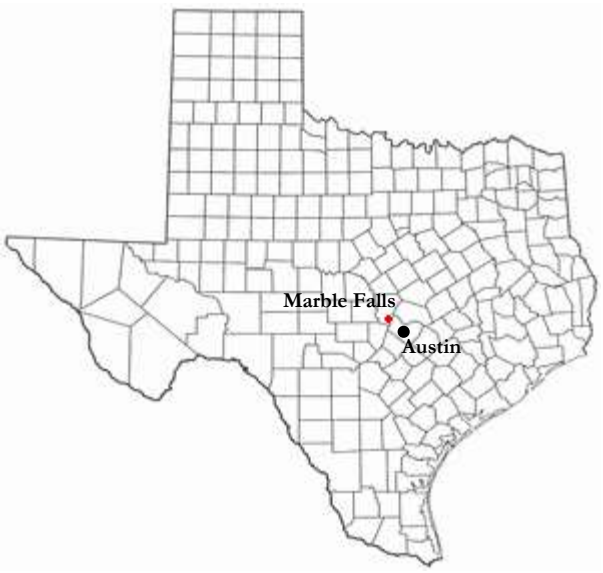
City of Marble Falls Hazard Mitigation Plan

Source: kut.org, October 2018 Flooding

ROJAS

SECTION 1: INTRODUCTION

Background



Marble Falls is located in the middle of the Texas Hill Country on the Colorado River, 58 miles northwest of downtown Austin, 85 miles north of San Antonio, in the middle of the Highland Lakes area, the largest chain of lakes in Texas. While large portions of the surrounding area 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. Marble Falls is susceptible to a wide range of natural hazards, including but not limited to hurricanes, flooding, hail, extreme heat, drought, and wildfire. The City of Marble Falls has a hazard profile similar to many Central Texas communities with heat waves and drought throughout the long summer and fall and flash flooding events typically in the spring and summer. With climate change affecting weather patterns, 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 and 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 Marble Falls 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 Marble Falls Hazard Mitigation Plan update is a single-jurisdictional plan covering the City of Marble Falls and its Extra Territorial Jurisdiction. The prior hazard mitigation plan for the area was the 2016 Burnet County Hazard Mitigation Plan. Additional entities that were reached out to and chose to participate as stakeholders were Burnet County, Texas Division of Emergency Management, Lower Colorado River Authority, and the Regional Flood Planning Group. Below is an example of outreach efforts to inform the public about the upcoming Hazard Mitigation Plan (HMP) development process.

<u>Notice of mitigation planning efforts on county and city websites and the local newspaper, Winter 2023</u>

The plan includes a CORE Planning team composed of key City of Marble Falls staff and officials to develop specific mitigation strategies unique to the community. Once the Core team begins to meet, Rojas said

that an on-line community survey would be conducted to understand top concerns, along with several public hearings. The survey will also be accessible in public facilities such as the library and city hall.

The CORE local planning team will be reviewing the community capabilities, conducting a risk assessment and identifying mitigation goals and actions, while gaining public input through public hearings. Once the plan is completed, a final public hearing will be held to present the completed plan and receive feedback. The plan will be submitted for FEMA's final approval and will then be adopted by the City of Marble Falls. Once adopted, the City is eligible for FEMA funds to help implement those action items within the plan.

Mayor Westermann says the city council's hope is that residents will become engaged, offer feedback about the plan and consider what their households would do in a wildfire, tornado or other emergency situation. This planning and public input process will help guide the city on what mitigate actions to take and how best to prioritize those actions before the next hazard.

The prior hazard mitigation plan was completed in 2016 and included Burnet County, City of Bertram, City of Burnet, city of Granite Shoals, City of Highland Haven, City of Marble Falls, and the City of Meadowlakes. This plan will expand upon the 2016 plan with new capabilities, risk assessments, and mitigation actions contained therein, with regard to history, landscape, risk, economy, transportation, and other factors.

This new plan scope is to develop a detailed understanding of the planning area with regard to existing capabilities and historical 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 Guiding Principle of the Plan is, **to reduce or eliminate the long-term risks to loss of life and property damage in the City of Marble Falls from the full range of natural disasters.**

The Plan was prepared by Marble Falls in accordance with FEMA hazard mitigation planning requirements and guidance. 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 within the planning area. 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.

Core Planning Team members identified 12 natural hazards to be addressed by the plan. More details about these hazards are contained in Section 4 with the risk assessments for each hazard discussed in more detail in Sections 5-16. The specific goals of the Plan are identified in Section 17 with specific mitigation actions contained in Section 18. The ongoing maintenance of the Plan is discussed in Section 19 with details on how the plan is incorporated into existing plans and funding mechanisms, monitoring, evaluation, annual and 5-year updates, and a commitment to continue public involvement with 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.

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.

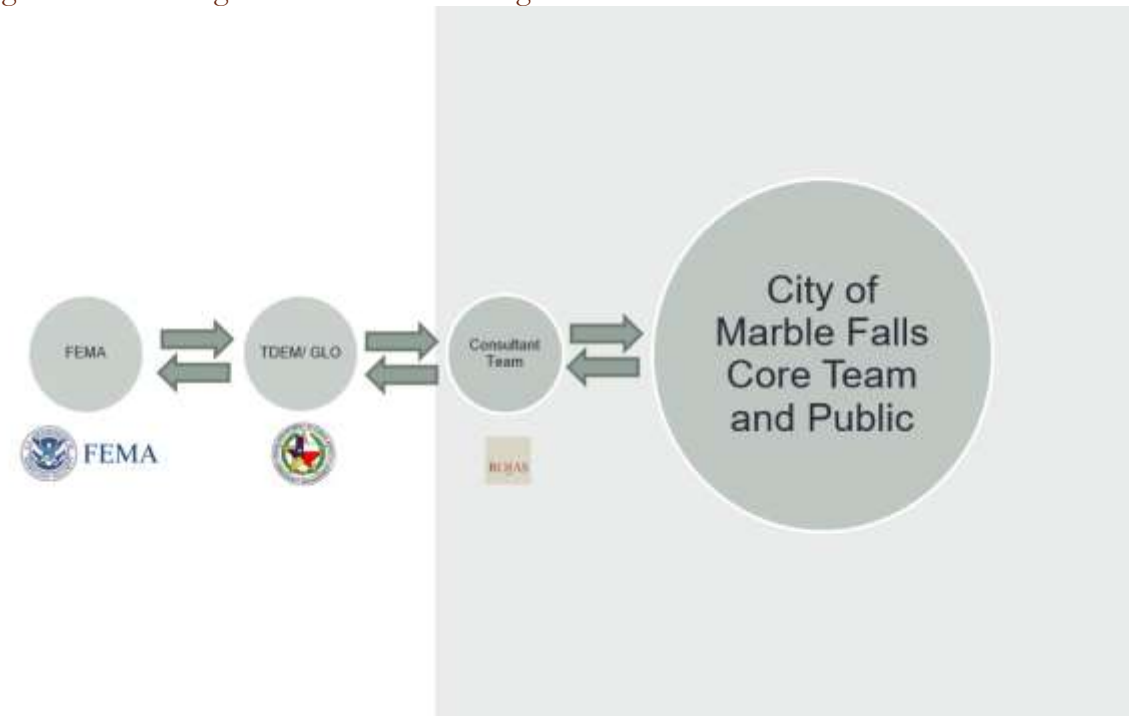
3. Develop a Mitigation Strategy – The local government then sets priorities and develops long-term strategies for avoiding or minimizing the undesired effects of disasters. The mitigation strategy addresses how the mitigation actions will be implemented and administered.

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

Marble Falls hired Rojas Planning to provide technical support and to oversee development of the 2023 Marble Falls Hazard Mitigation Plan Update. The Plan was organized using a direct representative model with each participating city department or local organization sending a representative to represent their interests. A local Core planning team was setup at the outset where the role and responsibilities of these representatives were communicated to attend meetings, provide community and stakeholder outreach, execute plan development tasks, and provide input and feedback. Ultimately, this is the group responsible for creating the momentum necessary to implement the mitigation actions at the local level.

Figure 1-2: Planning Team and Process Diagram



The first CORE meeting was held on Tuesday October 18, 2022 at the Fire Department Meeting Room at 700 Avenue N Marble Falls, Texas 78654. 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 Planning Team representative. Some of the responsibilities of the Core Planning Team that were discussed include Capability Assessment

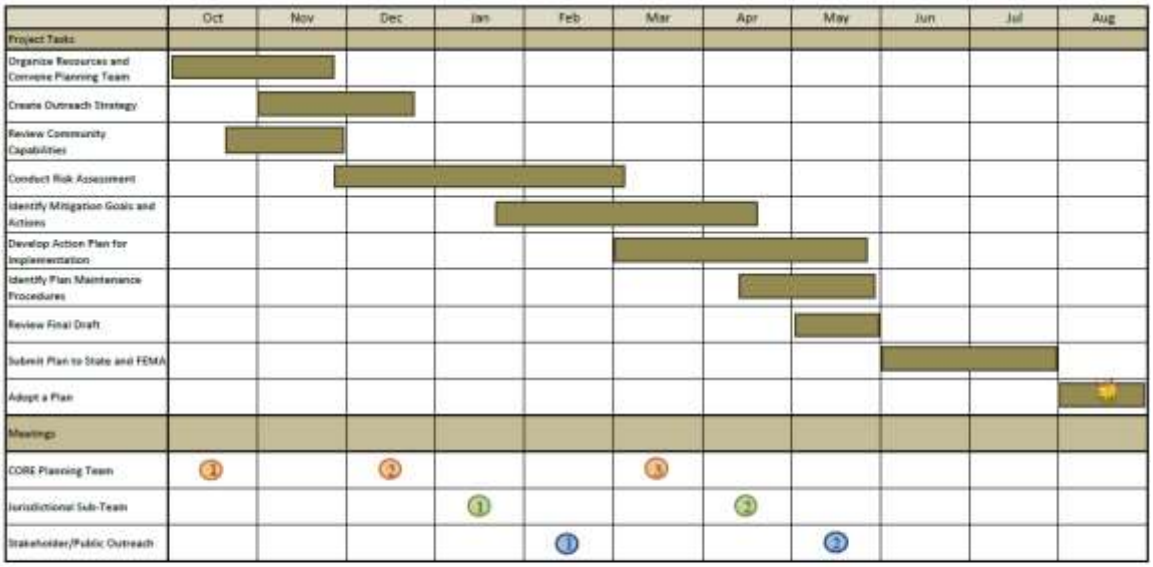
Surveys, identifying critical facilities, providing a public survey to the general public, providing input regarding the identification of hazards, identifying mitigation goals, and developing new mitigation actions and ranking mitigation actions.

Many staff and officials from Marble Falls were present at this kickoff Core Planning Team meeting. The first Core meeting included a discussion on Plan stakeholders, options for engaging the public, and developing a schedule for Plan development. Core Planning Team members were asked to attend all workshops and any that did not attend were given copies of the meeting materials and contacted by phone or e-mail.

Table 2-1. Core Planning Team (2020 Census)

Entity/Population	Position or Title	Agency
City of Marble Falls 7,037	Fire Chief Emergency Management Coordinator	Fire Emergency Management

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.
3	Conduct local risk assessments and identify information gaps, identify mitigation goals and actions, and develop implementation plan
Jurisdictional 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

In order to perform the hazard risk assessments, a number of resources were utilized to synthesize and develop previous hazard events and impacts to the planning area. The preliminary results of the hazard risk assessments were presented at the first public meeting as well as Core Meeting 2 and provided in their entirety after the meeting to assist with the development of mitigation actions. The information from these assessments were used to facilitate discussion that led to participants developing actions based on unique experiences

and responsibilities. Resources include the National Oceanic and Atmospheric Administration (NOAA), U.S. Geographic Society (USGS), U.S. Department of Health and Human Services, US Department of Agriculture, FEMA, U.S. Army Corp of Engineers (USACE), Texas Water Development Board (TWDB), Texas General Land Office (GLO) Texas A & M Forest Service, Texas Division of Emergency Management (TDEM), local reporting, local knowledge, and other sources.

Existing Plans

The following existing plans 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 (2018) - 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 version of this Plan.

Burnet County Hazard Mitigation Plan (2016) – The existing hazard mitigation plan that includes the City of Marble Falls to which this plan is an update. The action items that were completed, are still ongoing, or were discarded for this update are discussed in detail in Section 18, Mitigation Actions.

Marble Falls Flood Protection Planning Study – (2014) Three of the eight alternatives identified in this flood protection plan showed to be the most promising based on an evaluation and ranking of each according to seven criteria factors regarding the tangible and intangible benefits to the community. It is recommended that The City of Marble Falls develop a creek walk trail system to connect the downtown area with the community parks and upsize 2 bridge and culvert crossing along US Highway 281 to minimum 25-year standards.

Downtown Master Plan (To be updated next year) – Goals include tree lined sidewalks that will help to mitigate extreme heat and the extension of the creek walk trail system through the downtown area.

Lower Colorado-Lavaca Regional Flood Plan (2023) - Below is a summary of activities that are included in the regional flood plan that impact Marble Falls. Activities must be in the regional flood plan to be eligible for Flood Infrastructure Funding (FIF). (https://www.lowercoloradolavacaflood.org/2023-flood-plan)

Flood Management Evaluations (FMEs)

- Burnet County Low Water Crossings (LWC) Assessment - Assessment of LWC's includes the evaluation of existing condition LOS, average daily traffic, and emergency access routes to understand risk of each crossing. Post- assessment, LWC's can be prioritized to support future implementation of improvements.
- Burnet County Modeling and Mapping Update - The study should include the development of updated hydrologic and hydraulic models utilizing the best available science and data. Updated floodplain maps can then be used for regulation and update of outdated FEMA maps in this portion of Burnet County.

Flood Mitigation Projects (FMPs) – Task 12

- Marble Falls Broadway Avenue at Backbone Creek Low Water Crossing - This FMP replaces the Broadway Street bridge and does channel improvements adjacent to the bridge. The existing bridge is approximately 150 feet long. The new bridge length will be increased to approximately 350 feet long and be raised up 10.5 feet.
- Marble Falls Whitman Branch Industrial Area - Regional Detention - This FMP is regional stormwater detention that controls flows upstream of the Commerce Street area. The solution includes an approximately 36 ft tall earthen dam approximately 1750 feet long on Whitman Branch near Coach Drive.

Impact fee Study (2023) - In May 2022 the City of Marble Falls ("City") engaged Willdan Financial Services ("Willdan") and Miller Gray, LLC ("Miller Gray") to develop an update to their Water and Wastewater ("Utility") Impact Fees, last revised in 2018. The methodology used to develop the City's Utility impact fees is governed by Texas Local Government Code Title 12, Subtitle C, Chapter 395 ("Chapter 395").

As part of this process, the City's water and wastewater service areas are separate and distinct. The engineering consultant, Miller Gray, has developed a land use assumptions map and a capital improvement plan ("CIP") for each utility. The CIP identifies water and wastewater projects that will be required both to repair and replace current capacity and to expand total system capacity to meet the needs of new growth over the next decade. The results of this analysis, and the recommended maximum impact fees for each utility, are presented in this summary report.

Wildfire Prevention Plan (2018) - The purpose of the City of Marble Falls CWPP is to protect human life and reduce property loss due to wildland fire in the Marble Falls area. Although reducing the threat of wildland fire is a primary motivation, managing area wildlands for hazardous fuel reduction and fire resilience is only one part of the overall CWPP plan. Residents and visitors alike want healthy, fire resilient wildlands that provide habitat for wildlife, recreation, and scenic beauty. These wildland areas are a critical part of the community's value and economy. The CWPP outlines a strategy for long-term success by identifying priorities for action and suggests immediate steps that can be taken to protect the community from wildland fire while simultaneously protecting other important social and ecological values

Goals

- Provide for the safety of residents
- Limit the number of homes destroyed by wildfire
- Promote and maintain healthy ecosystems
- Educate citizens about wildfire

Objectives

- Establish secondary ingress/egress routes in subdivisions with one way in, one way out roads.
- Implement identified fuels reduction projects on public land near communities at highest risk to wildfire at a rate of 1 per year.
- Deliver wildfire prevention material and education programs through public outreach events

Development code updates (2019) - The City of Marble Falls embarked on a comprehensive review and update to the previous zoning/land use regulations. This project was prioritized as one of the key regulatory implementation actions of the adopted 2016 Comprehensive Plan. A Zoning Advisory Committee was formed to ensure the land use regulations were updated in accordance with the long-term vision and needs of the community. Several public meetings, walk-in meetings, and forums were held to ensure the community in Marble Falls had an opportunity to understand and vet the proposed land use regulations as it applies to building and development practices in Marble Falls. (https://marblefallstx.gov/564/Development-Code)

Public and Stakeholder Involvement

The hazard mitigation planning process is an opportunity for Marble Falls, including stakeholders and the general public, to evaluate and develop successful hazard mitigation actions to reduce future risk of loss of life and damage to property resulting from a disaster in 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:

County Commissioners	Mayor/ Chief Admin. Officer	City Council
Burnet County Appraisal District	Burnet County ESD #6	City Fire Department
City Police Department	Local EMS	Chamber of Commerce
Historical Commission	Planning Department	Public Works
City Water and WW Department	Pedernales Electric Cooperative	Waste Management
Marble Falls ISD	Texas General Land Office (GLO)	TDEM –Nicole Moore, Mitigation Coordinator
TDEM – Daniel Reyes, County Liaison Officer	Texas Water Development Board (TWDB)	Texas Commission on Environmental Quality (TCEQ)
Region 10 – Lower Colorado Regional Flood Planning Group	Central Texas Groundwater Conservation District	Lower Colorado River Authority (LCRA)
Texas Fire Marshal's Office	TxDOT – District Representative	Capital Area Council of Governments (CAPCOG)
Miller Gray LLC (Engineer)	Red Cross	

The public input process can be viewed as 3 tiers of groups based on participation and responsibility for plan development and implementation.

The first tier is the Core Planning Team Members that constitute representatives from Marble Falls that represent different departments within the city organization related to emergency management, emergency response, planning, development, and political leadership. Their responsibilities and participation rates are the second highest and are required to attend every Core team meeting in the project schedule and encouraged to attend the public meetings. Two

(2) Core Planning Team Meetings were held throughout the development of this plan with action items and tasks for each member.

Figure 1-3: 1st Core Team Meeting, October 20, 2022

The second tier was the jurisdictional sub-team comprised of two emergency management officials focused on leading the information gathering effort needed to guide the plan. This Jurisdictional Sub-Team functioned as an executive leadership team that clearly communicated and distilled wider city goals and objectives between Core team members, members of the public, and the consultant. For this plan participation structure, their responsibilities and participation rates are the highest and are required to attend every meeting in the project schedule. This includes Core Team Meetings, Jurisdictional Sub-Team Meetings, and the Public Meeting. This second tier had responsibilities associated with the specific tasks assigned to each of the 2 meetings scheduled for this group.

Figure 1-4: Public Meeting at The Lakeside Pavilion, Tuesday May 9, 2023

The final stakeholder group was the local officials and public that came to the public workshop and participated in the public survey. The public workshop was held on Tuesday May 9, 2023 at The Lakeside Pavilion in Marble Falls. An overview of the planning process was provided as well as how they may work with state and federal agencies to apply for future project funding to implement mitigation projects relative to their specific hazard risks. The critical facilities map as well as a floodplain map was presented to received community feedback on data gathering and risk assessment efforts up to that point. The on-line and paper surveys were "live" from May 1st, 2023 – July 1st, 2023. These workshops along with the results on the survey (Appendix B) were used to develop the final list of hazards to be studied and to understand the priorities of the community as they relate to hazard mitigation. Neighboring communities as well as local and regional stakeholders were invited via email and asked to participate in the public survey.

Figure 1-5: Public Meeting at The Lakeside Pavilion, Tuesday May 9, 2023

Survey Results

1. 58 total surveys, 0 manually entered
2. Just over 55% of respondents were within the city limits of Marble Falls, nearly 14% of the respondents stated that they were outside the City Limits but within the ETJ, and just over 20% are both outside the city limits and outside of the ETJ.
3. Floods was identified as the highest threat with nearly 28% of all responses, followed by drought, wildfire, extreme heat, and severe winter storms.
4. Extreme heat, Severe Winter Storms, Drought, Wildfire, tornado, lightning, and thunderstorms are the more prominent responses in the hazards that had been experienced or hazards expected to be experienced.
5. 81% of respondents are not located in a floodplain, with just more than 8% identified as having flood insurance.
6. 69% of respondents are somewhat concerned about being impacted by a disaster, 14% of respondents are not concerned, and 17% of respondents are extremely concerned.

7. The majority, 54%, have not taken steps to make home, business, or community more resistant to hazards with 73% that would like to know more about how to.
8. Internet was identified as the most effective way to receive information about how to make home, business, or community more resistant to hazards at 40%.
9. Contact by text or e-mail was identified as the best single way to alert public to an imminent disaster at 66% with an all of the above approach using text, email, social media, and tv reports preferred by the 28.
10. The mitigation activities that received the highest responses were to work on improving the damage resistance of utilities (electricity, communications, water / wastewater facilities, etc.), retrofit and strengthen essential facilities such as police, fire, emergency medical services, hospitals, schools, etc., inform property owners of ways they can mitigate damage to their properties, and to provide better information about hazard risk and high-hazard areas.
11. Hazard prevention through building regulations, natural resource protection, structural projects, public education, and emergency services actions were identified as very important. Property protection was the only answer that was identified overall as somewhat important.

SECTION 3: PLANNING AREA PROFILE

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

Overview

Marble Falls sits on the banks of Lake Marble Falls in Southern Burnet County and marks the middle of the Highland Lakes area, the largest chain of lakes in Texas. Marble Falls is located in the middle of the Texas Hill Country and is a convergence of business, industry, adventure, and small-town charm. It was founded by General Adam R "Stovepipe" Johnson on July 12, 1887 and was incorporated on May 18, 1907. The terrain of this area is characterized by rolling hills with local deep and dense dissections and the land is drained by the Colorado River, which forms most of the western Burnet County line. The average minimum temperature is 37° F in January, and the average maximum is 96° in July. The growing season averages 234 days annually, and the rainfall averages about thirty inches. Wildlife in Burnet County includes deer, coyotes, bobcats, beaver, opossums, ring-tailed cats, foxes, raccoons, turkeys, badgers, weasels, skunks, and squirrels, as well as assorted birds, fish, and reptiles. Among the county's mineral resources are granite, limestone, industrial sand, and graphite.[1] Figure 3-1 shows the Marble Falls City Limits, Extra Territorial Jurisdiction, as well as the surrounding communities.

Figure 3-1: Marble Falls Planning Area

[1] Source: https://www.tshaonline.org/handbook/entries/burnet-county

Population and Demographics

The official 2020 Census count for the City of Marble Falls is 7,037. The larger area described by zip code 78654 has a population of 25,514. More than 447,000 people live within a 30-mile radius of Marble Falls, including a workforce of over 163,800. Marble Falls is the regional economic hub for the Highland Lakes Area evidenced by a much larger daytime population that the city proper population count.

Table 3-1: Population of Marble Falls

2020 Census Population	2022 Population Estimate	Estimated Vulnerable or Sensitive Populations[2]		
		Youth (Under 5)	Elderly (Over 65)	Below Poverty Level
7,037	7,423	214	1,480	1,358

Population Growth

The Census 2010 Marble Falls Population is 6,077. The 2022 population for Marble Falls within the city limits is estimated to be 7,423. 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. Overall, Marble Falls experienced an increase in population between 2010 and 2022 of 1,346 persons, or 22.15%. Table 3-2 provides historic and projected growth rates in Marble Falls.

Table 3-2: Population Growth

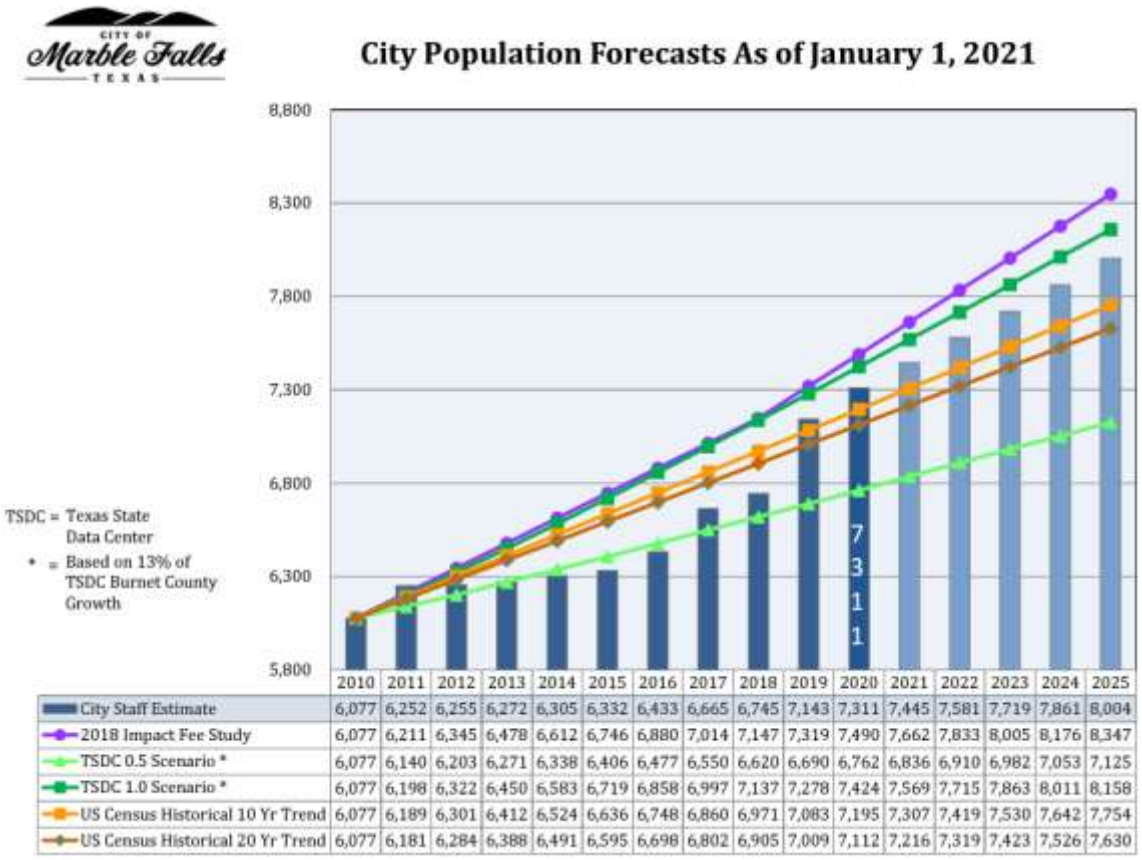
Jurisdiction	2010 Census	2020 Census	2022 Estimate[3]	2025 Projection[4]	Pop Growth (2010-2022)	Percent Growth	Pop Growth (2020-2025)	Percent Growth
Marble Falls	6,077	7,037	7,423	8,004	1,346	22.15%	967	13.74%

Future Development

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 for Marble Falls in 2025 are shown in figure 3-1 and provided by Marble Falls city staff. Population is expected to increase by 13.74% between 2000 and 2025, adding 967.

