford		
LESLIE RECTOR	Flying L PUD	jeddielynn@aol.com	830-460-1539
Gabriel Rojas	Rojas Planning	gricity@gmail.com	512-468-4455
Dave Mauk	BCRAGD	dmauk@bcragd.org	830 796 7260
Will Whitmire	BCRAGD	lwhitmire@bcragd.org	830 796 7260
Daniel Burns	Bandera Sheriff's office	sheriff@banderacountytx.org	830-796 3771

Bandera County

Hazard Mitigation Plan 2024 Update

"By failing to prepare, you are preparing to fail."

- Benjamin Franklin

The Bandera County Office of Emergency Services is leading the county-wide Hazard Mitigation Plan (HMP) update process to examine future natural hazards that could risk life and property. **The update is required to be eligible for future mitigation grants and help communities be prepared.**

WHAT?	HMPs are prepared and adopted by counties and jurisdictions with the primary purpose of **identifying, assessing, and reducing the long-term risks** from natural hazard events.
WHY?	Comprehensive, long-term planning will help Colorado County and the participating jurisdictions prepare for disasters **before they happen** to reduce the impact when a disaster occurs.
WHO?	FEMA regulations require **public participation in HMP development**. Support the plan by attending a public meeting, taking the public survey (at the link/QR code below), and checking the website for updates: https://www.banderacounty.org/page/emergency.management

Live or work in Bandera County?
Take our survey!
https://www.tiny.cc/banderahmp

LANGFORD COMMUNITY MANAGEMENT SERVICES

FAQs

What are the benefits of hazard mitigation?

- Identifying actions for risk reduction that are agreed upon by stakeholders and the public.
- Focusing resources on the greatest risks and vulnerabilities.
- Building partnerships by involving citizens, organizations, and businesses.
- Increasing education and awareness of threats and hazards, as well as their risks.
- Communicating priorities to state and federal officials.
- Aligning risk reduction with other community objectives.

What will the plan address?

The primary hazards of concern in the county include dam/levee failure, drought, erosion, expansive soils, extreme temperature, flood, hailstorm, land subsidence, lightning, tornado, wildfire, wind, and winter storms.

The study will focus on existing buildings and potential future development, infrastructure, and lifelines that might be impacted. Lifelines include but are not limited to municipal buildings and infrastructure such as power-generation facilities, water utilities, roadways, railroads and communication systems

Where can I see the 2024 plan?

Sections of the draft plan will be available for download, review, and comment on our website at
https://www.banderacounty.org/page/emergency.management

For more information about this process, please contact:

Bandera County Office of Emergency Services:
830-460-8299 – or eoc@banderacounty.org


ATTENTION! BANDERA COUNTY, THE CITY OF BANDERA, THE TOWN OF MEDINA, & FLYING L RANCH ARE HOSTING A PUBLIC OPEN
Learn about the Hazard Mitigation Plan and provide VALUABLE LOCAL FEEDBACK.
You're Invited!
Public Meeting
TUESDAY, FEBRUARY 27, 2024
BANDERA COUNTY COURTHOUSE
5 PM
THE STATE OF TEXAS
COUNTY OF BANDERA
Presented by:
LANGFORD
COMMUNITY MANAGEMENT
SERVICES
EST. 1983
ROJAS

APPENDIX F: ADOPTION RESOLUTION