[2] The Estimated Vulnerable or Sensitive Populations are based off of the 2021 American Community Survey
[3] U.S. Census Bureau population estimates (Vintage 2022)
[4] Source: https://marblefallstx.gov/DocumentCenter/View/2444/Population-Forecasts-PDF

Figure 3-2: City Population Forecasts



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
City Staff Estimate	6,077	6,252	6,255	6,272	6,305	6,332	6,433	6,665	6,745	7,143	7,311	7,445	7,581	7,719	7,861	8,004
2018 Impact Fee Study	6,077	6,211	6,345	6,478	6,612	6,746	6,880	7,014	7,147	7,319	7,490	7,662	7,833	8,005	8,176	8,347
TSDC 0.5 Scenario *	6,077	6,140	6,203	6,271	6,338	6,406	6,477	6,550	6,620	6,690	6,762	6,836	6,910	6,982	7,053	7,125
TSDC 1.0 Scenario *	6,077	6,198	6,322	6,450	6,583	6,719	6,858	6,997	7,137	7,278	7,424	7,569	7,715	7,863	8,011	8,158
US Census Historical 10 Yr Trend	6,077	6,189	6,301	6,412	6,524	6,636	6,748	6,860	6,971	7,083	7,195	7,307	7,419	7,530	7,642	7,754
US Census Historical 20 Yr Trend	6,077	6,181	6,284	6,388	6,491	6,595	6,698	6,802	6,905	7,009	7,112	7,216	7,319	7,423	7,526	7,630

Population projections from 2030 to 2080 are listed in Table 3-3 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 an increase in population for the Marble Falls Planning Area of 7,914 persons over the 50-year period, or 103.4%. Based on the city staff projections of a population of 8,004 in 2025, these projections by the TWDB are likely undercounting future population based on more recent local growth patterns.

Table 3-3: TWDB Population Projections

Entity Name	P2030	P2040	P2050	P2060	P2070	P2080
Marble Falls	7,655	8,823	10,169	11,720	13,508	15,569

Economic Profile

Marble Falls functions as the hub for shopping, dining, and entertainment for all of Burnet County. Despite the proximity to large urban centers like Austin (60 min. away) and San Antonio (75 min. away), Marble Falls is no bedroom community. It functions as the regional economic hub for the Highland Lakes area, with a trade area of 117,500 people who generate

more than $3 million every day in gross sales. The Marble Falls economy is a vibrant one with an unemployment rate of 2.8%.[5]

The top 5 employers within the City of Marble Falls are Marble Falls ISD, Baylor Scott & White Hospital, HEB Grocery Company, Wal-Mart, and the City of Marble Falls.

The average earning per job for Marble Falls in 2022 was $59.3K. From 2017 to 2022, jobs increased by 14.9% in Marble Falls, TX from 8,985 to 10,320. This change outpaced the national growth rate of 2.4% by 12.5%. The 5-year projected job growth (2022-2027) is 16%. The top 7 Industries by number of employees in the area is construction, retail trade, accommodation and food services, finance and insurance, health care and social assistance, real estate and rental and leasing, and government.

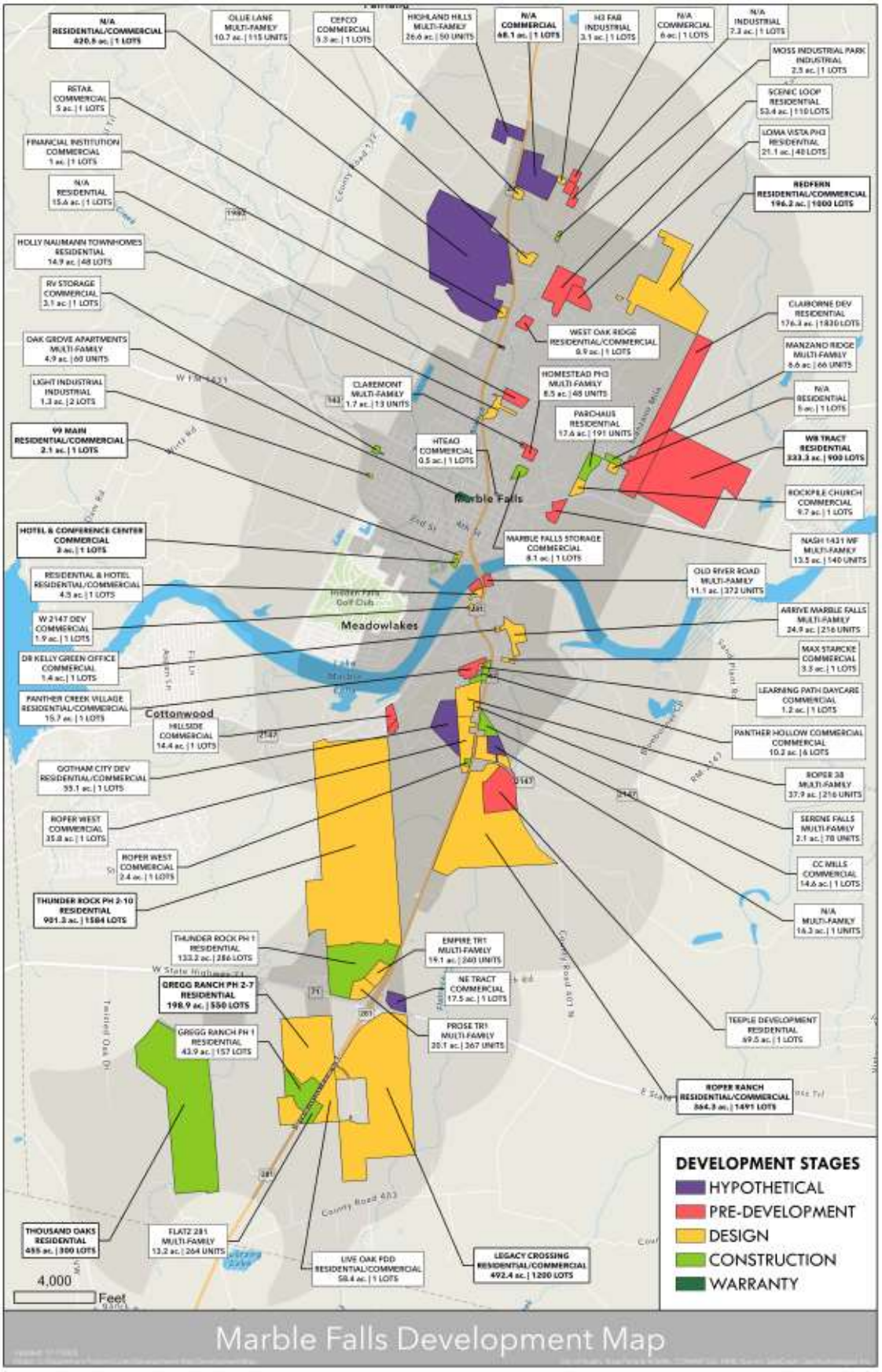
Existing and Future Land Use and Development Trends

Marble Falls has an existing Comprehensive Plan that was adopted in 2016 and is currently in the process of developing a new one. A Comprehensive Plan is a long-range planning document that guides growth over time. It provides a blueprint for future development and redevelopment in a community, based on an established framework. The plan considers existing and future needs and determines actions that the community should pursue to realize the overall vision. Once the plan is adopted, city-staff and decision-makers use the plan as a guide for community development. Comprehensive plans do not replace zoning regulations, budgets, capital improvement programs, or any other regulatory documents.

The Marble Falls Comprehensive Plan is a tool used to guide the decision-making by staff and City Council. When there are new development proposals submitted to the City, these groups will use the policy frameworks established in this plan to determine whether the proposal fits with the community-driven vision. The comprehensive plan is adaptable and can be amended over time as political and market realities change. This document is needed to ensure growth occurs in a manner that supports the community, economic development, and leads to a better future for Marble Falls' residents today and for future generations. Additionally, a Downtown Master Plan was adopted in 2011 to guide the development and determine the public revitalization projects in the downtown area. The development map on the following page, figure 3-2, shows the current private development plans in the planning area and their stage of completion. *This map shows a high level of growth in the planning area and impacts due to development in the wildland urban interface can be expected to increase.*

[5] www.marblefallseconomy.com

Figure 3-2: Marble Falls Development Map



Critical Facilities and Assets

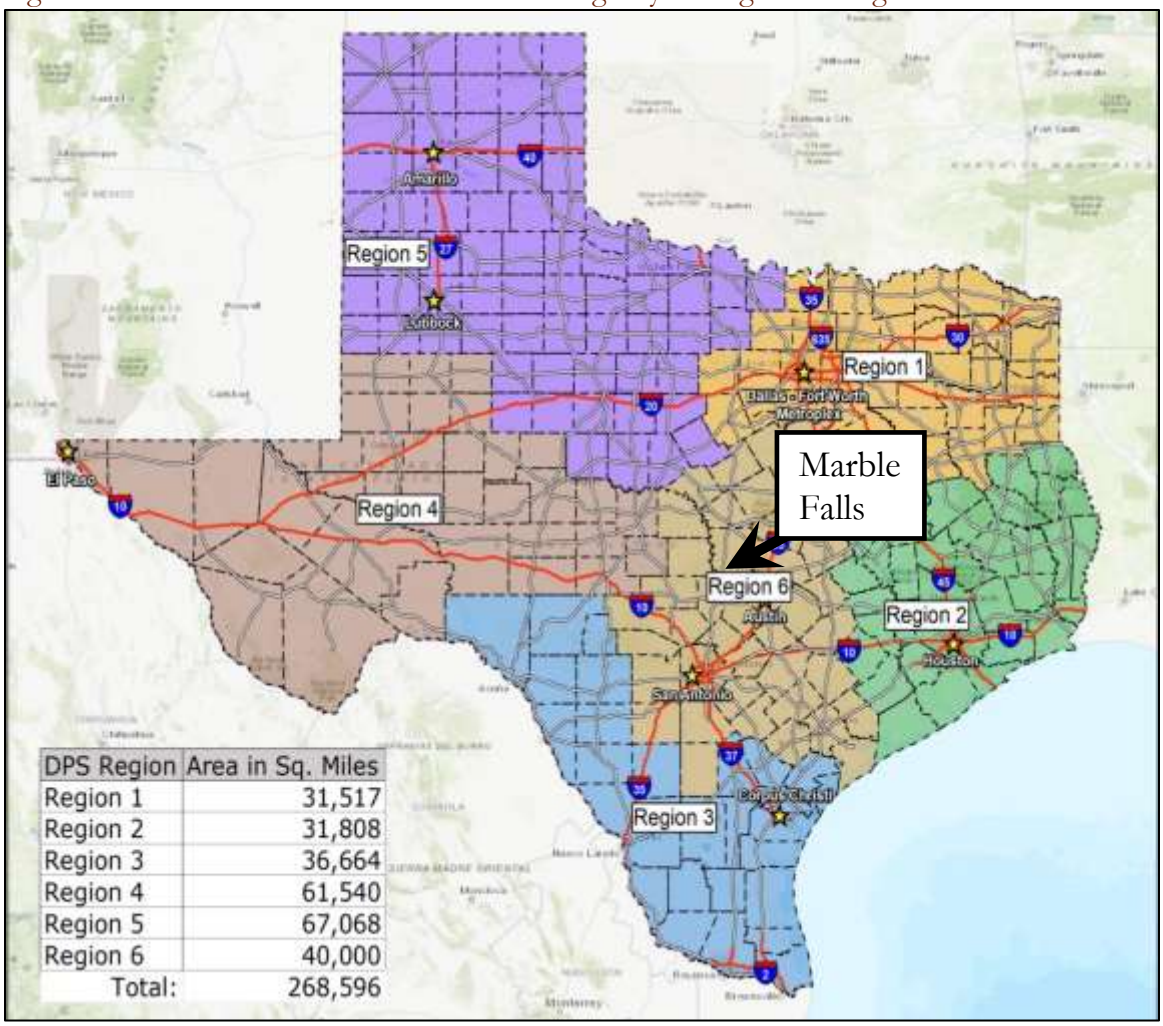
For certain activities and facilities, even a slight risk from a hazard event is too great a threat. FEMA defines these types of places as critical facilities; hospitals, fire stations, police stations, courthouse, communications, public schools, utility infrastructure and similar facilities where essential 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 18 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 Marble Falls Core Team members, 12 hazards have been identified as important to be addressed in the Marble Falls Hazard Mitigation Plan Update due to their probable risk to the area. These were chosen based upon a review of the State Hazard Mitigation Plan, a review of the historical record of disaster declarations for the Marble Falls 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, Marble Falls is located within the western 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



DPS Region	Area in Sq. Miles
Region 1	31,517
Region 2	31,808
Region 3	36,664
Region 4	61,540
Region 5	67,068
Region 6	40,000
Total:	268,596

Source: Texas Division of Emergency Management

The increased risk for specific hazards in the Marble Falls planning area can be further explored with the table below that lists disaster declarations by specific incident types. Disaster declarations are made at the county level and are not specific to any one city or sub-area, however, it is illustrative for Marble Falls 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: Summary of Declared Disasters in Burnet County

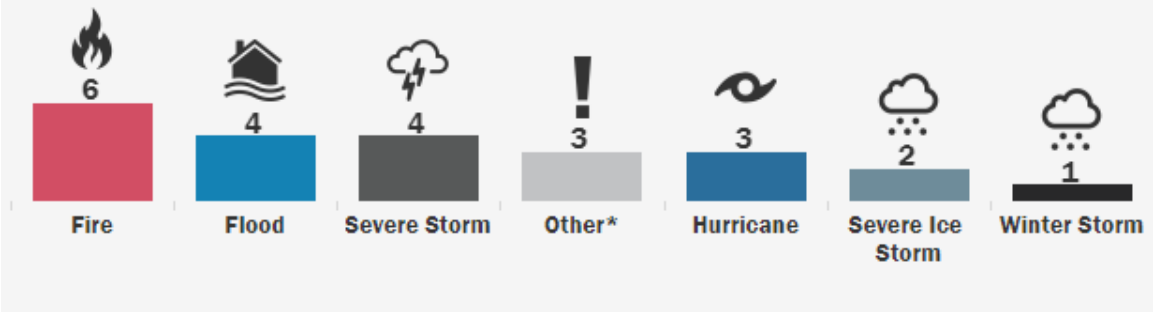
Disaster Number	Year	Title
365	1973	Severe Storm
828	1989	Severe Storm
930	1991	Flood
3113	1993	Drought
1179	1997	Flood
1239	1998	Severe Storm
3142	1999	Fire
2275	1999	Fire
1425	2002	Flood
3216	2005	Hurricane
3261	2005	Hurricane
1606	2005	Hurricane
1624	2006	Fire
1709	2007	Severe Storm
3284	2008	Fire
1999	2011	Fire
5264	2018	Fire
4416	2018	Flood
3458	2020	Biological
4485	2020	Biological
3554	2021	Severe Ice Storm
4586	2021	Severe Ice Storm
4705	2023	Winter Storm

Source: www.FEMA.gov

Since the US Federal Government began issuing disaster declarations in 1953, Burnet County has had 23 disaster declarations where individual and/or public assistance has been approved. Based on Table 4-1 above, 19 of the 23 disaster declarations have been issued in the past 25 years, since 1997. The infographics below provide a summary of the type of hazard, year, and time of year in which it occurred.

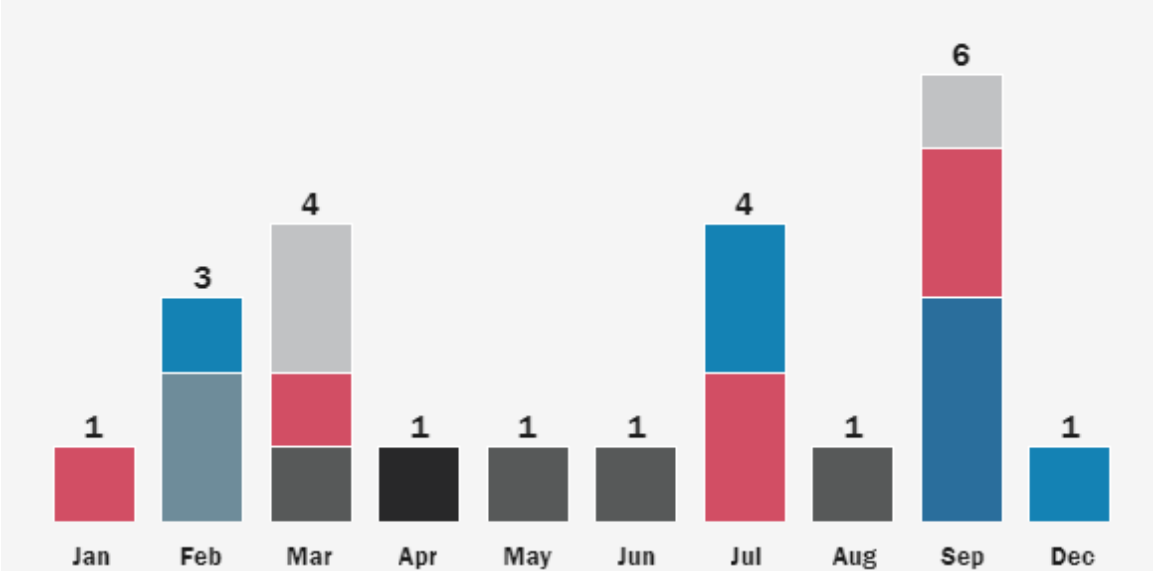
The types of hazards that have had disaster declarations for the planning area since 1953 are shown in Figure 4-2 below.

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



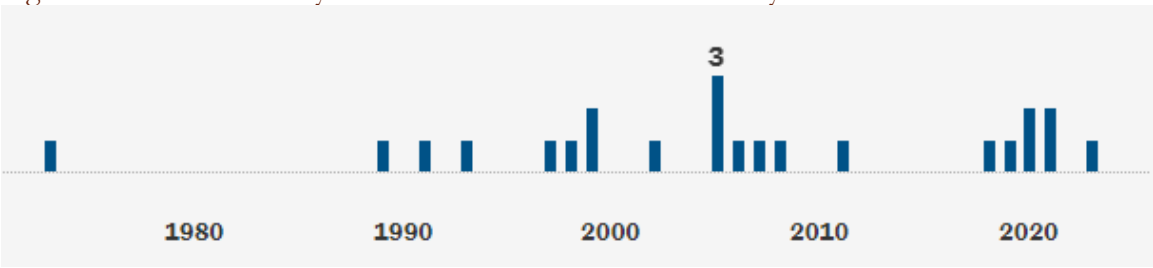
The months during which disasters have been declared in the planning area are shown in Figure 4-3 below.

Figure 4-3: Burnet 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.

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



Hazard Descriptions

There are three main categories of natural hazards: hydrologic, atmospheric, and technological. Hydrologic hazards are events or incidents associated with water related damage and account for over 75 percent of Federal disaster declarations in the United States. Hydrologic hazards identified as significant for the planning area include flood, and drought. Atmospheric hazards are events or incidents associated with weather generated phenomenon. Atmospheric hazards that have been identified as significant for the planning Area include extreme heat, hail, hurricane/tropical storms, lightning, thunderstorm wind, tornado, and severe winter storms. Technological hazards refer to the origins of incidents that can arise from human activities, such as the construction and maintenance of dams. They are distinct from natural hazards primarily because they originate from human activity, therefore, dam failure is classified as technological. The earthquake and wildfire hazards are considered "other," since these hazards is not considered atmospheric, hydrologic, nor technological. (Table 4-2)

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 significant future impacts are not expected and, therefore, are not necessary to include in the hazard assessment.

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 both 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 performing a historical review and statistical analysis on past data gathered with regard to hazards impacts to the planning area. Records were retrieved from National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA) that were reported for the Marble Falls planning area. Other records from local sources were also evaluated and included in the analysis when available. Geographic information system (GIS) mapping software was also used to identify and assess risks for Marble Falls by evaluating community critical facilities and their vulnerability to the hazards. The general parameters that are described for each hazard in the Risk Assessment include the location in the planning area, the extent or magnitude of the hazard to be expected, the frequency of return based on the number of historical events over the time period of study, 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 1997-2022 for the City of Marble Falls.

Table 4-5: Marble Falls Hazard Impact Summary

Hazard	Deaths	Injuries	Property Damage	Crop Damage	Frequency	Potential Severity
Drought	0	0	$0	$0	Likely	Low
Floods	0	0	$167,192,504	$206,827	Highly Likely	High
Earthquake	0	0	$0	$0	Unlikely	Low
Extreme Heat	0	0	$0	$0	Highly Likely	Medium
Hailstorm	0	0	$700,000	$0	Likely	Low
Hurricanes, Tropical Storms, and Depressions	0	0	$0	$0	Unlikely	Low
Lightning	0	0	$0	$0	Highly Likely	Low
Severe Winter Storms	0	0	$287,000	$0	Likely	Medium
Tornado	0	0	$10,000	$0	Unlikely	Low
Windstorms	0	0	$261,000	$50,000	Likely	Low
Wildfire	0	0	$0	$0	Highly Likely	Medium
Dam Failure	0	0	$0	$0	Unlikely	High

Source: NCEI Storm Events Database 1997 to 2022

The 25-year hazard profile shows that floods have had an outsized impact on the planning area. While no deaths and injuries have been attributed to this list of hazards over the past 25

years, floods are the leading cause of property damage and crop damage. In fact, the second highest number of damages can be attributed to hailstorms which represent less than 0.5% of the total damages to the planning area from 1997-2022. The cumulative total of all other hazard damages is less than 0.8% of the flood total. Based on the historical impact summary, flooding is the priority hazard from which to protect people and property in the Marble Falls planning area. This is followed by Hail, Severe Winter Storms, Windstorms, and Tornadoes. All other hazards included in this hazard analysis present a lower mitigation priority 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 Marble Falls 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 coast. Marble Falls is approximately 180 miles away from the Gulf of Mexico at its closest point. The table below lists Hurricanes or Tropical Storms events with a storm track (center of the storm) that crossed the planning area and in order of the reported date of the event. 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.

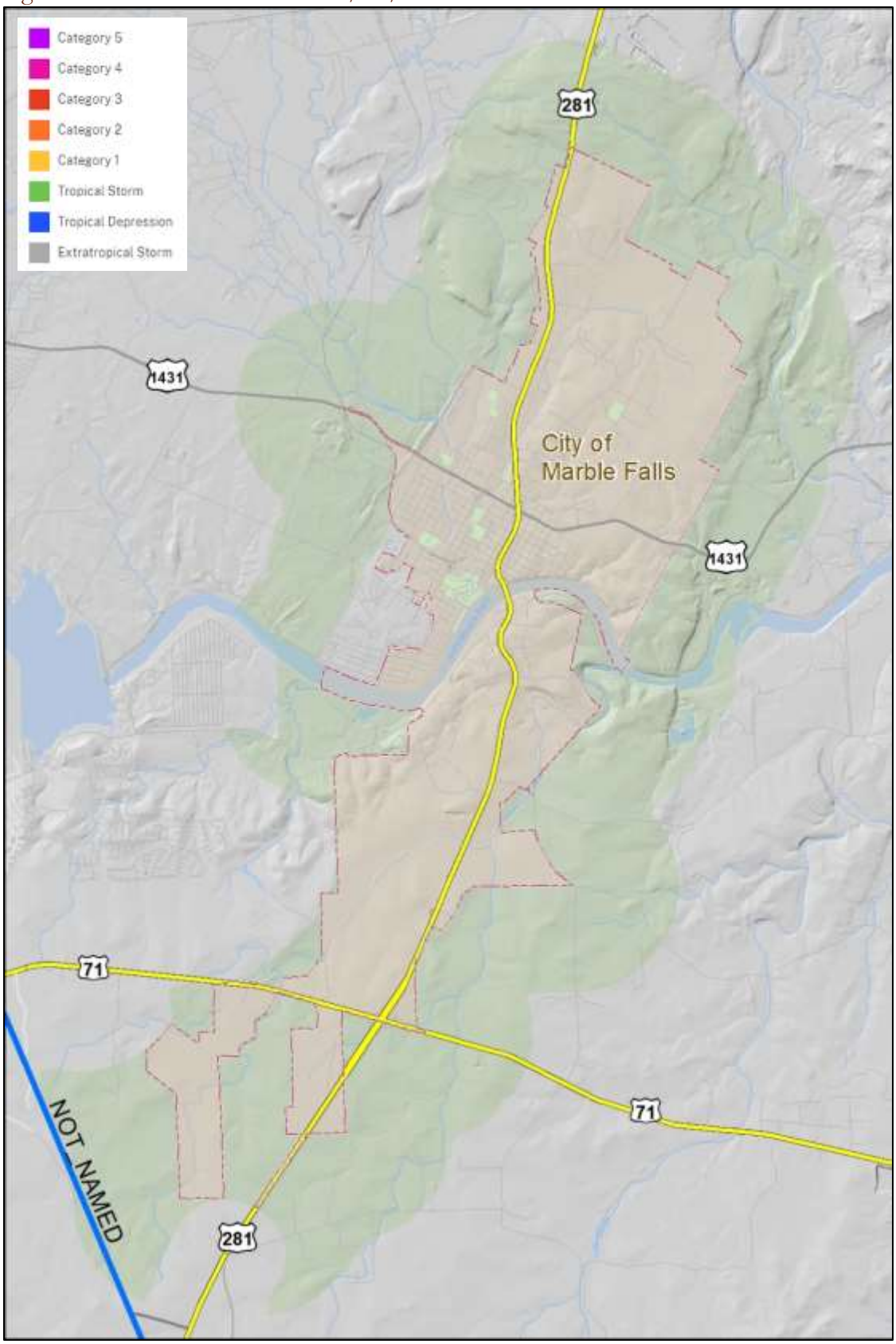
Table 5-1: Hurricane/TS/D Storm Track Events Table

Storm Name	Year	Dates	Category
Unnamed	1866	Jul 16	Tropical Storm (TS)

WWW.NOAA.ORG

The map below shows the historical tracks of hurricanes through the planning area from 1842 to 2022. The category assigned to each storm on the map is its magnitude at the time it traveled across the Marble Falls planning area. Based on data provided by NOAA's National Climatic Data Center (NCDC) and the FEMA National Risk Index, Marble Fall'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: Marble Falls Hurricane/TS/D Storm Tracks



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

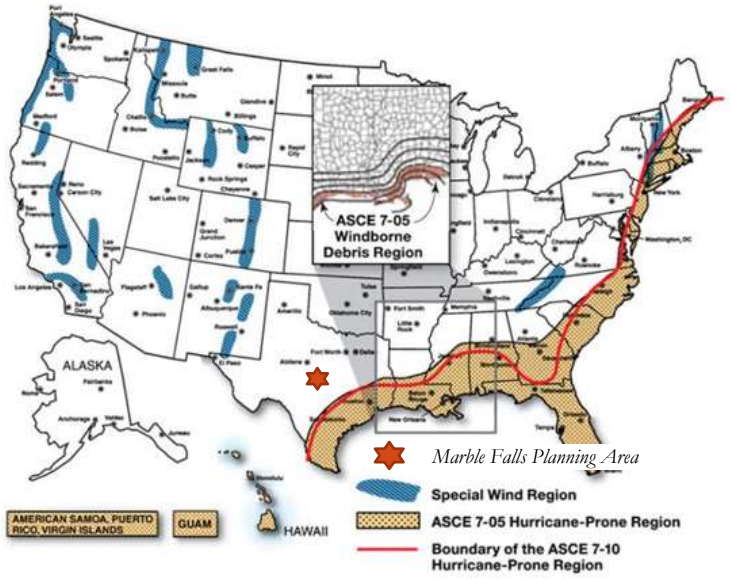
Extent

For Hurricanes, extent can be expressed separately for flood, wind, and surge. Flooding will be examined in the next section and surge is not an issue for Marble Falls 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, Marble Falls is not located in a hurricane-prone region. Based on the location and the historical storm tracks for hurricanes and tropical storms in the Marble Falls planning area, the extent to be mitigated for is a Tropical Storm.

Historical Occurrences

Hurricanes and Tropical Storms that had a direct path through the Marble Falls planning area as well as tracks that went through adjacent counties yet still impacted the Marble Falls planning area are identified in this section. Based on historical storm data provided by NOAA's National Climatic Data Center (NCDC), only one (1) 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, 1997-2023

Events	Magnitude	Injuries	Fatalities	Property Damage	Crop Damage
1	Tropical Storm	0	0	$0	$0

***Source**: NOAA NCEI Storm Events Database, August 2020*

Significant Events

There have been no significant hurricane, tropical depression, or tropical storm events in the planning area since record keeping began in 1842.

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 1 occurrence 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 180 years. This frequency provides an **unlikely** likelihood or future 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 impact the Marble Falls planning area is **"low."** The distance of Marble Falls from the Texas Coast makes this area only 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 and cause 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 or 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, cropland resulting in large-scale economic impacts and population displacement. Warning time for hurricanes, however, has lengthened due to modern and early warning technology allowing the community time to reduce the impact of tropical storm and hurricane events.

Historic Hurricane Impacts

There have been no recorded property damage or crop damage impacts to the planning area.

The Marble Falls 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 2021 American Community Survey estimates, there are 2,857 housing units in Marble Falls of which 3.6%, or 104 units, are mobile or manufactured homes. In addition, 985 (34.6%) 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
City of Marble Falls	2,857	104 (3.6%)	985 (34.6%)
Burnet County	17,941	3,087 (17.2%)	5,476 (30.5%)

Source: 2021 American Community Survey 5-year estimate, selected housing characteristics

Based on the ACS 2021 data, when compared Burnet County as a whole, the City of Marble is at a higher risk of damage from windstorms when considering age of residential structures and the higher standard of building codes enacted after 1980. The City of Marble Falls is at a lower risk of damage from windstorms when considering number and ratio of manufactured homes.

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 Burnet County delineates the Special Flood Hazard Areas (SFHAs) as those at highest risk of flooding. Flood areas or zones from the most recent 2011 DFIRMs from FEMA for Burnet County, and specifically, the City of Marble Falls are illustrated in Figure 6-1.

Figure 6-1: City of Marble Falls Floodplain Map

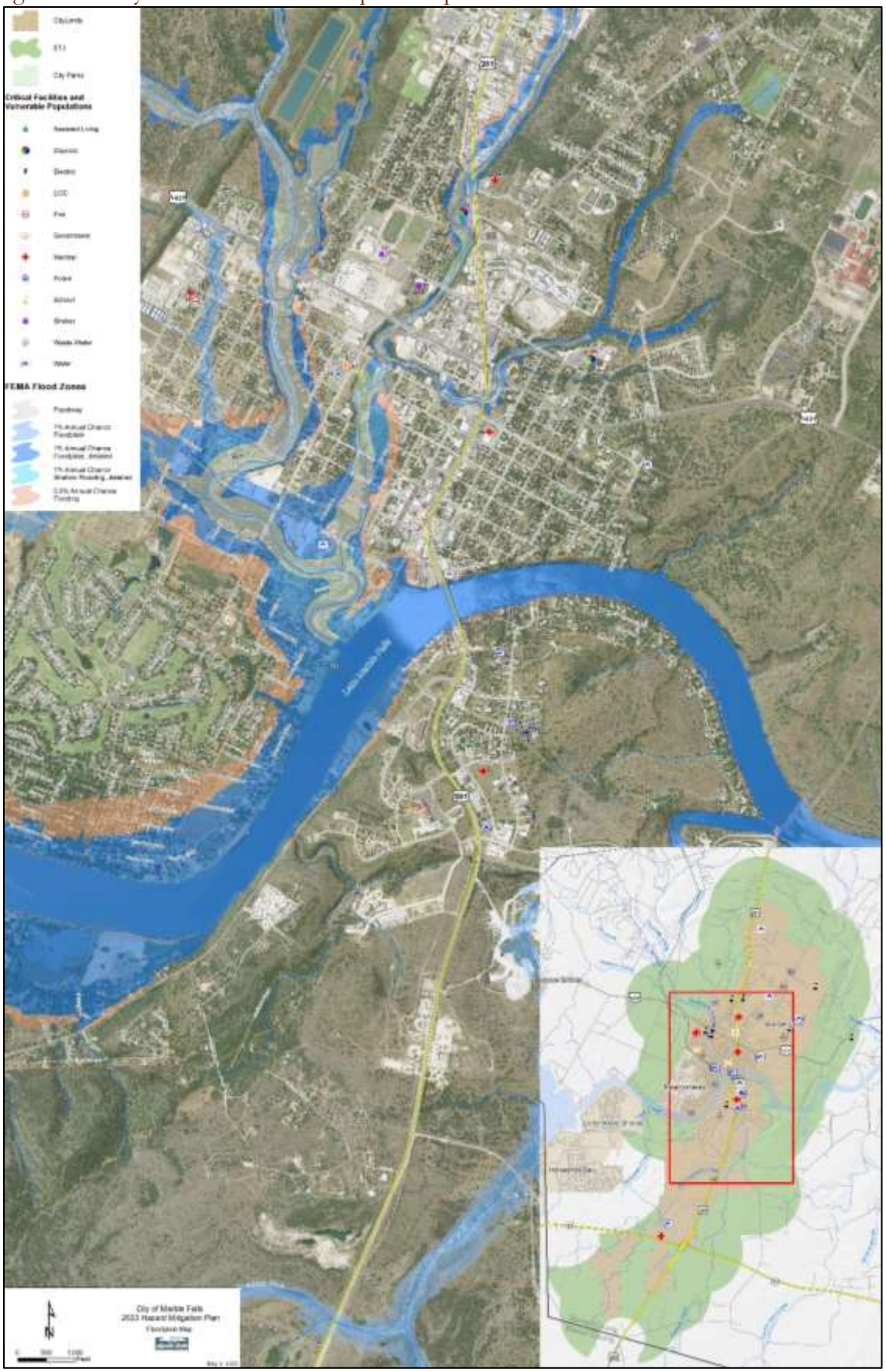


Figure 6-2: City of Marble Priority Low Water Crossing Map

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 and 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

Tuesday, Oct. 10, 2018, in Marble Falls, Texas.

the planning area. Historical Data is provided by the Storm Prediction Center (NOAA), NCEI database for the City of Marble Falls. There have not been any events recorded past the listed dates. The flood event is listed below if the begin or end location was identified as "Marble Falls", "Countywide", or "Southern Portion." For damages listed for countywide events, the population ration of the county to the City of Marble Falls was used to allocate damages accordingly.

Table 6-2: Historical Flood Events, 1997-2022

Begin Location	End Location	Date	Deaths	Injuries	Property Damage	Crop Damage
Countywide	Countywide	9/20/1996	0	0		
Countywide	Countywide	10/27/1996	0	0	$3,000	
Countywide	Countywide	10/28/1996	0	0	$100,000	$50,000
Countywide	Countywide	4/25/1997	0	0	$5,000	
Countywide	Countywide	4/25/1997	0	0	$3,000	
Countywide	Countywide	6/6/1997	0	0	$5,000	
Countywide	Countywide	6/8/1997	0	0	$30,000	
Countywide	Countywide	6/22/1997	0	0	$1,000,000	$50,000
Countywide	Countywide	12/20/1997	0	0	$20,000	
Countywide	Countywide	3/16/1998	0	0	$15,000	
Countywide	Countywide	7/4/1998	0	0	$10,000	
Countywide	Countywide	10/17/1998	0	0	$10,000	
Countywide	Countywide	5/10/1999	0	0	$10,000	
Countywide	Countywide	5/28/1999	0	0	$10,000	
Countywide	Countywide	11/3/2000	0	0	$5,000	
Countywide	Countywide	11/15/2001	0	0	$50,000	
South Portion	South Portion	6/30/2002	0	0	$10,000	
South Portion	South Portion	7/2/2002	0	0		
Countywide	Countywide	7/3/2002	0	0		
Countywide	Countywide	7/4/2002	0	0		
Countywide	Countywide	7/5/2002	0	0		
Countywide	Countywide	9/7/2002	0	0	$20,000	
Countywide	Countywide	9/8/2002	0	0	$30,000	
Countywide	Countywide	2/21/2003	0	0	$5,000	
Countywide	Countywide	1/16/2004	0	0	$3,000	
South Portion	South Portion	4/6/2004	0	0		
South Portion	South Portion	6/29/2004	0	0		
South Portion	South Portion	11/23/2004	0	0		
Countywide	Countywide	11/17/2004	0	0		
Spicewood	Marble Falls	3/11/2007	0	0		
Marble Falls	Marble Falls	6/26/2007	2	0	$137,000,000	
Marble Falls	Marble Falls	3/20/2012	0	0		
Marble Falls	Marble Falls	11/22/2013	0	0		
Smithwick	Marble Falls	11/22/2013	0	0		
Marble Falls	Marble Falls	5/14/2016	0	0		

Spicewood	Marble Falls	6/4/2018	0	0		
Marble Falls	Marble Falls	10/16/2018	0	0	$30,000,000	
Marble Falls	Marble Falls	10/16/2018	0	0		

Source: 2023 NCEI NOAA Storm Events Database

Significant Events

October 16, 2018

After a day of heavy flooding, Marble Falls was one of the hardest hit areas Tuesday. At its peak, the water of the Colorado River was about three feet higher than usual. The levels have since come down. According to one homeowner, he packed up last night as a precaution only to return today to find his home surrounded by water. "Now I don't know where I'm going to spend the night," said Marble Falls resident Jim McCollum. Across town, first responders use military grade vehicles to bring supplies to the Meadow Lakes and Pecan Valley communities, both cut off and surrounded. According to city leaders, anywhere between 75 and 85 homes are flooded in Marble Falls, that includes this home behind me, and parts of this neighborhood. "It still hasn't hit me. I still think I'm going to take a hot shower tonight and go to bed. I'm not going to," said Cookie Haseman, another Marble Falls resident affected by today's flooding. Around Marble Falls, 67 city facilities were damaged, including everything from parks to water treatment facilities. That's in addition to 63 homes also damaged, with 28 of those suffering major damage.

June 26, 2007

Two lines of thunderstorms, one moving south from the Dallas area and one moving southeast from the Abilene area, intersected and stalled near Marble Falls, producing a sustained heavy rainfall over Burnet County from just before midnight into the early and mid-morning hours. General rainfall over the southern half of Burnet County was between 10 and 15 inches with the highest rain totals in the Marble Falls area, where up to 19 inches fell. The hardest hit area was Marble Falls, where more than 315 homes and businesses were damaged or destroyed. The worst of the damage occurred along Whitman Branch Creek. This included businesses and even a day care facility. Personnel from Texas Military Forces were mobilized and sent into Marble Falls to help with rescues and evacuations. The military personnel, along with swift water rescue and other first responders, completed 32 high water rescues and evacuated hundreds of residents. Shelters were set up at the Marble Falls Middle School. At least eight bridges in Burnet County were destroyed with some amount of damage to nearly every road and structure in the southern half of the county. Most roads remained closed all day, but a few were re-opened in the late afternoon. Cars and vans were strewn all up and down US281 in the Marble Falls area. Nearly all parks and lakes were closed. Businesses in Marble Falls were also closed. Drinking water in Marble Falls was contaminated by the flood and over 1000 residents were without water for at least a week. Total estimates of the damages were placed at $130,000,000. One swift water rescue team member was forced to save himself when his vehicle was washed off SH71 near Double Horn Creek. He was able to get to dry land after a prolonged struggle. A couple in Marble Falls awoke to find their home flooded and with the water rising rapidly. They scrambled to the highest point in the one-story house as the water continued to rise. Finally, they had to use a shotgun to blast holes in the ceiling so they could break through to climb up on the roof. They waited with their two dogs on the roof in the dark for 2 hours, then were able to climb down and take shelter in a barn as the water receded slightly. They waited for an additional 12 hours until they were finally rescued by boat. Two young men were attempting to drive from a home in Marble Falls to Leander via FM 1431 sometime in the early morning hours of June 27 when their jeep was swept into high water east of Marble Falls. The vehicle was located a few days later in a creek about 10

miles east of Marble Falls. The body of one of the young men was recovered several days later but the remains of the other young man have not been found.

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 City of Marble Falls planning area, 77 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 impact from flooding is **"high."** The flood hazard areas throughout the City of Marble Falls 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. The intersection of 10th and Arbor Ln is the confluence of Backbone Creek and a large tributary of Backbone Creek and is an example of an area with structures that are built fully within the regulatory floodway.

Table 6-3: Critical Facilities in the Floodplain in the City of Marble Falls

Critical Facilities in the 1% and 0.2% Annual Chance Floodplain
1 Wastewater Treatment Plant, 1 Daycare, 1 Government, 3 Lift Stations, 1 Water Intake, 1 Elementary School, St. Peters School, 1 Boys and Girls Club, 1 Animal Control Facility Access is cutoff during heavy flooding to fire department on Ave U and EMS building on Industrial Blvd

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), including routinely clearing debris from roadside ditches and bridges and expanding drainage culverts and storm water structures to more adequately convey flood waters. Table 6-3 below shows City of Marble Falls dollar losses from January 1997 through December 2022.

Table 6-3: City of Marble Falls Impact from Flooding

Time Period	Fatalities	Injuries	Property Damage	Crop Damage
Loss Summary				
25-year Total	0	0	$167,192,504	$206,827
Per Year	0	0	$6,966,354	$8,618
Per Capita Dollar Losses (2020 Pop)				
25-year Total	0	0	$23,759	$990
Per Year	0	0	$29	$1

Source: NCEI Storm Events Database 1997 to 2022 subset for Texas

National Flood Insurance Program (NFIP) Participation

The City of Marble Falls participates in the National Flood Insurance Program (NFIP). 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, the City of Marble Falls does participate in CRS. The city is guided by its Floodplain Management Ordinance and will continue to promote the public health, safety, and general welfare by minimizing public and private losses due to flood conditions in specific areas. NFIP requirements are met through local permitting, inspection, and record-keeping requirements for new and substantially developed construction.

Table 6-5: Repetitive Loss and Severe Repetitive Loss Properties

Jurisdiction	Building Type	Number of Structures	Number of Losses
City of Marble Falls	Single Family	2	15

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 the City of Marble Falls. 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 abnormally dry (D0) conditions or moderate drought (D1). 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, October 17, 2023

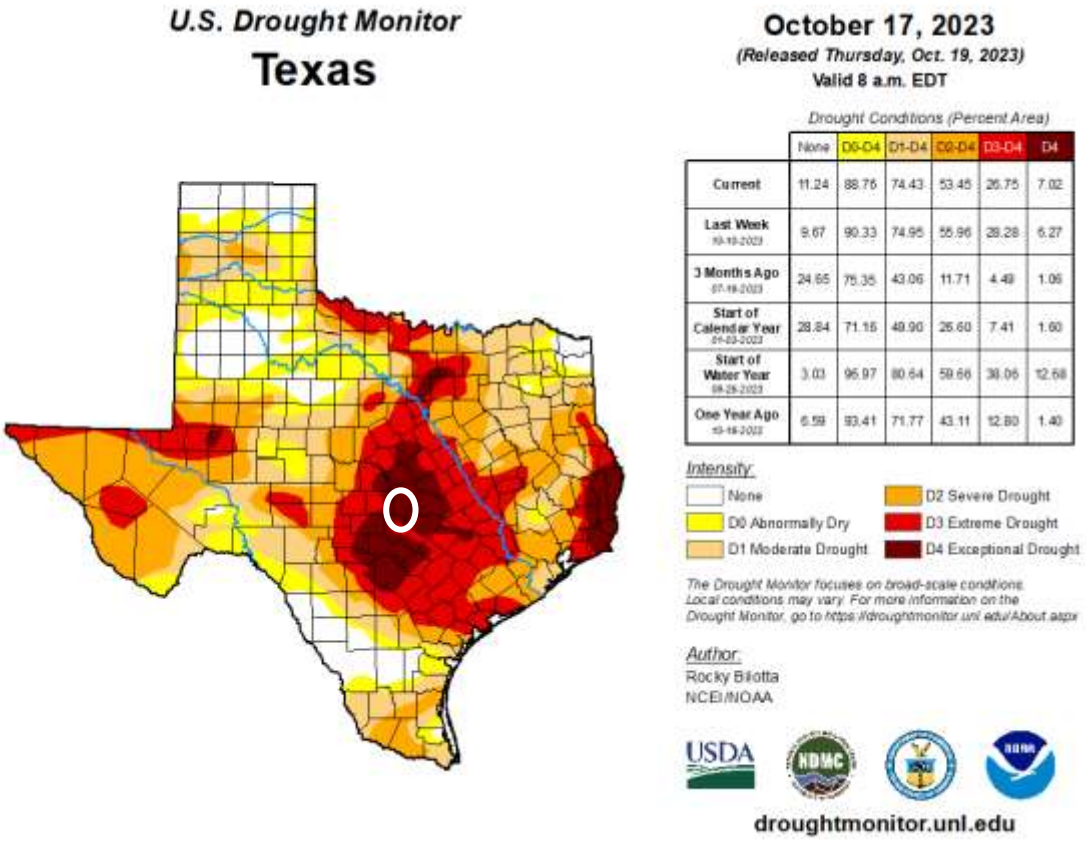
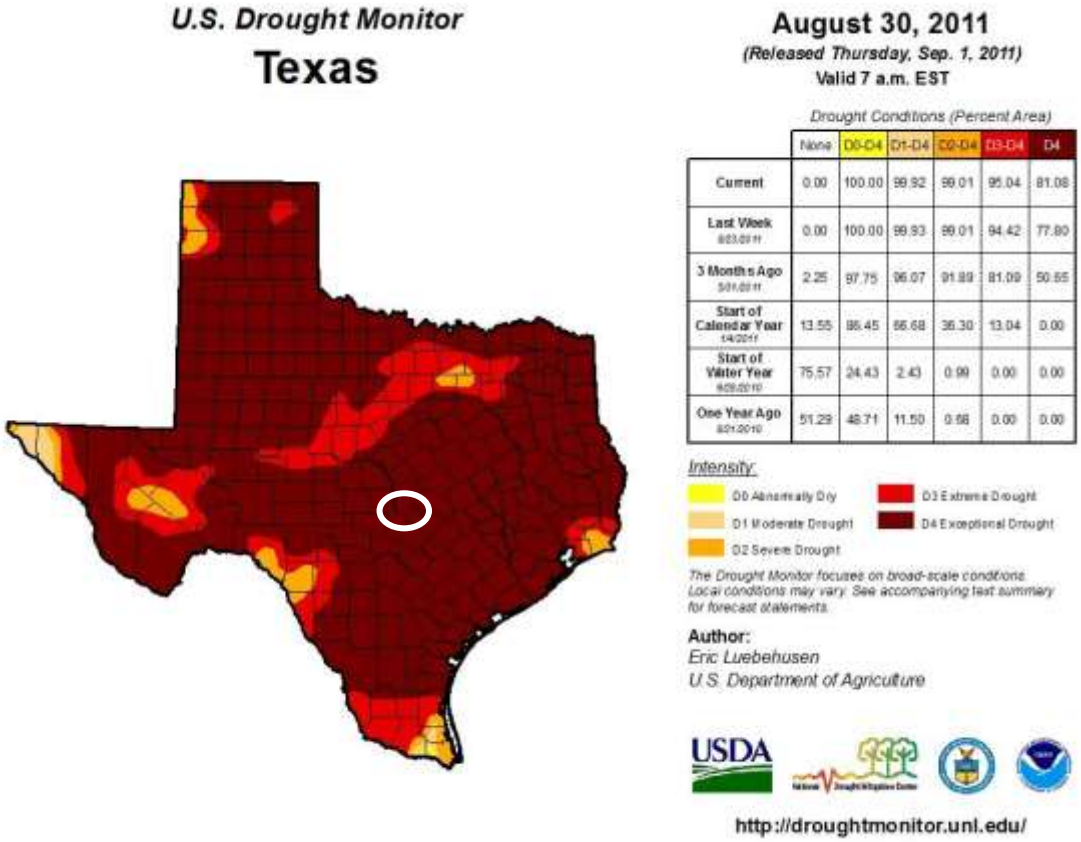


Figure 7.2: US Drought Monitor, August 30, 2011



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 7.1 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

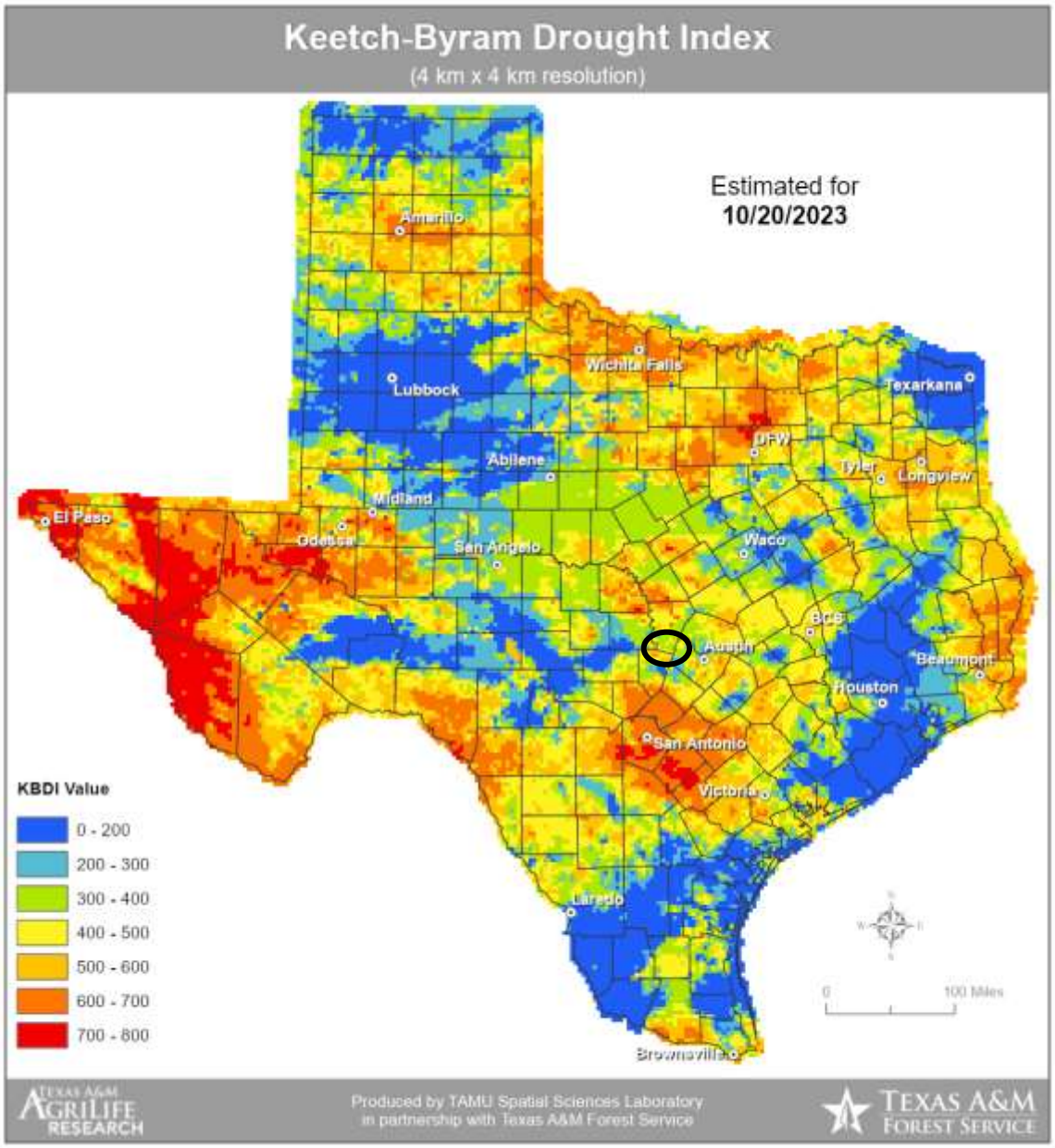
Table 7-1: Drought Severity Classification

			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 City of Marble Falls 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). The City of Marble Falls is in the 300-400 risk category at the time this report was written. The Keetch-Byram Drought Index is also discussed in relation to wildfires in section 13.

Figure 7-3: Keetch-Byram Drought Index



Historical Occurrences

The City of Marble Falls 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.[6] 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 1997 thru 2022 (a 24-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 7-2 lists historical events that have occurred in the City of Marble Falls as reported in the NCEI. There have not been any events recorded past the listed dates.

Table 7-2: Historical Occurrences of Drought in the City of Marble Falls

Date Range	Direct Injuries	Direct Fatalities	Property Damage	Crop Damage
June - October, 2000	0	0	0	0
May, 2011 - February, 2012	0	0	0	0
June, 2012	0	0	0	0

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

November, 2012 - April, 2013	0	0	0	0
June, 2013	0	0	0	0
January - May, 2014	0	0	0	0
August - November, 2014	0	0	0	0
September - October, 2015	0	0	0	0
January – February, 2018	0	0	0	0
July - September, 2018	0	0	0	0
October, 2019 - January, 2021	0	0	0	0
January, 2022 - Present	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 and 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 2/14/2023. This nearly 28-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 7-3: Historical Drought Magnitude

Drought Category	Description	Burnet County	
None	Normal to Wet Conditions	486	40%
D0	Abnormally Dry	152	13%
D1	Moderate Drought	234	19%
D2	Severe Drought	178	15%
D3	Extreme Drought	113	9%
D4	Exceptional Drought	43	4%
	Total	1,202	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 twelve (12) time periods of drought within a 25-year reporting period. This provides a probability of occurrence of approximately one event every one to two years. Based on the drought monitor data above, the planning area is in severe to exceptional drought approximately 28% of the time. This frequency supports a **likely** probability of future events occurring within the City of Marble Falls planning area 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

The impact from drought to the City of Marble Falls planning area is **"low."** 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 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 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 the City of Marble Falls is vulnerable to water supply shortages which can 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 6,892 according to the 2021 ACS 5-year population estimate. Those over the age of 65 represent 21.5% (1,480) of the total population and children under the age of 5 represent 3.1% (214) of the total population. The total population of the county that is estimated to be below the poverty level is 10.0% (687). Table 7-4 presents the 2021 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
City of Marble Falls	1,480/ 21.5%	214/ 3.1%	687/10%

Source: 2021 American Community Survey (Note: County totals include both incorporated and unincorporated areas)
*Blanco Pedernales Water population counts for the planning area are included in the County total.

The environment of the Marble Falls 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 Marble Falls 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 1997-2023 are provided

below. Table 7-5 lists the drought impacts in Burnet 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 7-5: Drought Impacts, 1997-2023

Marble Falls	
Agriculture	112
Business & Industry	1
Energy	3
Fire	26
Plants & Wildlife	75
Relief, Response & Restrictions	57
Society & Public Health	16
Tourism & Recreation	9
Water Supply & Quality	75
County Impact Reports	189

Source: https://droughtreporter.unl.edu/map/

Based on 25 years of data from the NCEI, the direct impacts of droughts in the Marble Falls 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 1997-2023. 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 typically not 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.

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

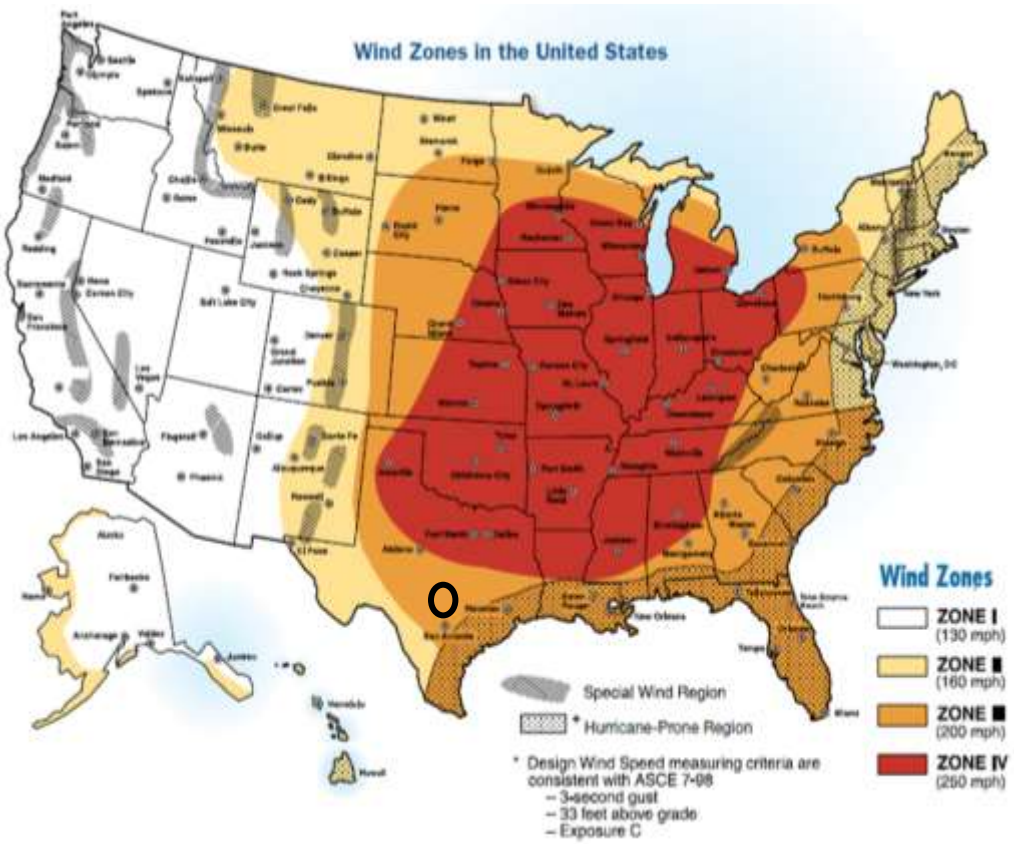
Description

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 develop randomly and are not confined to any geographic area and can occur at any location within the planning area. It is assumed that the City of Marble Falls is uniformly exposed to the threat of thunderstorm winds. According to FEMA Wind Zones in the United States (Figure 8-1), the planning area is located in Wind Zone III which is associated with winds as high as 200 mph and near a coastal region that is susceptible 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 Marble Falls 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 1997-2022, there have been 48 thunderstorm wind events recorded in the NCEI storm events database that have impacted the Marble Falls 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, 1997-2023

Year	Month	Magnitude	Injuries	Fatalities	Property Damage	Crop Damage
1999	May		0	0	$10,000	
2000	May		0	0	$20,000	
2002	May		0	0		$50,000
2004	November	70	0	0		
2005	July	60	0	0		
2005	August	60	0	0		
2006	April	55	0	0		
2006	September	65	0	0	$200,000	
2007	June	65	0	0		
2008	May	50	0	0	$5,000	
2015	May	52	0	0		
2017	June	56	0	0	$1,000	
2021	June	65	0	0	$25,000	

Source: NCEI Storm Events Database

Significant Events

September 23, 2006

Severe thunderstorms struck the area between Marble Falls and Spicewood, knocking over trees, phone lines, and power lines. The winds, estimated near 65 knots, also damaged roofs in both Marble Falls and in Spicewood.

June 21, 2021

There was widespread wind damage to mainly trees reported in southern Burnet County. An NWS damage survey concluded that a large swath of severe thunderstorm microburst winds moved south to southwest across the area from Lake Marble Falls to across East FM 2147 at around 9:50 PM CST. Roof damage to a barn was also reported. Large oak trees were blown down as well as other large limbs broken off numerous trees. Radar was showing winds in excess of 70 mph in that area, and based on the damage seen at ground level it appears that surface winds estimated at 75 mph likely occurred. It is plausible that a small tornado could have occurred in this area amongst the large microburst wind area, but a definite tornado path could not be found.

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 Marble Falls planning area has experienced, on average, approximately 1 thunderstorm wind events every one to two years. Wind events categorized as Forces 10-12 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 wind impact is rated as **"low."** 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 and structures can 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 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 resulted in any reported injuries or fatalities.

The Marble Falls 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 thunderstorm hazard but more prone to being isolated from essential needs and emergency services in the event of a disaster. Based on 2021 American Community Survey estimates, there are 2,857 housing units in Marble Falls of which 3.6%, or 104 units, are mobile or manufactured homes. In addition, 985 (34.6%) 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
City of Marble Falls	2,857	104 (3.6%)	985 (34.6%)
Burnet County	17,941	3,087 (17.2%)	5,476 (30.5%)

Source: 2021 American Community Survey 5-year estimate, selected housing characteristics

Based on the ACS 2021 data, when compared Burnet County as a whole, the City of Marble is at a higher risk of damage from windstorms when considering age of residential structures and the higher standard of building codes enacted after 1980. The City of Marble Falls is at a lower risk of damage from windstorms when considering number and ratio of manufactured homes.

Historic Windstorm Impacts

Below is the summary table, 8-4, for the City of Marble Falls 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 from property and crop damage is $12,440 for the City of Marble Falls.

Table 8-4: Loss Summary

Time Period	Fatalities	Injuries	Property Damage	Crop Damage
Loss Summary				
24-year Total	0	0	$261,000	$50,000
Per Year	0	0	$10,440	$2,000
Per Capita Dollar Losses (2020 Census Pop)				
25-year Total	0	0	$37	$7
Per Year	0	0	$2	$0.28

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.[7] 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 even heat stroke. In addition, 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.[8]

Location

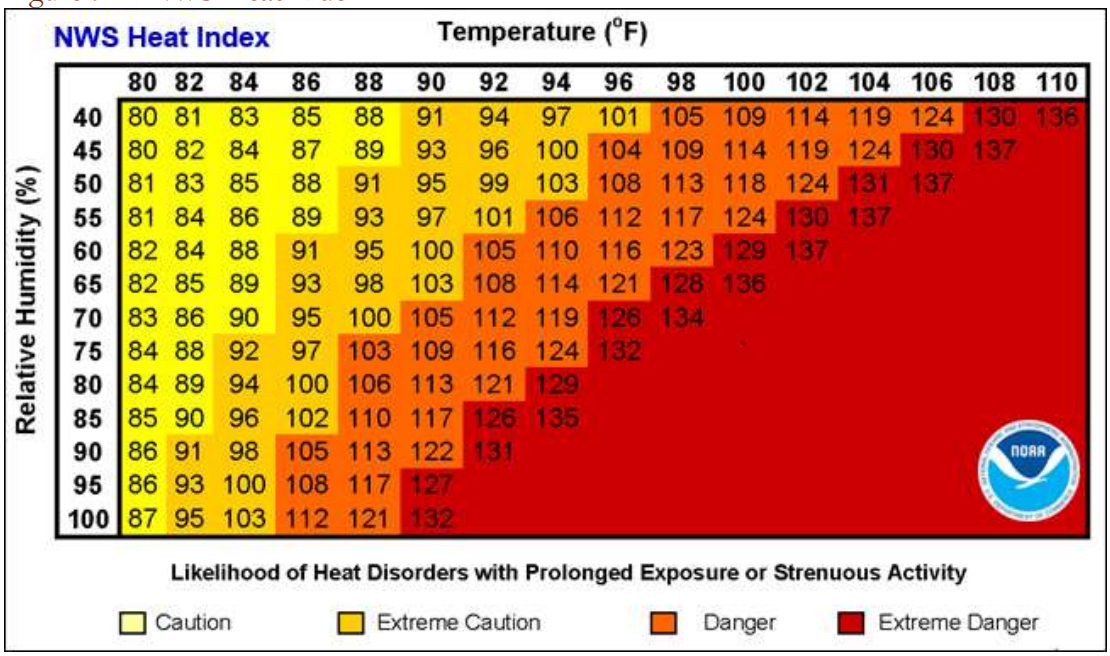
Extreme heat is not confined to any specific geographic area and can occur anywhere within the planning area. City residents can face a heightened risk to extreme heat because of warmer temperatures in cities from the urban heat island effect. The urban heat island effect is caused by large amounts of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

[7] http://www.nws.noaa.gov/om/hazstats.shtml
[8] 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 heat 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.

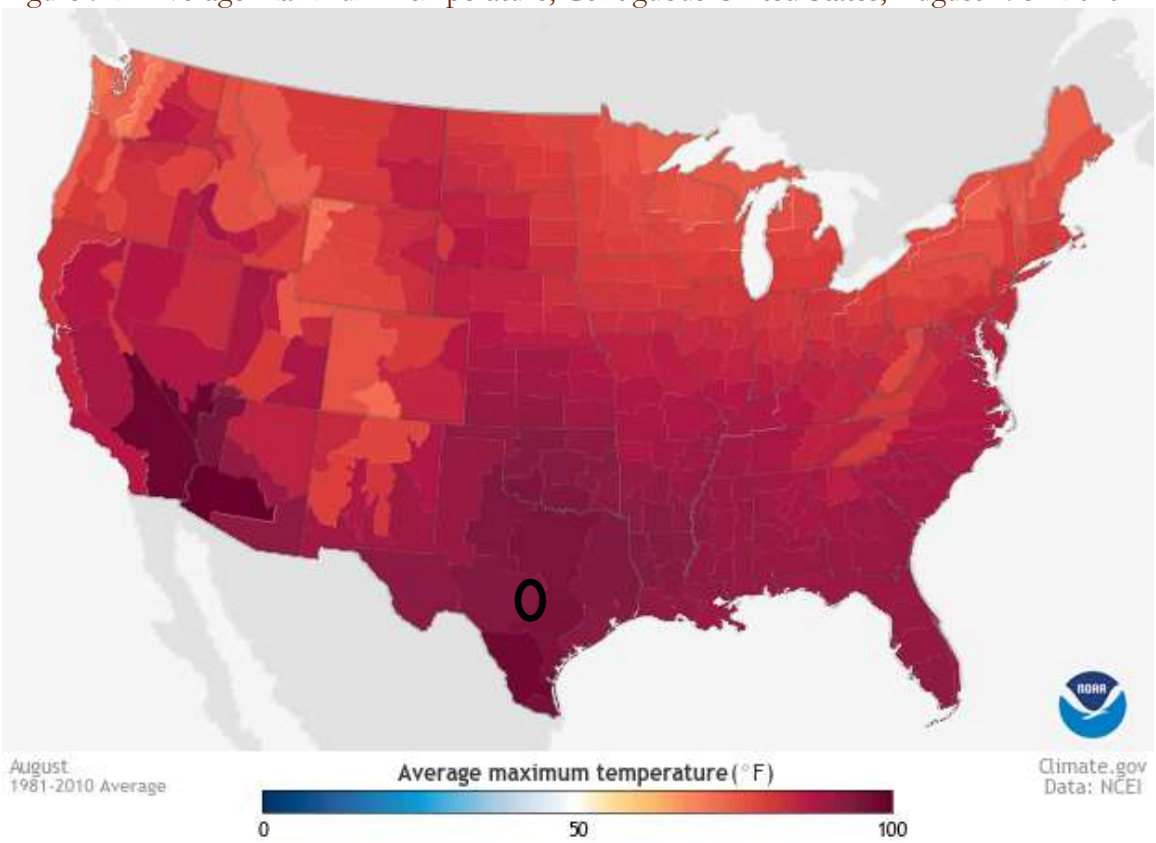
Table 9-1: Heat Index and Warnings

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 Marble Falls planning area is typically August with an average relative humidity of 67%. 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(67°F) in the Marble Falls planning area, extreme heat events to the extent of "Danger" and "Extreme Danger" should be mitigated for. When the heat index reaches a "Danger" classification, effects can include sunstroke, muscle cramps, heat exhaustion, and potential heatstroke with prolonged exposure. When the heat index reaches an "Extreme Danger" classification, effects on the body can include all of the above in addition to heat stroke and even death.

Historical Occurrences

There are two historical occurrences of extreme heat found in the NCEI database for the Marble Falls Planning Area for time period from 1997-2022. This doesn't necessarily indicate that the area has rarely experienced an extreme heat event or that impacts to people, property, and agriculture are negligible. 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.

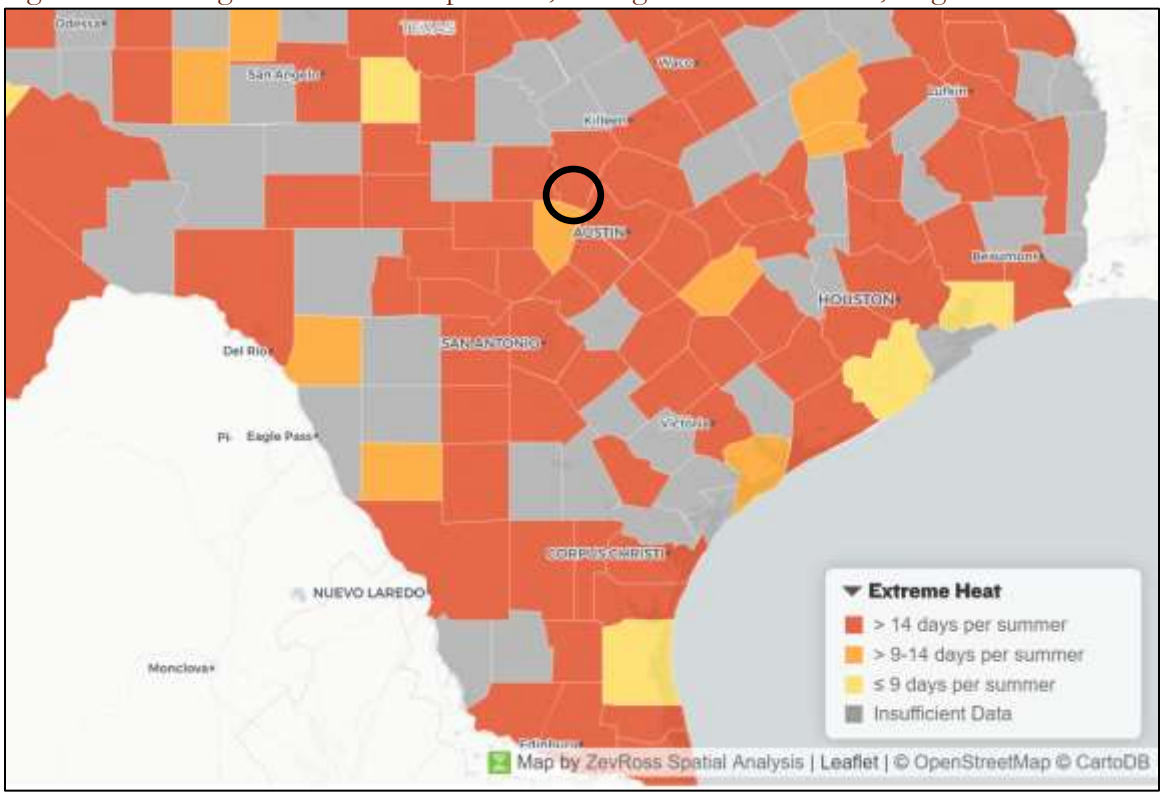
Table 9-2: Historical Excessive Heat Events Table, 1997-2022

Year	Month	Day	Injuries	Fatalities	Property Damage	Crop Damage
2018	July	19	0	0	$0	$0
2020	July	13	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 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

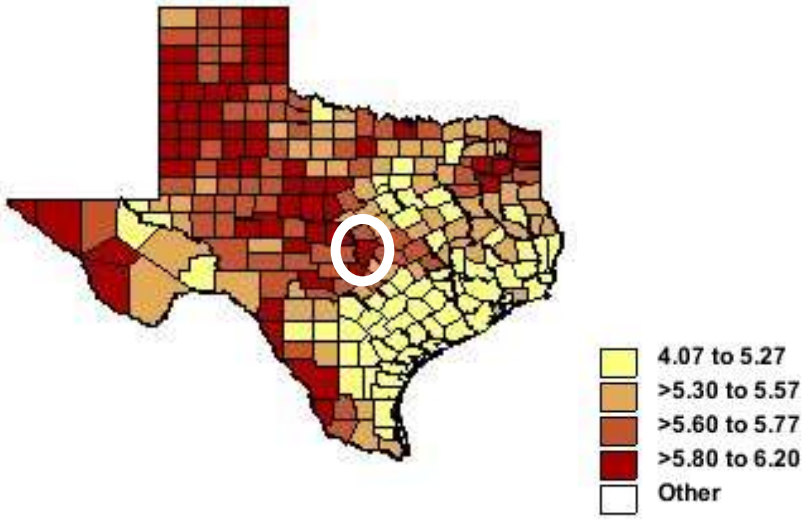


https://www.nrdc.org/climate-change-and-health-extreme-heat#/map/detail/TX

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 the City of Marble Falls as having greater than 14 days of extreme heat per summer. This analysis shows that the Marble Falls planning area is experiencing more heat days during the summer than it did past.

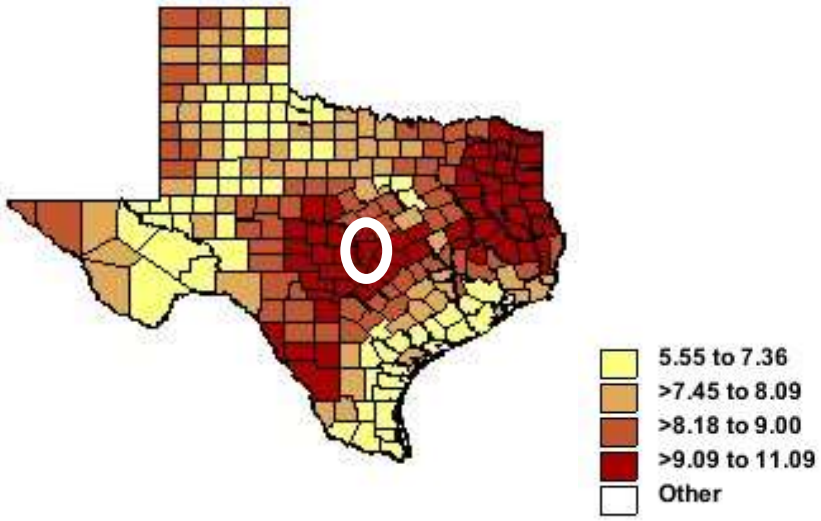
Data from CDC can also help tell a story of how the number of extreme heat days to be expected each summer are increasing. The two maps below depict a 29-year period from 1981-2010 and a 10-year period from 2000-2010. The Marble Falls planning area is depicted within the white circle in Central Texas 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 greater than 14 extreme heat days and at least 1 extreme heat event, or heat wave, each summer due to the warm, sunny, and humid subtropical climate in the Marble Falls 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 (1880-2022) across the globe have all occurred within the past 12 years. The table below ranks the warmest years on record with land and ocean annually averaged measurements compiled from 1880-2020.

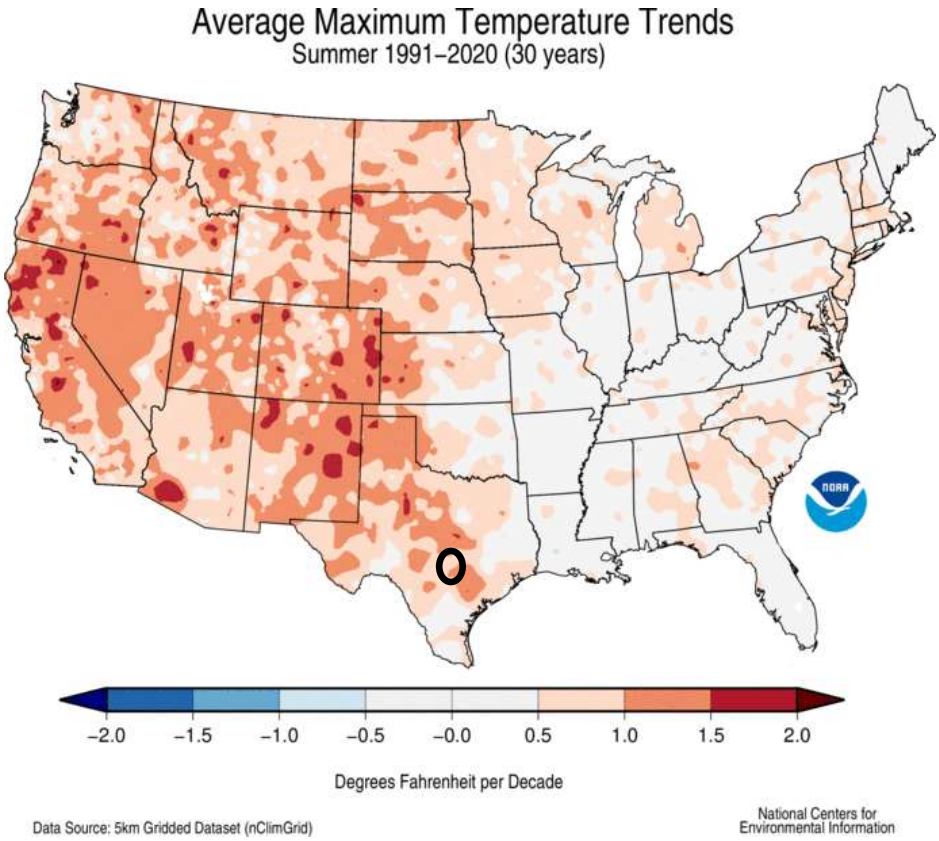
Table 9-2: Top 10 warmest years, globally (NOAA, 1880-2022)

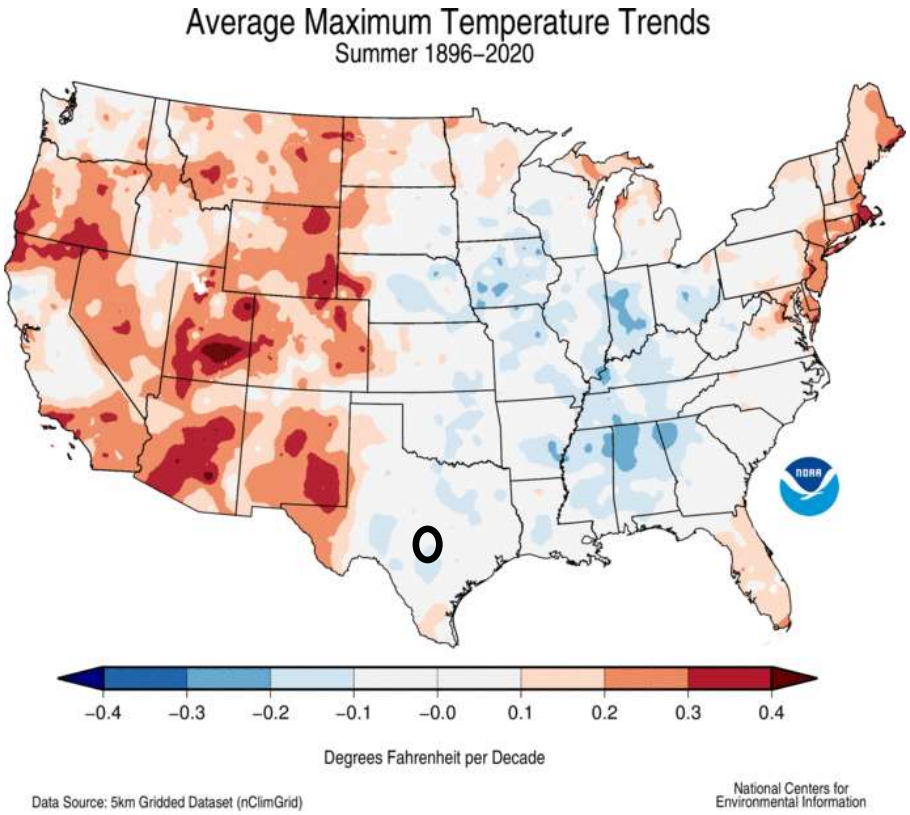
Rank	Year
1	2016
2	2020
3	2019
4	2015
5	2017
6	2022
7	2021
8	2018
9	2014
10	2010

"Global Climate Report – Annual 2022". NOAA. Retrieved 26 January 2023.

The average maximum temperature maps in Figure 9-6 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 Marble Falls planning area is in an area that can expect an increase of 0.5-1.5ºF in average maximum summer temperatures over the next century.

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





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 9-7 below is produced by NOAA with tips on how to practice heat safety in different situations.

Figure 9-7: 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.[9] 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.

[9] 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.

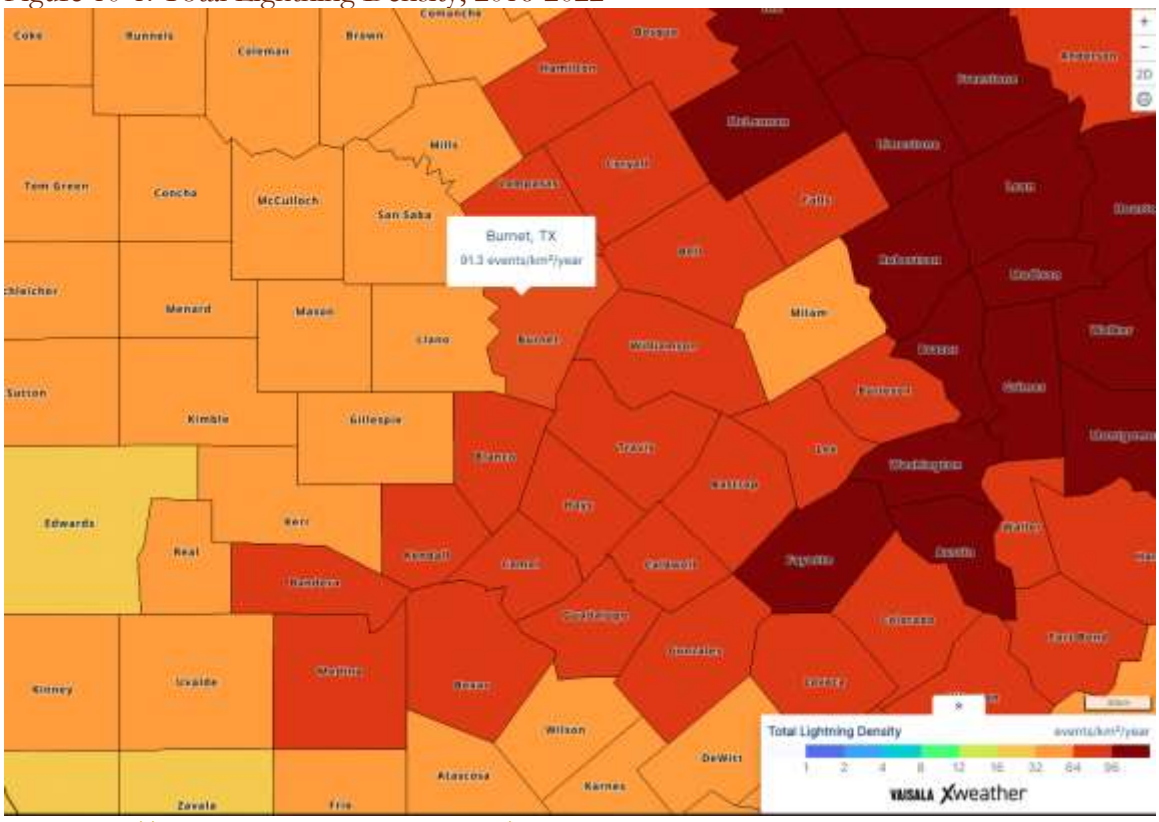
Location

The City of Marble Falls 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 the city are uniformly exposed to the threat of lightning due to the consistent geography and terrain found.

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, Burnet County, which encompasses the Marble Falls planning area has a total lightning density of 91.3 events/km^2/year for the planning area from 2016-2022. Burnet County is on the higher end of the Vaisala total lightning scale.

Figure 10-1. Total Lightning Density, 2016-2022



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.

The magnitude for lightning hazard events can also be measured in terms of the number of strikes in a smaller interval of time. The Lightning activity levels (LALs) scale is used by NOAA to express the extent of lightning events and is on a scale of 1 to 6 along with descriptions of corresponding cloud and thunderstorm development. The LAL rankings scale reflects the frequency of lightning strikes from cloud to ground within a 15-minute interval. Lightning activity levels are described in more detail in table 10-1 below.

Table 10-1: Lightning Activity Levels

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

The Marble Falls planning area can generally experience all lightning activity levels based on the extent and location of thunderstorm conditions and all areas are vulnerable to a LAL of 5, the most severe threat of lightning.

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 have been no lightning events reported since 1997 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.

Significant Events

There have been no lightning events reported since 1997 according to the NOAA National Centers for Environmental Information (NCEI) data.

Texas Forest Service

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. One other source for lightning strikes is the Texas Forest Service. Table 10-3 lists wildfires caused by lightning strikes recorded by the Texas Forest Service from 2005-2022 within the Marble Falls ETJ planning area and sorted by date.

Table 10-3: Texas Forest Service (TFS), Wildfire Ignition History 2005-2022

Date	Name	Responder	Area Burned (Acres)
8/12/2011	Hwy 71 (11-0093)	Cassie VFD	15
9/26/2011	Tokim Rd	Marble Falls Area Vol Fire Dept.	0.5

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 91.3 lightning flashes per square kilometer per year. The Marble Falls planning area is 28,680 Acres for a total of 116 square kilometers in the planning area. The Vaisala flash density estimate combined with the total area produces an estimate of approximately 10,591 flashes per year. A highly likely probability of occurrence for future lightning events in the Marble Falls 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 Marble Falls 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 strikes are a cause of wildfires making agricultural land vulnerable as well. Agricultural losses from this hazard can be extensive. Lightning is attracted to tall metal structures making the drilling equipment and tanks in the areas particularly vulnerable to strikes.

Risk of injury or death represents the greatest risk for the hazard of lightning. 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.

Historic Lightning Impacts

There have been no recorded historic lightning impacts in the planning area.

SECTION 11: TORNADO

Description

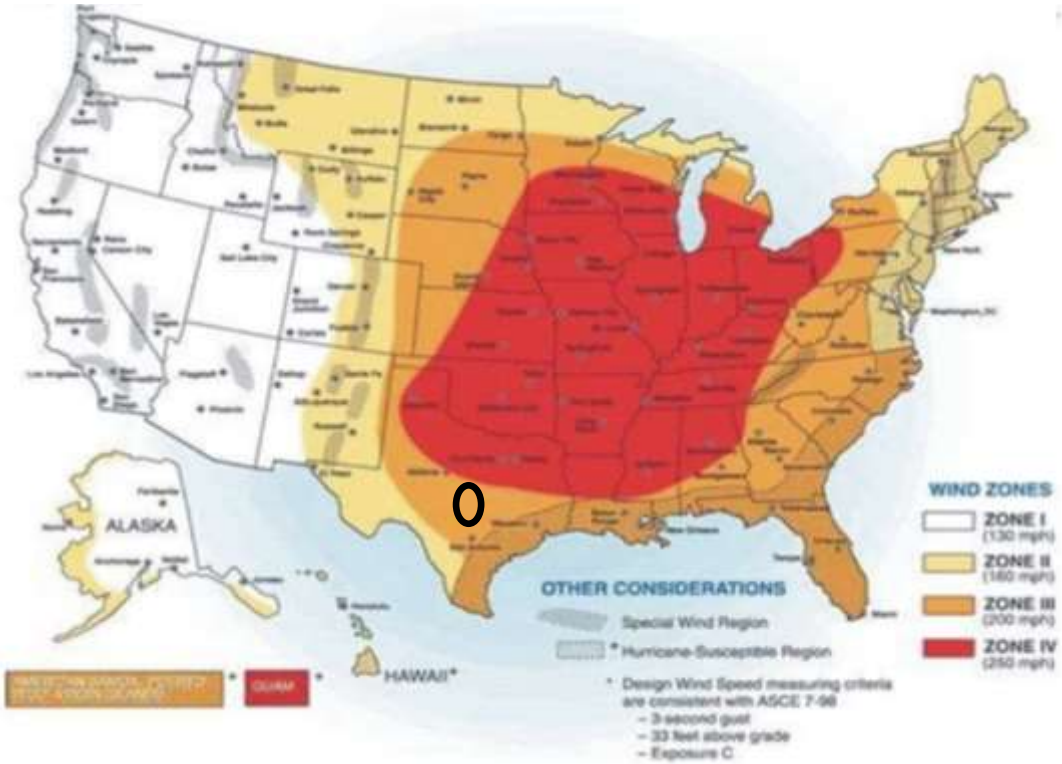
A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. Tornadoes, among the most violent storms on the planet, are capable of tremendous destruction with wind speeds that can reach as high as 250-300mph. Typically, the vortex of air will 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 in excess of 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. The Marble Falls planning area 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

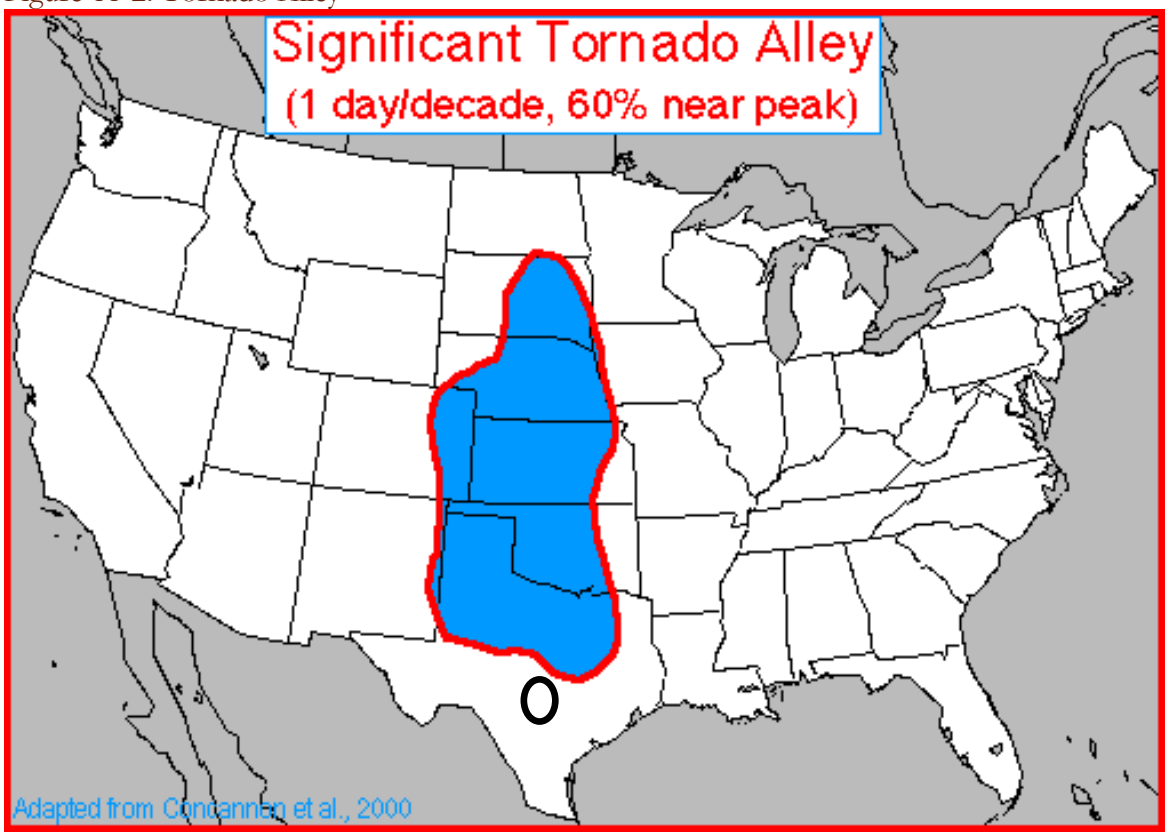


www.fema.gov/plan/prevent/saferoom/tsfs02_wind_zones.shtm

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 Marble Falls planning area is less than 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

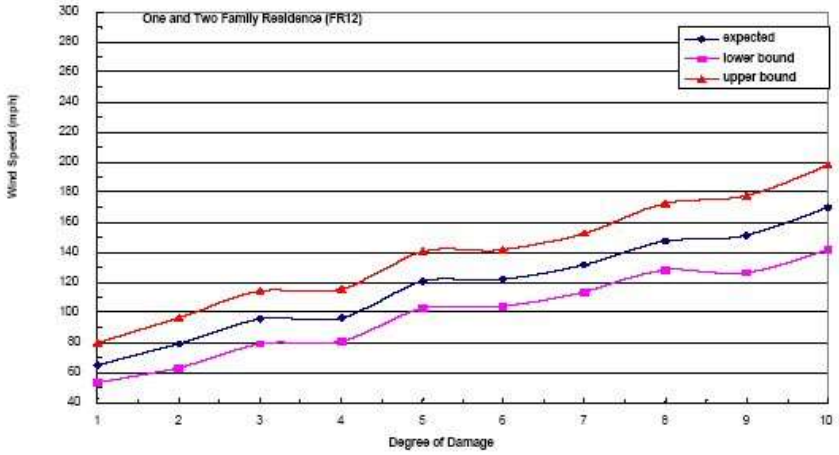
2. ONE-AND TWO-FAMILY RESIDENCES (FR12)
(1000 – 5000 sq. ft.)

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 events in Marble Falls planning area have been between EF0 to an EF2 (Table 11-3). However, because Marble Falls are in Wind Zone III, the planning area could experience anywhere from an EF0 to an EF4. Therefore, the range of intensity that the planning area would be expected to mitigate is a tornado event that would be a low to severe risk, an EF0 to EF3.

Historical Occurrences

Table 11-4 lists historical tornado events in the planning area from 1997-2022 that were reported to the NCEI or NOAA. The impact of the tornado events in Marble Falls are listed by date with additional impact information related to the specific jurisdiction of touchdown, magnitude of event, total dollar-losses related to crop and property damage, injuries, and fatalities. Local sources state that the 2020 Tornado event occurred outside of the planning area but it was chosen to remain in the historical events table due to its close proximity. There have not been any events recorded past the listed dates.

Table 11-4: Historical Tornado Events by Jurisdiction, 1997 – 2022

Jurisdiction	Year	Month	Extent: Fujita Scale (pre-2007), Enhanced Fujita Scale (post-2007)	Fatalities	Injuries	Property Damage	Crop Damage
Marble Falls	1999	Mar	F0	0	0	0	0
Marble Falls	2020	Apr	EF1	0	0	$10,000	0

Source: NCEI Storm Events Database

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

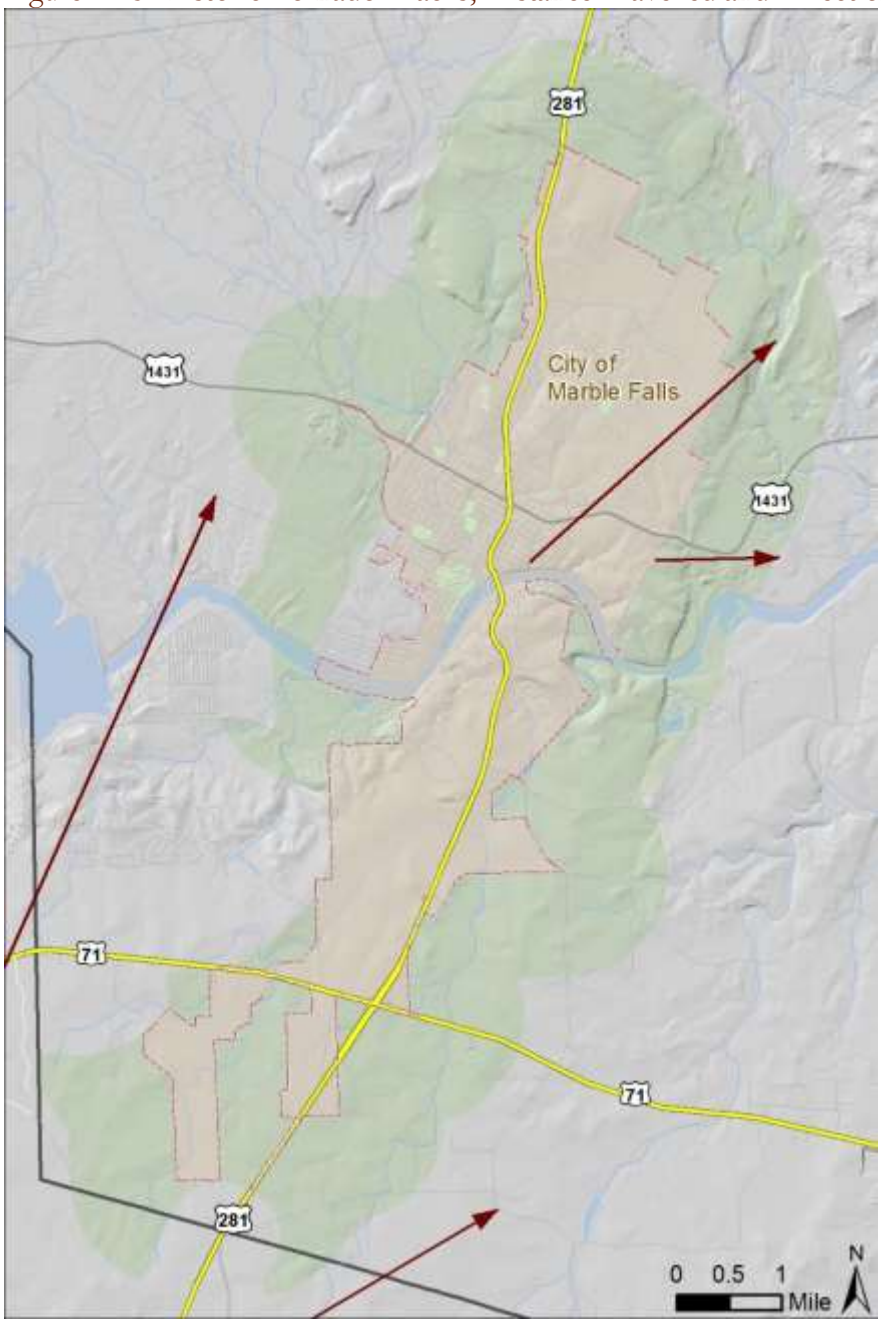
Number of Events	Magnitude (Fujita Scale)						
	N/A	F0	F1	F2	F3	F4	F5
1	0	1	0	0	0	0	0

Table 11-6: Historical Tornado Events Magnitude Summary, 2007-2022

Number of Events	Magnitude (Enhanced Fujita Scale)						
	N/A	EF0	EF1	EF2	EF3	EF4	EF5
1	0	0	1	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 11-5: Historic Tornado Tracks, Distance Travelled and Direction



Significant Events

April 12, 2020 – Marble Falls

A small tornado touched down near Round Mountain in northern Blanco County. It first appeared to touch down near RR 962 then moved northeast by Coyote Trail before impacting two RV parks on Hwy 281 and Hof Brau. Estimates from Blanco County Emergency Management show that a total of approximately 60 residences were impacted with at least 11 being completely destroyed and eight more sustaining major damage. There were two minor injuries. The tornado continued moving northeast and crossed the Blanco/Burnet County line near Creek Ln. and then dissipated in southern Burnet County near CR 401 S. The damage and injuries occurred in Blanco County.

An upper-level shortwave trough moved around a low over the southwestern US and enhanced lift over the mountains in northern Mexico and a dryline in West Texas. These features interacted with a warm, moist airmass over South Central Texas to generate thunderstorms. Some of these storms produced tornadoes and large hail. The large hail that hit the City of Del Rio and near Brackettville likely caused in excess of 10 million dollars in damage but as of this writing do not have an accurate estimate of damage from city/county/state officials or private insurance companies.

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 11-8 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 2 events in a 25-year reporting period in the planning area. This provides a probability of occurrence of approximately once every ten years or more for the Marble Falls planning area. This frequency supports an unlikely probability of future events for the planning area, including all participating jurisdictions, meaning that an event is probable in the next ten years or more.

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 Marble Falls 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. Tornados pose a significant threat to people as they commonly cause power outages which could cause health and safety risks to vulnerable populations that rely on power for medical necessities as well as patients in hospitals. Falling trees/branches, utility lines, poles and flying debris have the ability to cause injury and are also a significant safety risk. First responders and those needing to evacuate an area may also encounter blocked roads as a result of the debris rendering some areas inaccessible or inescapable. Some buildings and structures are more likely to be damaged than others from the high wind velocity associated with tornado events. The following three types of structures are most susceptible to damage by a tornado:

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 Marble Falls planning area features mobile and manufactured home parks which are more vulnerable to tornados 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.

Table 11-8. Structures at Greater Risk by Jurisdiction

Jurisdiction	Total Housing Units	Mobile Homes	Housing units built prior to 1980
City of Marble Falls	2,857	104 (3.6%)	985 (34.6%)
Burnet County	17,941	3,087 (17.2%)	5,476 (30.5%)

*County totals include all jurisdictions in addition to unincorporated areas.
Source: 2021 American Community Survey 5-year estimate, selected housing characteristics

Based on the ACS 2021 data, when compared Burnet County as a whole, the City of Marble is at a higher risk of damage from windstorms when considering age of residential structures and the higher standard of building codes enacted after 1980. The City of Marble Falls is at a lower risk of damage from windstorms when considering number and ratio of manufactured homes.

Historic Tornado Impacts

The summary table below, 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 $400 for Marble Falls.

Table 11-9, Marble Falls Loss Summary

Time Period	Fatalities	Injuries	Property Damage	Crop Damage
Loss Summary, Marble Falls				
25-year Total	0	0	$10,000	$0
Per Year	0	0	$400	$0
Per Capita Dollar Losses				
25-year Total	0	0	$1.42	$0
Per Year	0	0	$0.06	$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.

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 Marble Falls 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 Marble Falls planning 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

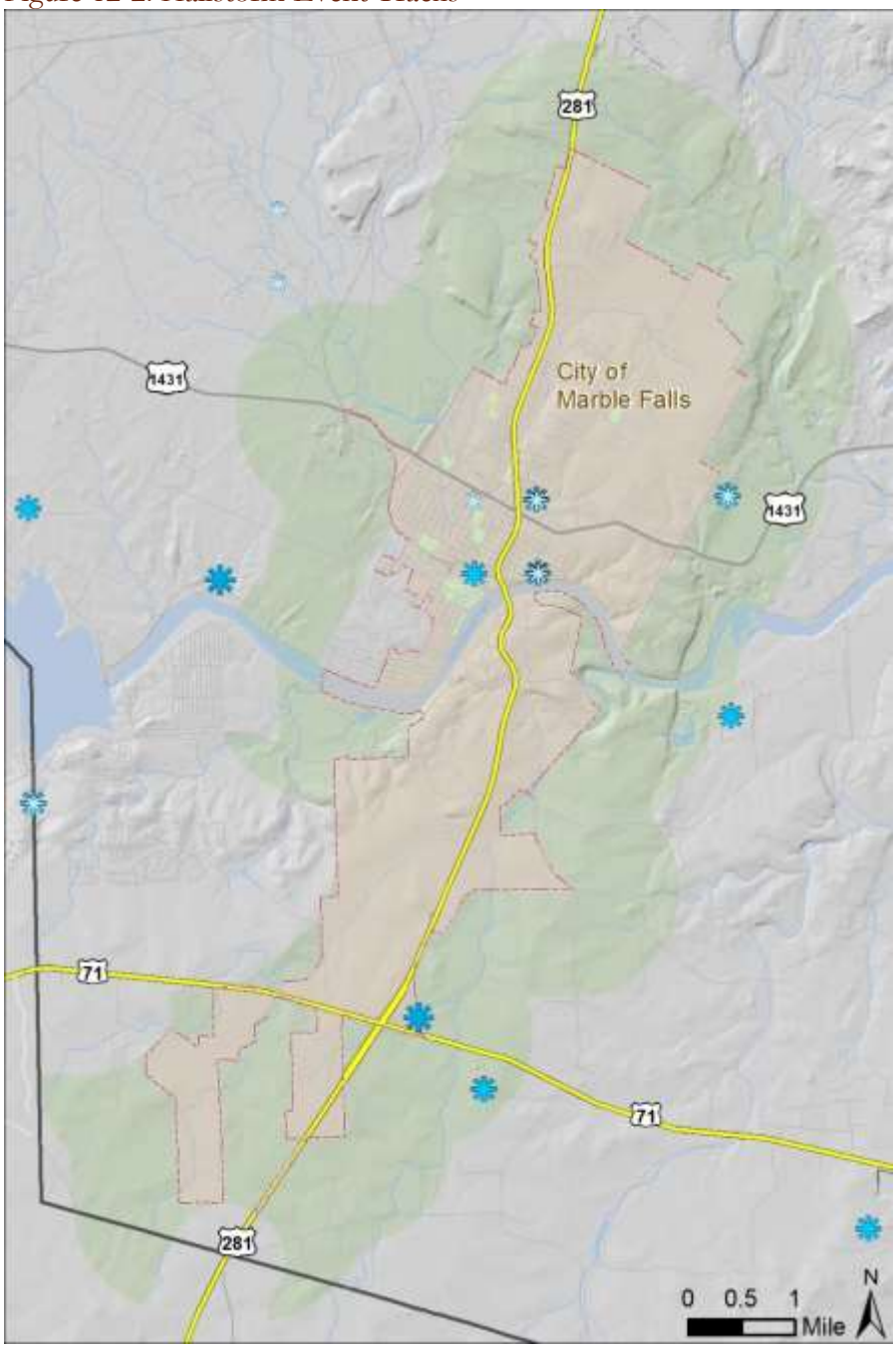
Historical evidence for Marble Falls suggests that the entire planning area is vulnerable to hail events. Historical events with reported damage, injuries or fatalities are shown in Table 12-2 below. A total of 62 reported historical hail events impacted Marble Falls during the 25-year period from 1997 through 2022. These reported events may not represent all hail events to have occurred during this time since they were only the events reported to NCEI and NOAA databases. There have not been any events recorded past the listed dates.

Table 12-2: Historical Hail Events, 1997 - 2022

Jurisdiction	Year	Month	Magnitude	Injuries	Fatalities	Property Damage	Crop Damage
Marble Falls	1998	March	0.75	0	0		
Marble Falls	1999	March	1.75	0	0		
Marble Falls	1999	March	2.75	0	0	$700,000	
Marble Falls	2000	May	1.75	0	0		
Marble Falls	2002	May	0.88	0	0		
Marble Falls	2006	April	0.88	0	0		
Marble Falls	2006	April	1.5	0	0		
Marble Falls	2007	June	1	0	0		
Marble Falls	2008	April	1	0	0		
Marble Falls	2008	April	0.88	0	0		
Marble Falls	2009	March	2	0	0		
Marble Falls	2011	May	0.88	0	0		
Marble Falls	2013	April	1	0	0		
Marble Falls	2013	April	2.75	0	0		
Marble Falls	2013	April	2	0	0		
Marble Falls	2013	April	1.75	0	0		
Marble Falls	2013	April	1.75	0	0		
Marble Falls	2022	March	0.75	0	0		

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

Figure 12-2: Hailstorm Event Tracks



Significant Events

March 12, 1999 – Marble Falls

Heavy rain was reported in Marble Falls, followed by large hail just in advance of a small and short-lived tornado. The tornado was observed by an Amateur Radio spotter just east of the town of Marble Falls itself. After the tornado had dissipated, a second severe thunderstorm moved across the Marble Falls area, producing grapefruit-sized hail. The hail damaged over 300 homes and more than 500 cars. Damage totals were estimated to be near $700,000.

Probability of Future Events

Based on available records of historic events there were 12 unique events in a 25-year reporting period for the Marble Falls planning area. This provides a probability of at least 1 event every 3 years. This frequency supports a 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. Hail poses a significant threat to people as they could be struck by hail and 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 most commonly damaged by hail. Older structures not built to current codes may be more vulnerable 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 Marble Falls 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 hailstorm hazard but more prone to being isolated from essential needs and emergency services in the event of a disaster.

Table 11-8. Structures at Greater Risk by Jurisdiction

Jurisdiction	Total Housing Units	Mobile Homes	Housing units built prior to 1980
City of Marble Falls	2,857	104 (3.6%)	985 (34.6%)
Burnet County	17,941	3,087 (17.2%)	5,476 (30.5%)

*County totals include all jurisdictions in addition to unincorporated areas.
Source: 2021 American Community Survey 5-year estimate, selected housing characteristics

Based on the ACS 2021 data, when compared Burnet County as a whole, the City of Marble is at a higher risk of damage from windstorms when considering age of residential structures and the higher standard of building codes enacted after 1980. The City of Marble Falls is at a lower risk of damage from windstorms when considering number and ratio of manufactured homes.

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 $28,000 for Marble Falls.

Table 12-4, Marble Falls Loss Summary

Time Period	Fatalities	Injuries	Property Damage	Crop Damage
Loss Summary, Marble Falls				
25-year Total	0	0	$700,000	$0
Per Year	0	0	$28,000	$0
Per Capita Dollar Losses				
25-year Total	0	0	$99.47	$0
Per Year	0	0	$3.98	$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.

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 more populated, urban area of the planning area is less likely to experience large, sweeping fires. The more rural and sparsely populated unincorporated areas of the Marble Falls planning area 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 Marble Falls 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.

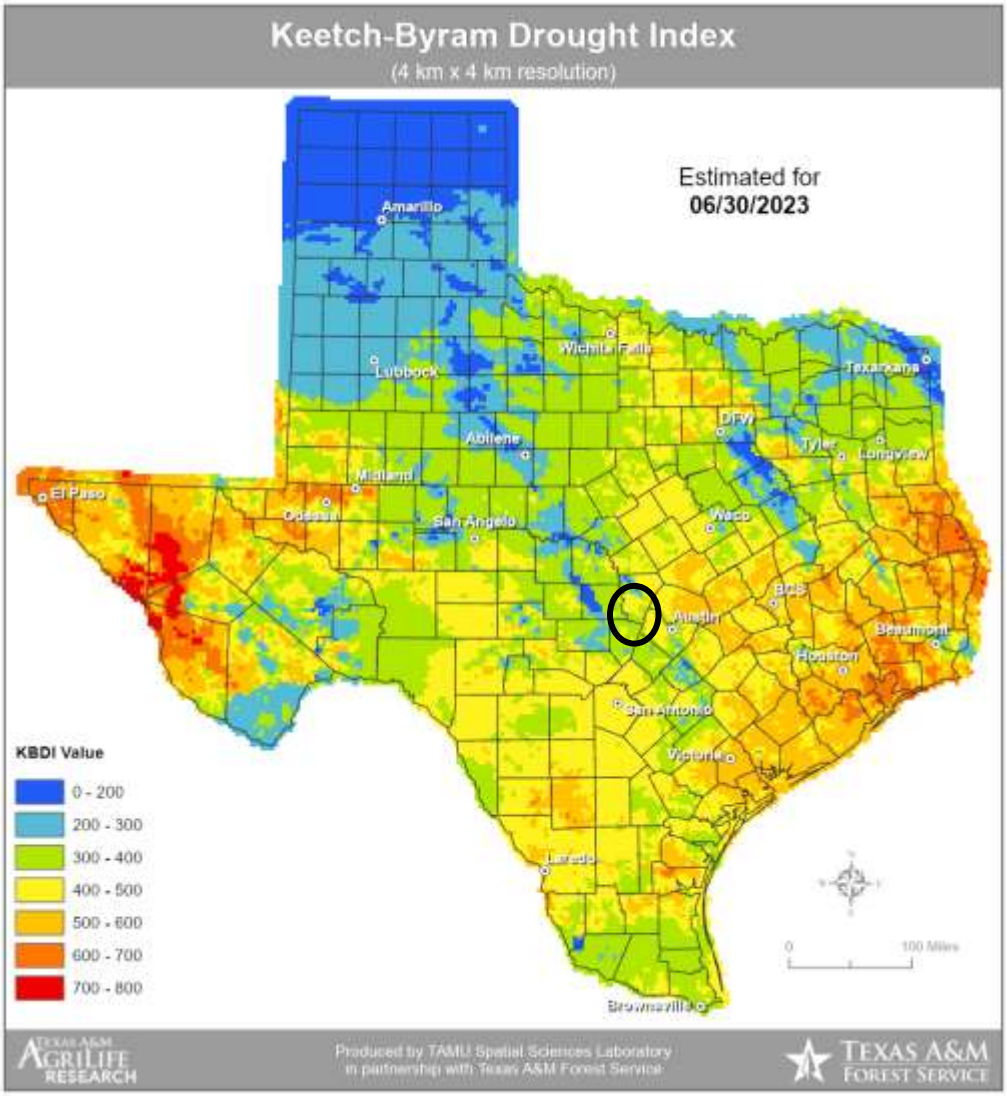
Table 13-2, Marble Falls Planning Area KBDI Values (June 30, 2022)

	KBDI Average	KBDI Maximum	KDBI Minimum
Burnet County	390	484	163

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

The average KBDI values for the planning area is approximately 390 and is the average extent to be mitigated for (Table 13-2). Based on figure 13-1 below, areas of Southern Burnet County have values in the 400-500 range 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 we 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 6/30/2022



https://twc.tamu.edu/kbdi

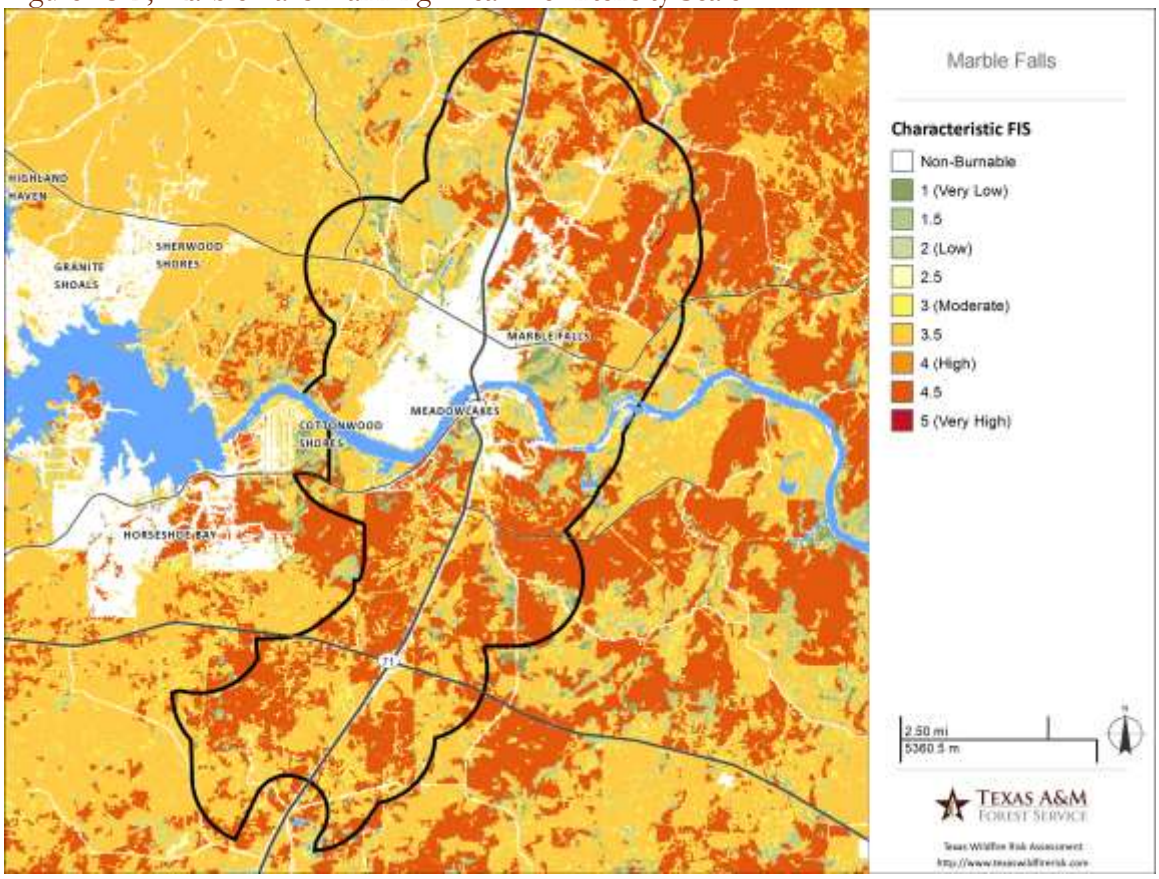
The Texas Wildfire Risk Assessment Portal (TXWRAP) is the primary mechanism for the Texas A&M Forest Service to deploy risk information and create awareness about wildfire issues across the state. www.TexasWildfireRisk.com The tool uses the Fire Intensity Scale (FIS) layer to determine the potential 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 Marble Falls planning area has a Non-burnable FIS classification within the central urbanized area and a high to very high FIS classification in the more vegetated areas just outside of the urban core. Figure 13-2 identifies the wildfire intensity for the Marble Falls planning area.

Figure 13-2, Marble Falls Planning Area Fire Intensity Scale



Source: https://wrap.texaswildfirerisk.com/Map/Pro/#project-areas retrieval 6/30/2023

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 1997-2022. The following events occurred in Burnet County but there have not been any reported occurrences in the NCEI in the Marble Falls planning area specifically.

Jurisdiction	Year	Month	Injuries	Fatalities	Property Damage	Crop Damage
Burnet County	2018	July	0	0	$0	$0
Burnet County	2018	July	0	0	$0	$0
Burnet Conty	2018	August	0	0	$0	$0

Significant Events

September, 2011

In September 2011 a wildfire developed around Spicewood in Travis County that moved into Burnet County. The burned for eight days and consumed 6,500 acres. It also destroyed 67 homes.

July, 2015

A wildfire occurred on the golf course along Summit Rock Blvd. The consumed 40 acres and threatened several homes.

May, 2017

Malfunctioning electrical equipment started a wildland fire between Mormon Mill Road and Highway 281, just north of the city limits. The fire moved into very rough terrain making extinguishment difficult for firefighters. An approximate 150 acres burned in the fire and threatened one home.

July 23, 2018 – Burnet County
The CR108 Wildfire burned 737 acres from July 23 until the 26th in Burnet County.

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

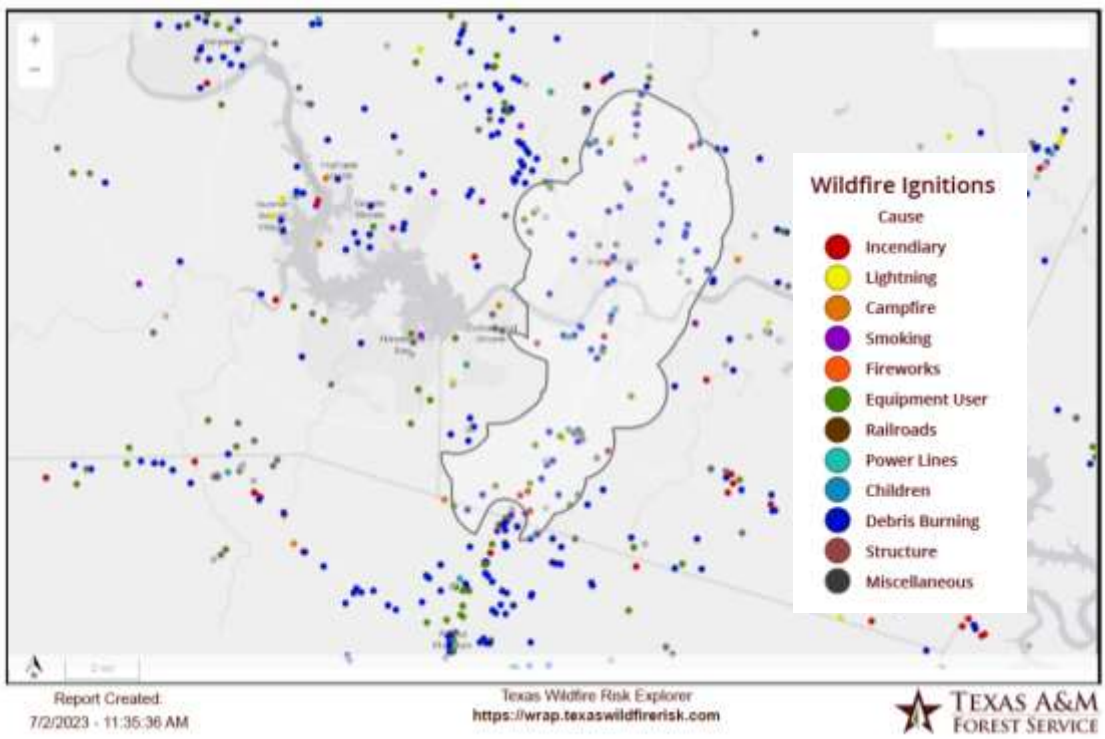


Table 13-3 below lists the ignition causes for all wildfires in the planning area between 2005-2021, the number of times of each unique ignition cause, and the percent of total ignitions.

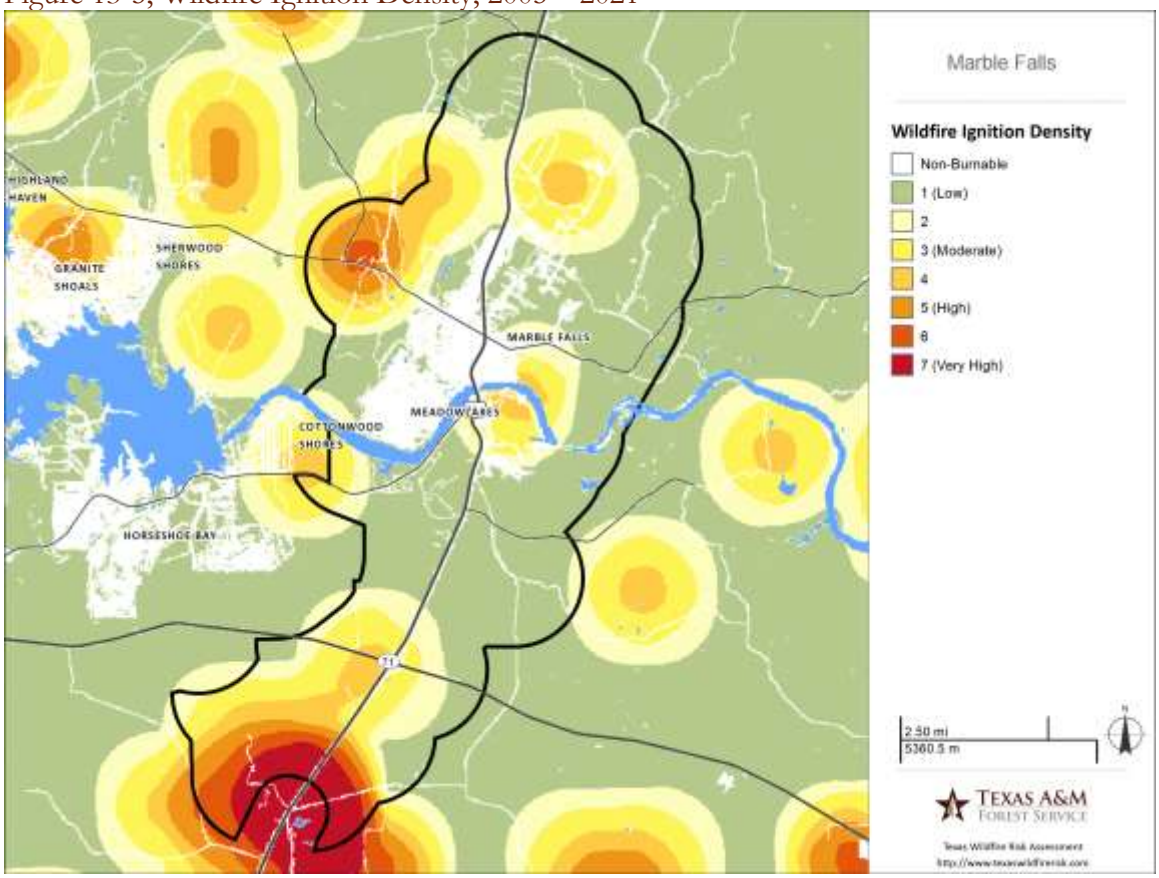
Table 13-3, Wildfire Ignition Causes 2005-2021

Ignition Cause	Count	% of Total
Debris burning	55	48%
Equipment use	15	13%
Incendiary	8	7%
Lightning	2	2%
Miscellaneous	20	17%
Power Lines	5	4%
Smoking	2	2%
Structure	1	1%
Unknown	7	6%
Grand Total	**115**	**100%**

Source: Texas Wildfire Risk Assessment Portal(TxWRAP)

The Wildfire Ignition Density map is another tool when considering local and regional hazard mitigation and prevention planning. The map in Figure 13-5 shows the likelihood of a wildfire starting based on historical ignition patterns. Occurrence is derived by modeling historic wildfire ignition locations to create an average ignition rate map. Wildfire Ignition Density is a key input into the calculation of the Wildfire Threat output. In particular, with most Texas fires being human caused, there is a repeatable spatial pattern of fire ignitions over time. This pattern identifies areas where wildfires are most likely to ignite and prevention efforts can be planned accordingly.

Figure 13-5, Wildfire Ignition Density, 2005 – 2021



Probability of Future Events

Based on reported historical occurrences of wildfire in the Texas Wildfire Risk Assessment Portal, 115 wildfire events occurred in a 16-year reporting period for the Marble Falls planning area. This establishes an approximate probability of occurrence of 7 wildfire 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. Population growth within the WUI substantially increases the risk from wildfire. Natural vegetation provides the fuel for wildfires in natural uninhabited areas, while WUI fires consume both vegetation and materials from the built environment. In Texas nearly 85 percent of wildfires occur within two miles of a community. Texas is one of the fastest growing states in the Nation, with much of this growth occurring adjacent to metropolitan areas. This increase in population across the state will impact counties and communities that are located within the Wildland Urban Interface (WUI).

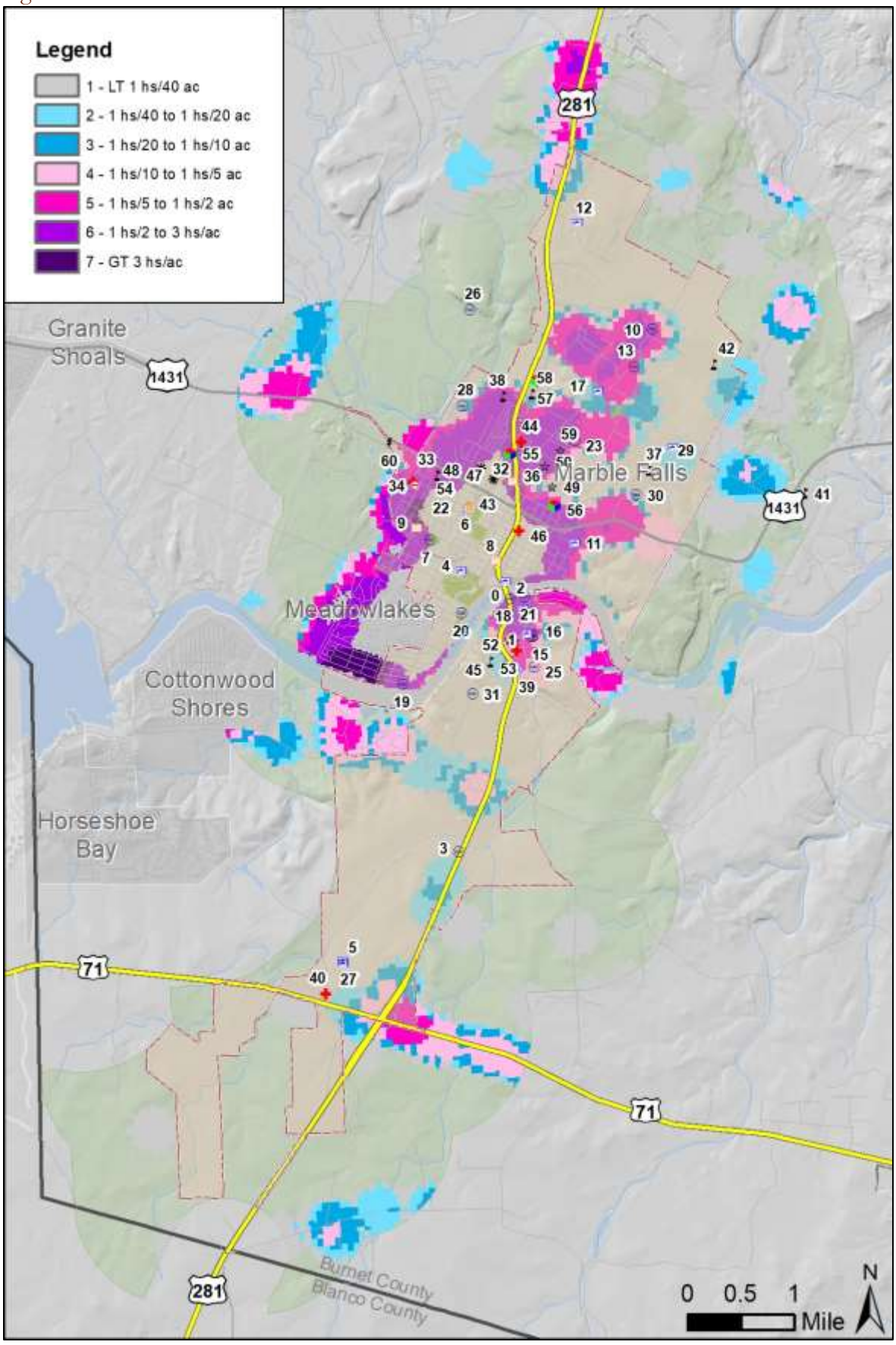
The severity of impact from major wildfire events can be substantial. Such events have caused deaths and injuries, damaged and destroyed property and critical facilities, and disrupted infrastructure and services. Severity of impact is gauged by homes and structures lost, acreage burned, and the number 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. For the Marble Falls project area, it is estimated that 5,303 people or 55.2% percent of the total project area population (9,600) live within the WUI. Figure 13-6 on the following page shows the wildland urban interface and the threat of wildfire across the Marble Falls planning area. Critical facilities located within the WUI of the Marble Falls planning area are listed in Table 6-3 below.

Table 6-3: Critical Facilities in the Wildland Urban Interface (WUI)

Critical Facilities
2 assisted living facilities, 1 boys and girls club school, 1 church/school, 3 daycare, 1 elementary school, 1 EMS, 1 high school, 1 hospital, 1 clinic, 2 pump stations, 11 lift stations, 1 nursing home, 1 raw water farm (wastewater), 1 urgent care, 1 volunteer fire department, 1 public works building, 2 water towers

The City of Marble Falls maintains a wildfire safety webpage that can be found at https://marblefallstx.gov/438/Wildfire-Safety.

Figure 13-6: Wildland Urban Interface



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 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).

Figure 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 Marble Falls planning area are considered to be uniformly exposed to a winter storm hazard and could potentially be impacted.

Extent

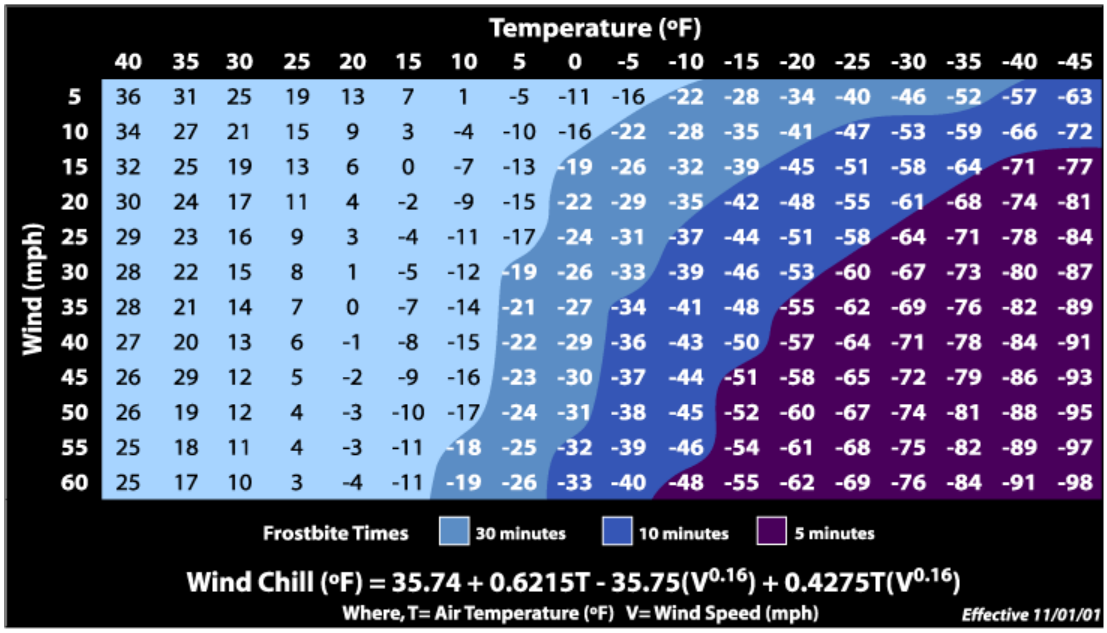
The extent or magnitude of a severe winter storm is measured by on an intensity scale from "Mild" to "Severe" based on temperature ranges and snow accumulation levels. Table 14-1, Magnitude of Severe Winter Storms, is an index developed by the National Weather Service (NWS). This table should be referenced with the wind chill factor, Figure14-2, 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 14-1: 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 14-2: Wind Chill Chart



Source: National Weather Service

Historical Occurrences

Based on NCEI data, from 1997 through 2022 the larger Burnet County planning area experienced 16 severe winter events. No damages, injuries, or fatalities were reported for the following severe winter events.

Table 14-2: Historical Occurrences of Severe Winter Weather Events

Year	Month	Day	Injuries	Fatalities	Property Damage	Crop Damage
1998	December	23	0	0		
2000	December	12	0	0		
2001	November	28	0	0		
2003	February	24	0	0		
2007	January	15	0	0		
2009	January	27	0	0		
2011	February	3	0	0		
2015	February	27	0	0		
2018	January	16	0	0		
2020	December	31	0	0		
2021	January	10	0	0		

2021	February	11	0	0	$287,000	
2021	February	13	0	0		
2021	February	16	0	0		
2021	February	3	0	0		

Significant Events

February 11, 2021 – Burnet 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.

The emergency manager in Marble Falls reported all major roadways had ice, from both sleet and freezing rain. The emergency manager in Burnet reported freezing rain ongoing with some accumulation noted. Roads were getting worse. A trained spotter reported over half or an inch of ice accumulation near Bertram with large tree limbs down.

Probability of Future Events

According to historical records, Marble Falls 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 Marble Falls 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 6,892 according to the 2021 ACS 5-year population estimate. Those over the age of 65 represent 21.5% (1,480) of the total population and children under the age of 5 represent 3.1% (214) of the total population. The total population of the county that is estimated to be below the poverty level is 10.0% (687). Table 7-4 presents the 2021 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
City of Marble Falls	1,480/ 21.5%	214/ 3.1%	687/10%

Source: 2021 American Community Survey (Note: County totals include both incorporated and unincorporated areas)
*Blanco Pedernales Water population counts for the planning area are included in the County total.

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

The summary table below, 7-5, 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 $11,480 for Marble Falls.

Table 7-5: Severe Winter Storm Impact Summary

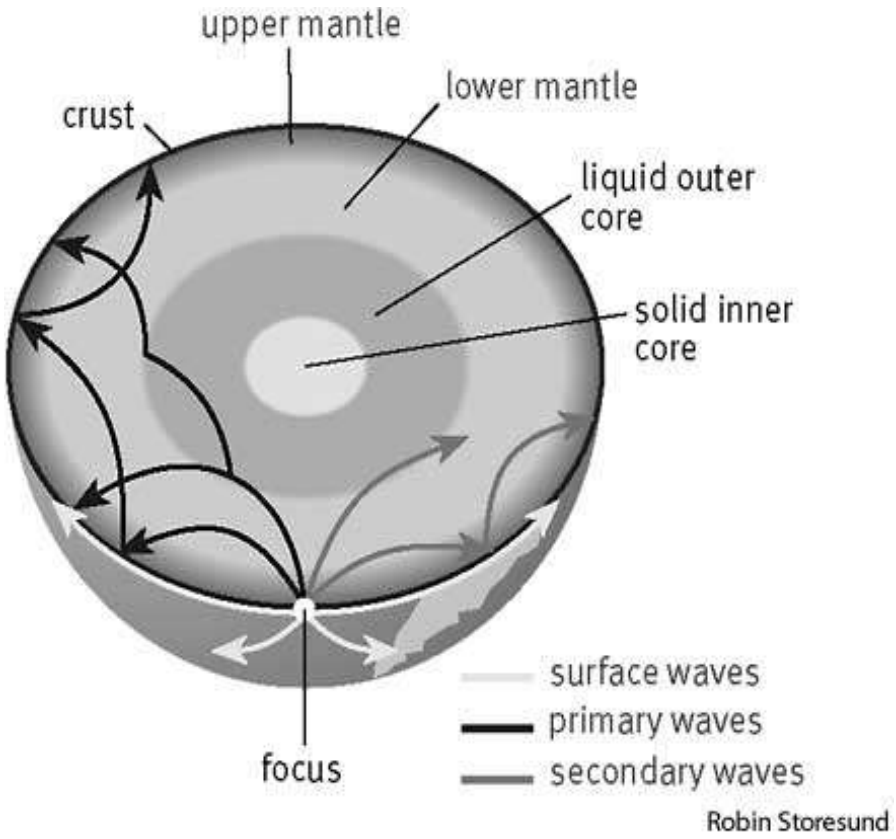
Time Period	Fatalities	Injuries	Property Damage	Crop Damage
Loss Summary, Marble Falls				
25-year Total	0	0	$287,000	$0
Per Year	0	0	$11,480	$0
Per Capita Dollar Losses				
25-year Total	0	0	$38.66	$0
Per Year	0	0	$1.55	$0

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>.*

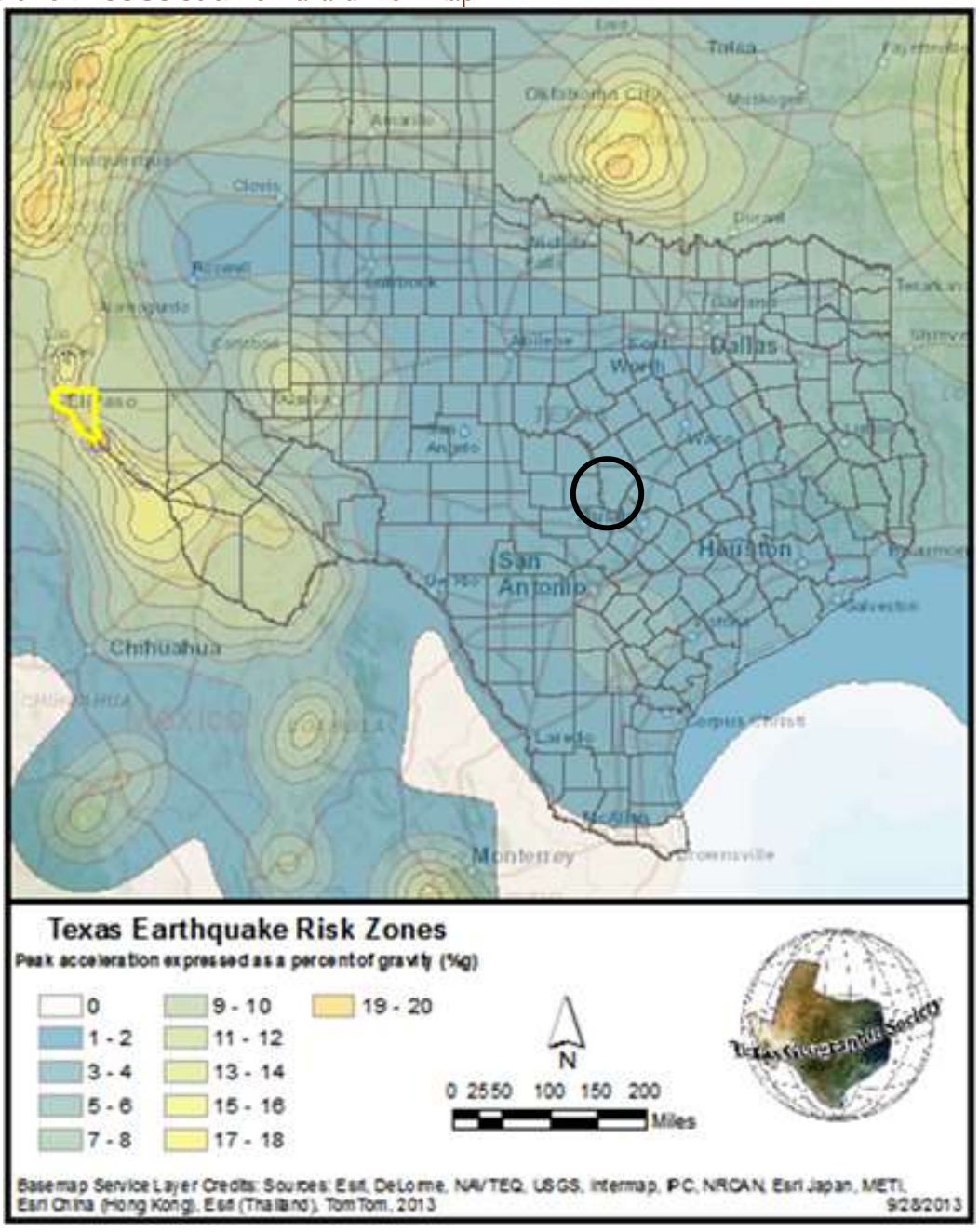
Primary (P) waves have a push-pull type of vibration. Secondary (S) waves have a side-to-side type of vibration. Both P and S waves travel deep into Earth, reflecting off the surfaces of its various layers. S waves cannot travel through the liquid outer core. Surface (L) waves—named after the nineteenth-century 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 much of the state experiencing earthquake events of less than 2% of gravity peak acceleration over 50 years. The Marble Falls planning area Falls is well within the zone of 1-2% peak acceleration.

Figure 15-2. USGS Seismic Hazard Risk Map



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 2.9 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.

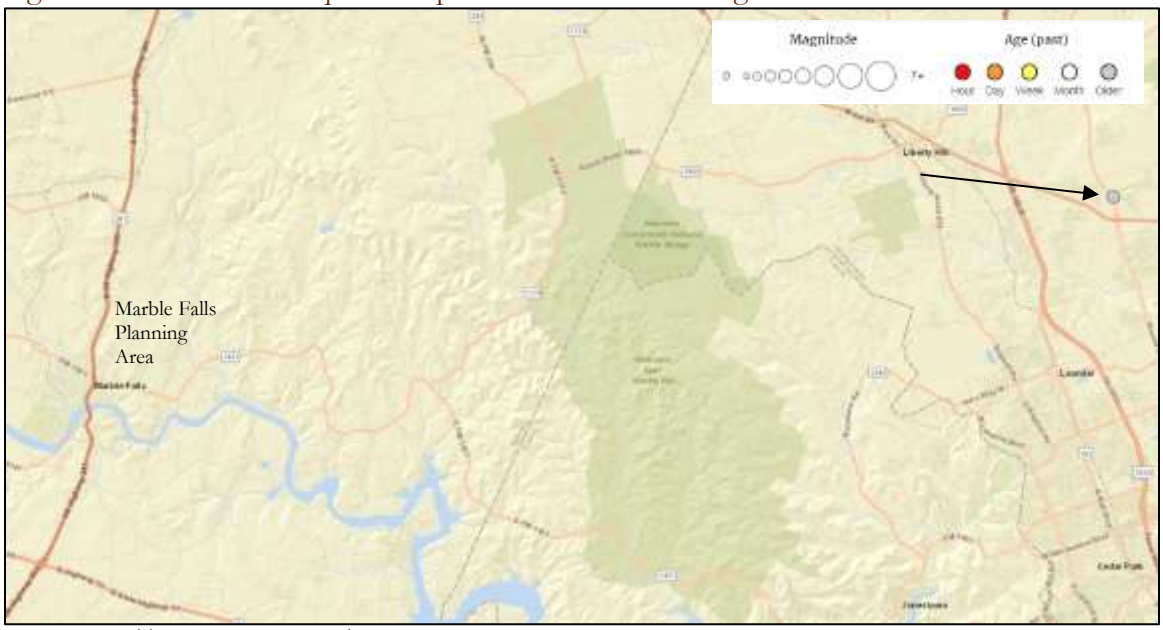
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.
XII	Virtually total destruction. 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 Marble Falls planning area did not experience any earthquakes. This is consistent with accounts by Planning Team Members that earthquakes have not occurred in the past. 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.

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



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 Marble Falls planning area with a magnitude of 2.5 or greater. Table 15-3 below provides details for the 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 northeast in Travis County which was recorded in 2015.

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

Date	Location	Magnitude
9/03/2015	7 kilometers NNE of Leander, TX	2.9

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

Significant Events

September 3, 2015 – Travis County

At 5:01 PM on September 3, 2015, a magnitude 2.9 earthquake had its epicenter 7 kilometers north northeast of Leander, Texas.

Probability of Future Events

Based on the USGS estimates in the seismic hazard risk map provided at the beginning of this section and produced in 2013, the planning area has a 1-2% chance of experiencing an earthquake over the next 50 years. Over the 100-year period there are 0 occurrences of earthquakes for the Marble Falls planning area. Based on most recent data, the probability of an earthquake occurring somewhere in the planning 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 Marble Falls are vulnerable to the impacts of earthquakes. The impact of earthquakes to the planning area is **"low."**

In addition to buildings, roads and bridges and underground assets such as utilities can also be severely damaged by earthquakes depending on the magnitude and epicenter. Subterranean utilities that can be impacted by earthquakes include underground sanitary sewer collection systems that 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 can also be damaged generating hazardous conditions.

SECTION 16: DAMS

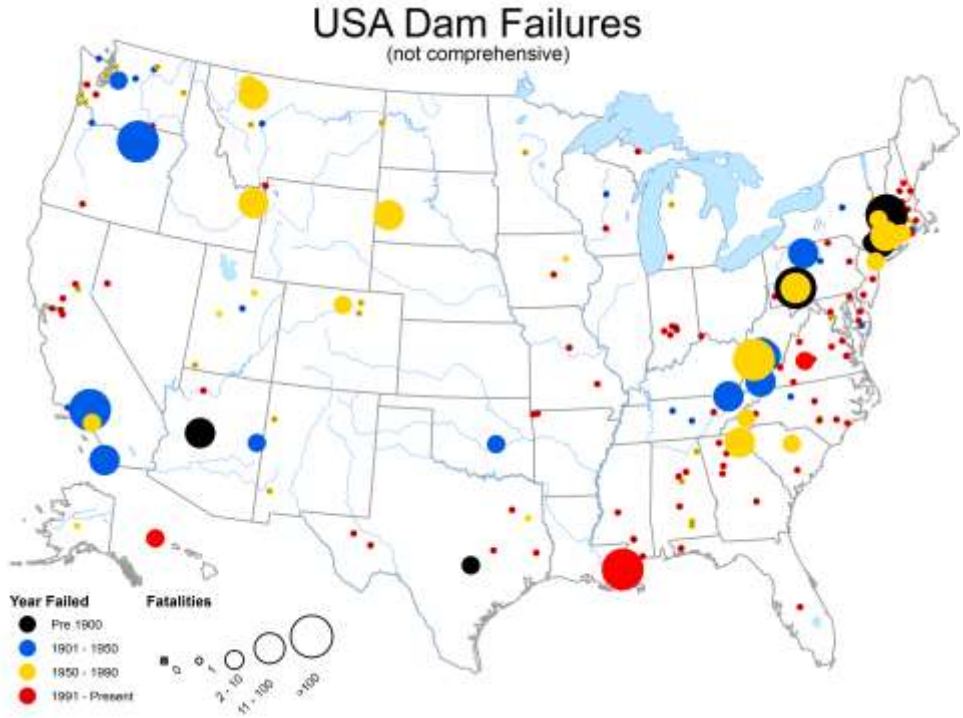
Description

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; 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 Max Starke 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 15-2: 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 15-3 and 15-4, provide a summary and illustrate general locations for each dam in the region surrounding the planning area. Currently, there are 0 dams located in the Marble Falls

planning area, however 2 dams are located just outside the planning area that have the ability to significantly impact the City of Marble Falls and its residents. Wirtz Dam forms Lake LBJ just upstream of the Colorado River and Max Starcke Dam form Lake Marble Falls and is downstream. The Lower Colorado River Authority is responsible for operation and maintenance of all the dams that form the highland lakes.

Figure 16-2: Dam Summary for Burnet County, Texas

23 Total Dams	**56 years** Average Dam Age	**92%** High Hazard Potential Dams with an EAP	**0%** Federally Regulated Dams
		17% Dams with Hydropower	**61%** State-Regulated Dams

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

Figure 16-3: Dam Locations in and around Burnet County by Hazard Potential

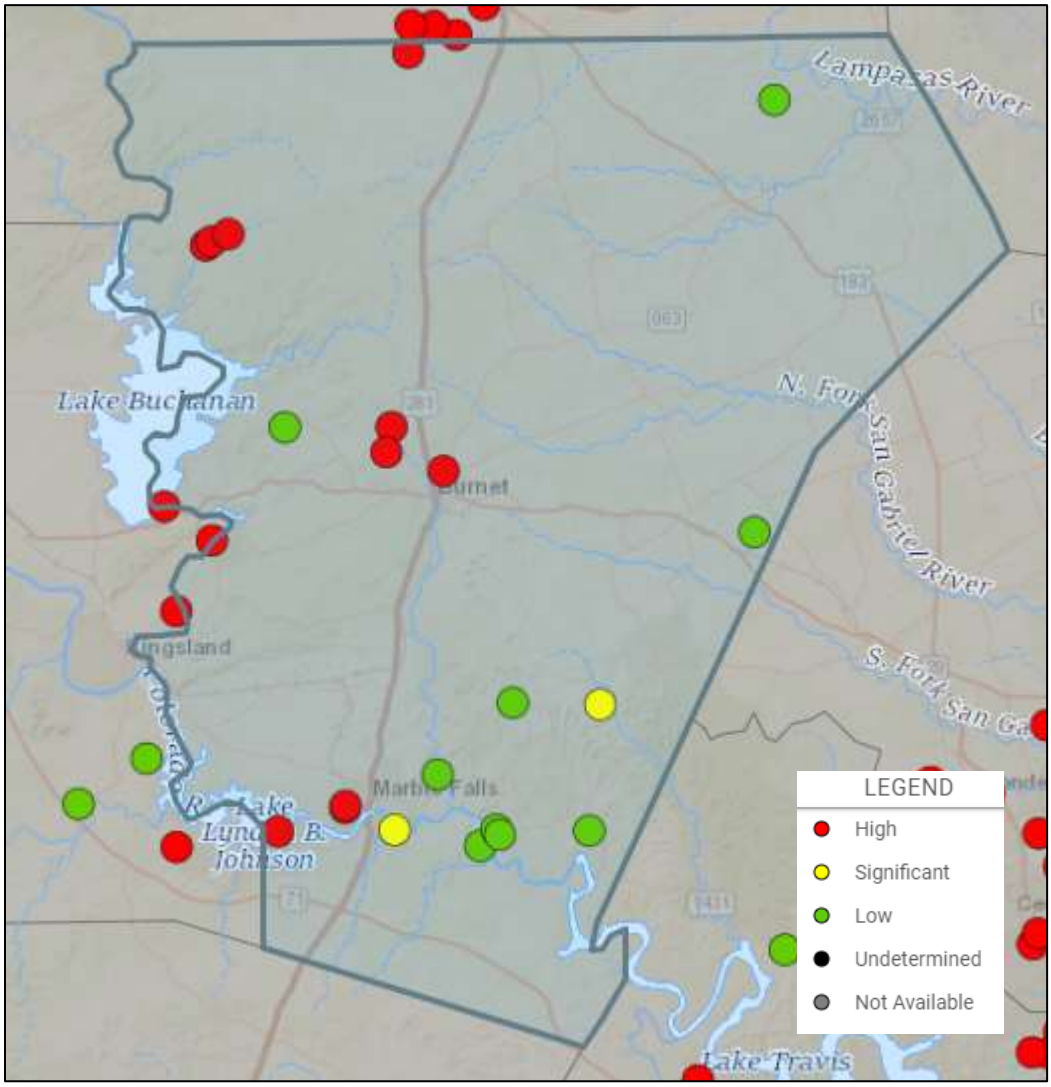
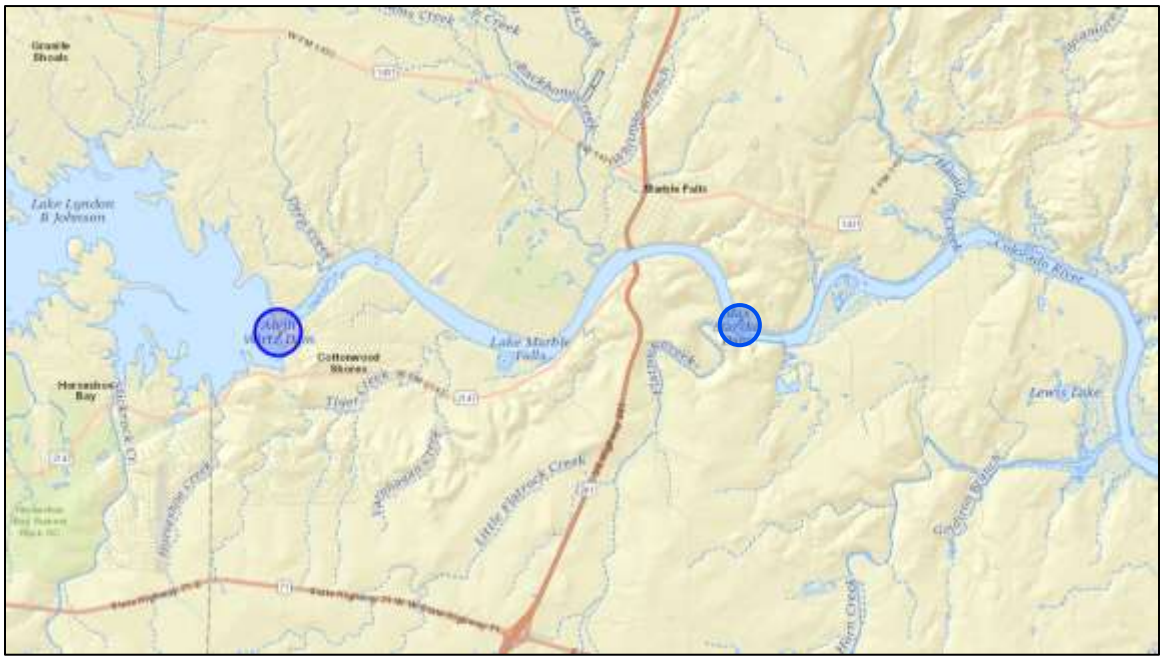


Figure 16-4: Dam Locations near in Marble Falls



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

The survey of dams that could affect the Marble Falls planning area is presented in Table 15-1 below. The survey provides the dam name, the year built, height of dam, normal storage in acre feet of the impoundment, max storage, and the hazard potential.

Table 16-1: Marble Falls Dam Survey

Dam Name	Year Completed	Height (Ft.)	Normal Storage (Acre Ft.)	Max Storage (Acre Ft.)	Hazard Potential
Wirtz Dam	1951	118	134,353	223,000	High
Max Starke Dam	1951	99	8,760	8,760	Significant

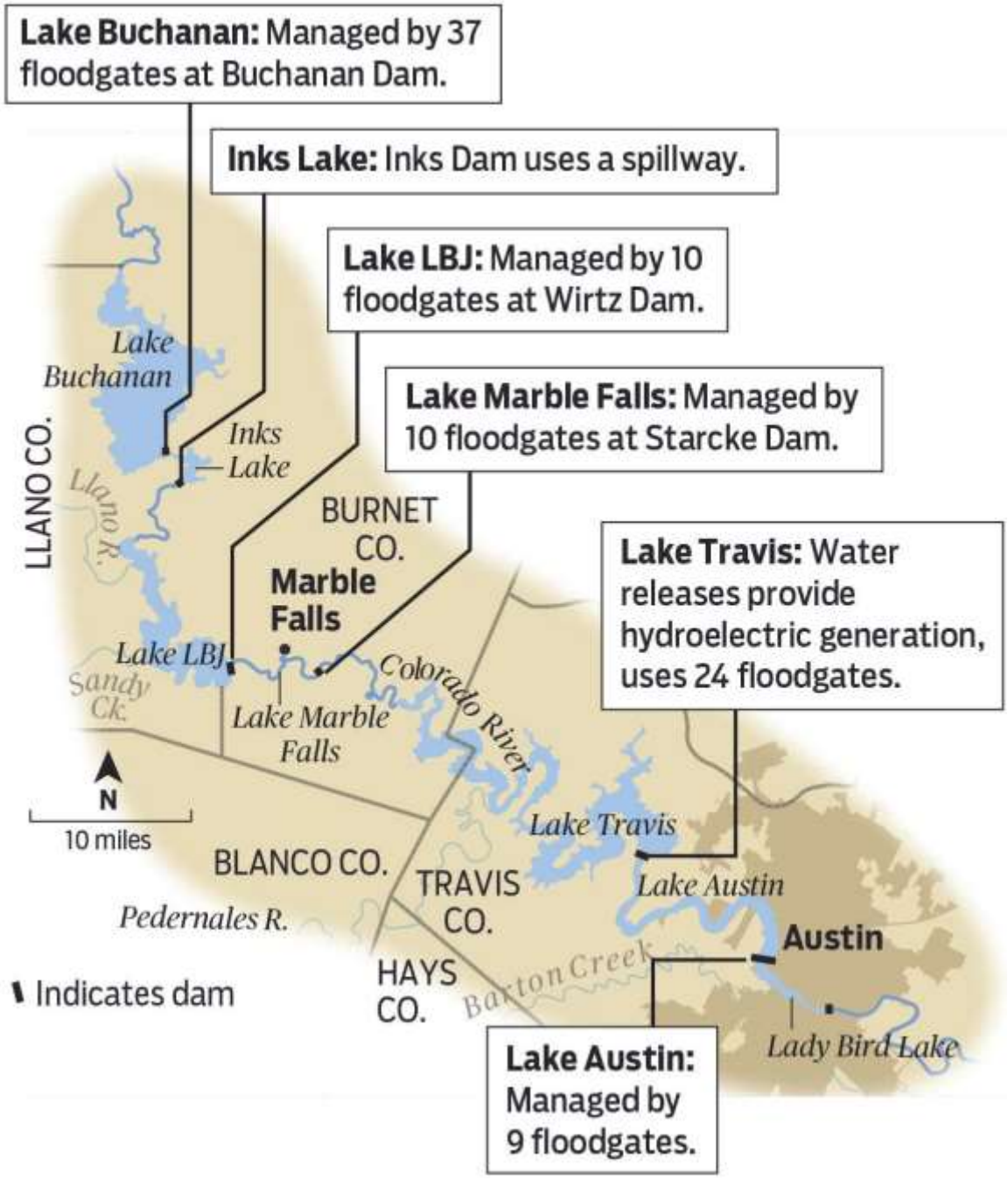
Source: https://nid.sec.usace.army.mil, NID

For dams with a maximum storage capacity of 100,000 acre-feet or more or "high" hazard dams, all census blocks within five miles are considered to be at risk to 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 developments downstream of the dams, all populations located downstream of the dams are considered to be a risk to public safety if a dam failure occurred. 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 more accurately determine risk from dam failure. The US Army Corp of Engineers and the LCRA is in possession of this extremely sensitive data for the high hazard dam near the planning area, Wirtz Dam.

LCRA operates six dams on the lower Colorado River in Central Texas: Buchanan, Inks, Wirtz, Starcke, Mansfield and Tom Miller. These dams form the six Highland Lakes: Buchanan, Inks, LBJ, Marble Falls, Travis and Austin. Two of the Highland Lakes –Buchanan

and Travis – are the region's water supply reservoirs to serve more than 1 million people as well as businesses, industries, the environment and agriculture in the lower Colorado River basin. Each of the dams was built to help manage floods and generate hydroelectric power. The dams in the Highland Lakes chain have hydroelectric generation stations that contribute to the Central Texas energy supply. Together, the hydroelectric plants at the dams can provide more than 295 megawatts of power.

Figure 16-5: Highland Lakes Dams



Source: Lower Colorado River Authority

Figure 16-6: Wirtz Dam

Source: https://www.lcra.org/water/dams-and-lakes/

Wirtz Dam, just upstream of Marble Falls, is one of the six dams on the Colorado River that form the Highland Lakes upstream from Austin. Wirtz was built in 1951 to create Lake LBJ, with nine gates to pass floodwaters downstream. The LCRA added a 10th gate in 1974 when the original Thomas C. Ferguson Power Plant was built nearby in Llano County. Construction has recently begun on a $76 Million 3-year renovation project to upgrade each of the 10 Wirtz dam floodgates with new 120,000 pound custom-made floodgates that meet up-to-date engineering standards.

All of the highland Lakes between Buchanan and Travis are designed for "pass through" and, as such, there are and will be times when a flood event exceeds expectations and the capabilities of the system. Any release at one dam has an impact on those below and flood operations are made in a manner to move floodwater through the system to Lake Travis, the only lake in the system designed for storage. Think of the lakes as train cars carrying passengers, and when one car gets overloaded, the passengers move to the next car forward. Wirtz Dam connects Lake LBJ, which sits behind it, to the next car forward, Lake Marble Falls. When events are overwhelming, there are areas along the system that will become inundated. The damaging floods of 1997, 2007, and 2018 with steep financial losses to the planning area and Central Texas more generally presented just such a scenario where water tops the dams and moves downstream at will. The system has evolved considerably since the 1997 flood with a list of relevant changes and improvements below.

- 1998 Major Expansion and Improvement Project for Hydromet begins (original USGS gauges were from 1982)
- 2004 Previous notification system was replaced with the Flood Operations Notification System (FONS)
- 2006 Hydromet data is retrieved every 15 minutes.
- 2014 Telemetry is migrated to a new radio system.

The Dams and their floodgates along the Highland Lakes are operated as a system and the River Operations Center conducts flood operations in accordance with agreements maintained with FEMA and the U.S. Army Corps of Engineers. Heavy rains in flash flood alley can quickly transform into walls of fast-moving water with great destructive potential. Having operational floodgates on the dams allows LCRA to manage flooding on the Colorado River by moving floodwaters downstream into Lake Travis, in which they can be temporarily stored until they can be released in a controlled manner. The agency opens gates during flooding to move the water in a more predictable and safe way. The floodgates act as protective gear for the dams allowing LCRA to move a deluge of water downstream into the next lake without endangering the dam. Without the floodgates, flooding would overtop the dams and threaten the integrity of the dams. [10]

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 15-2 on the following page.

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 15-3 represents the extent or magnitude of a dam failure event that could be expected for the Marble Falls planning area. 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 Marble Falls

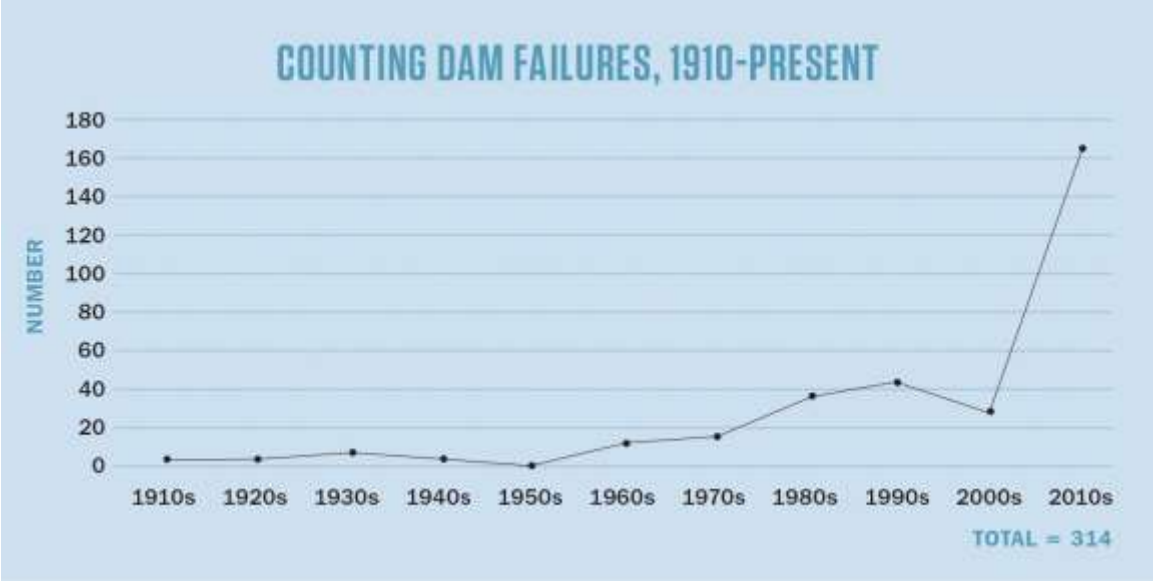
Jurisdiction	Dams and Classification	Extent Classification	Level of Intensity to Mitigate
Marble Falls	1 – High 1 - Significant	High	Dam failure presents a high threat for Marble Falls as Wirtz Dam represents a very large impoundment of water forming Lake LBJ. Loss of life is expected and economic loss is significant in the event of a catastrophic dam failure.

[10] https://www.statesman.com/story/news/environment/2023/02/21/lower-colorado-river-authority-replace-wirtz-dam-floodgates-lake-lbj/69841756007/

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 ten years.

Figure 16-6: Texas Dam Failures, 1910-Present



Source: Texas Observer

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 are exempt from inspections and oversight.

Based on an investigation by the Texas Observer,

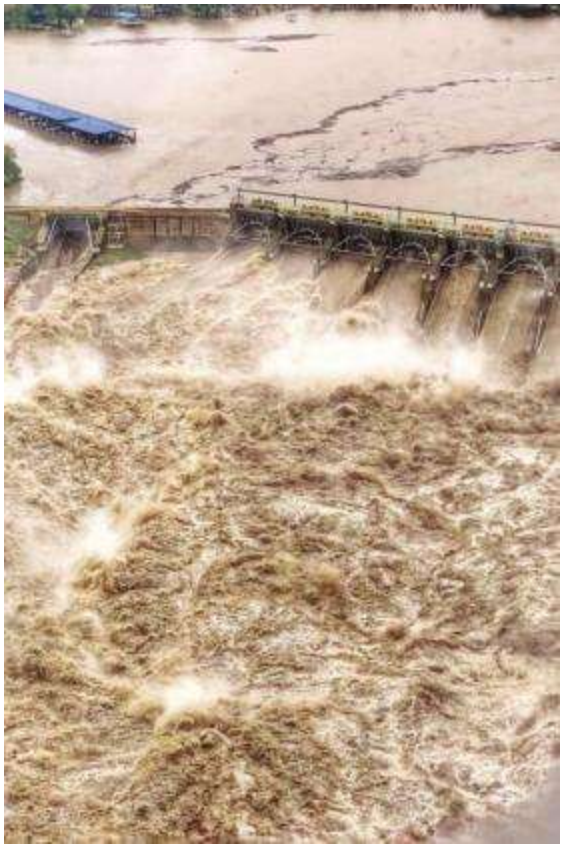
> This investigation found that the vast majority of failures in Texas involve dams that impound less than 1,000 acre-feet. Despite their size, many small dams are ticking time bombs, according to safety experts. Big dams are usually owned by government agencies such as river authorities, which have 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

October 16, 2018

The Llano Bridge was closed to traffic - and remained so for most of the day - for fear it was compromised due to the tremendous amount of fast flowing water going under the bridge, only one of two feet from the roadway of the bridge. In the picture below Wirtz Dam overflowed its spillway.

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



Source: https://www.highlandernews.com/features/remember-when-flood-devastates-highland-lakes

June 22, 1997

Based on feedback from the Core team members, the operation of the Wirtz Dam floodgates has caused severe flooding in the past. The floodgates were manually operated during the June 1997 flood and were opened to release water from Lake LBJ into Lake Marble Falls causing downstream flood damage to the City of Marble Falls. The floodgates are now controlled by a system that prevents this type of rapid release from happening in the future.

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.

Tremendous flow down the James River, reinforced by 8-to-15-inch rainfall east of Mason Sunday afternoon and evening, sent the Llano River at Llano to over 38 feet shortly near midnight Sunday night, some 6 feet above the 1952 flood of record. Several buildings and a dozen homes were flooded in Llano, and major damage was reported to the city park. At least two dozen homes were flooded between Llano and Castell and 5 to 6 homes flooded south of Llano. At Kingsland, complete destruction was reported to docks along the River above Lake LBJ. Most boats were destroyed, although no homes were flooded. Along the Colorado River, over a dozen homes and lodges were flooded. Flooding along Lake Marble Falls on the north side of Lake LBJ, involved some 35 homes on one side alone. At Lake Marble Falls, inflow was so great that the lake volume was being replaced every 12 minutes on Sunday evening. The Red Cross and FEMA totals for homes and businesses damaged or destroyed in this flood in South Central Texas included nearly 300 homes across the Highland Lakes northwest of the Austin area.

Probability of Future Events

According to historical records, from 1997-2022 the Marble Falls 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 probable 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 of Marble Falls are directly downstream of Wirtz Dam are vulnerable to a dam breach and the impact of a dam failure is **"high."** 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. If the 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, and disrupt local utilities, such as water and wastewater, and could result in school closures. Marble Falls is at risk of flooding due to dam failure from Wirtz Dam. Marble Falls it at risk of water supply disruption due to dam failure from Max Starke Dam.

Table 16-3: Dam Inspections, Condition Assessments, and EAP Revisions

Dam Name	Last Inspection Date	Condition Assessment	Condition Assessment Date	Date of Last EAP Revision
Wirtz Dam	11/12/2020	Satisfactory	09/29/2017	06/05/2020
Max Starcke Dam	04/08/2021	Satisfactory	09/29/2017	06/05/2020

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

Wirtz Dam, the only high hazard dam that has the capability of impacting the planning area based on size, could have a catastrophic impact to downstream communities, infrastructure, riverine systems, and even downstream dams. The City of Marble Falls would be need to be immediately evacuated in the event of a Wirtz dam 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 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 similar to that of a flash flood with loss of life possible and injuries from impacts with 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 economy increases as well. For these reasons, creating mitigations 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 TCEQ. The TCEQ 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 3 main components: mitigation goals, mitigation actions, and an action plan for implementation. These 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 actions will be prioritized and implemented. For this plan update, the City of Marble Falls has had the opportunity to consider ranking and implementation responsibilities in the action plan specific to its 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 Burnet 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 2023 Marble Falls Mitigation Action Plan Update. The first was held during the second Core Planning Team at the Fire Department Training Room and the second was held virtually with the sub-jurisdictional team. The goals and objectives from the 2016 Burnet 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 Marble Falls Hazard Mitigation Action Plan update are presented below.

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

Goal #1: Protect public health and safety.

Objective 1.1: Advise the public about health and safety precautions to guard against injury and loss of life from hazards.

Objective 1.2: Maximize the utilization of the latest technology to provide adequate warning, communication, and mitigation of hazard events.

Objective 1.3: Reduce the damage to, and enhance protection of, dangerous areas during hazard events.

Objective 1.4: Protect critical facilities and services.

Goal #2: Protect existing and new properties.

Objective 2.1: Reduce repetitive losses to the National Flood Insurance Program.

Objective 2.2: Use the most cost-effective approaches to protect existing buildings and public infrastructure from hazards.

Objective 2.3: Enact and enforce regulatory measures to ensure that development will not put people in harm's way or increase threats to existing properties.

Goal #3: Increase public understanding, support, and demand for hazard mitigation.

Objective 3.1: Heighten public awareness of the full range of natural hazards they face.

Objective 3.2: Educate the public on actions they can take to prevent or reduce the loss of life or property from natural hazards.

Objective 3.3: Publicize and encourage the adoption of appropriate hazard mitigation measures.

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

Objective 4.1: Build and support local partnerships to continuously become less vulnerable to hazards.

Objective 4.2: Build hazard mitigation concerns into planning and budgeting processes.

Goal #5: Promote growth in a sustainable manner.

Objective 5.1: Incorporate hazard mitigation into the long-range planning and development activities.

Objective 5.2: Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.

Objective 5.3: Utilize regulatory approaches to prevent creation of future hazards to life and property.

Goal #6: Maximize the resources for investment in hazard mitigation.

Objective 6.1: Maximize the use of outside sources of funding.

Objective 6.2: Maximize participation of property owners in protecting their properties.

Objective 6.3: Prioritize mitigation projects, based on cost-effectiveness and starting with those sites facing the greatest threat to life, health, and property.

SECTION 18: MITIGATION ACTIONS

The mitigation actions developed by Core planning team members, Jurisdictional sub-team, and community stakeholder input are presented in this section for Marble Falls. Core Planning Team members and Jurisdictional sub-team members met for two mitigation workshops in July 2023 and September 2023 to develop mitigation actions for each of the natural hazards included in the Plan; Sections 5-16. This began with a review of mitigation actions from the prior 2016 Burnet County 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, LCRA, community and regional plans, capital improvement plans, and mitigation ideas guides developed by FEMA and the Texas Department of Emergency Management (TDEM). Based on local input, the following action items from the previous 2016 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 2016 Burnet County Hazard Mitigation Plan and are listed as completed. No actions were discarded from the previous plan and on-going actions or those that had 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.

ACTION: Create defensible space around structures and prevent fires from advancing and endangering homes and lives. Work through the five steps of Firewise recognition until complete.	
Action Completed:	Firewise recognition gained and defensible space around structures is maintained.

Core Planning Team members 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 18 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 the action will be implemented as soon as funding is received, both locally 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
City of Marble Falls											
1	Relocate Wastewater Treatment Plant out of Floodplain	Relocate the Wastewater treatment plant out of the 1% and 0.2% annual chance floodplain.	Hurricane, Flood, Dam Failure		G1, G5	Y	Engineering, Public Works	$73M	Local, PDM, HMGP, TWDB	36	High
2	School District Fuel Center Generator	install a generator for the school district fuel center used by first responders and public works	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G6	Y	Public Works, Marble Fall ISD	$90,000	Local, PDM, HMGP, ISD	48	Medium
3	Creek and crossing clearing projects	Remove trees and other vegetation along with debris along the floodway and culvert crossing to increase conveyance.	Hurricane, Flood, Wildfire, Dam Failure		G1, G4	N	Parks Department	$500,000	Local, PDM, HMGP, TWDB	36	High
4	Raise primary water intake system control and pumps out of floodplain	The primary water intake system control and pumps will be raised out of floodplain at 2 locations: Lakeshore and Colorado	Hurricane, Flood, Dam Failure		G1, G5	Y	Engineering, Public Works	$3.5M	Local, PDM, HMGP, TWDB	36	High
5	Raising of emergency water intake pump	Place emergency raw water intake pump on a motorized operated rail system that can move pump out of flood waters	Hurricane, Flood, Dam Failure		G1, G5	Y	Engineering, Public Works	$1.5M	Local, PDM, HMGP, TWDB	36	High
6	Build a bridge at Ave N & Backbone Creek	Build a bridge at Ave L at Whitman Branch to remove low water crossing	Hurricane, Flood, Dam Failure		G1, G2, G5	Y	Engineering, Public Works	>$1M	Local, PDM, HMGP	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
City of Marble Falls											
7	Build a bridge at Nature Heights & Whitman and Hwy 281	Build a bridge at Nature Heights & Whitman and Hwy 281 to remove low water crossing	Hurricane, Flood, Dam Failure		G1, G2, G5	Y	Engineering, Public Works	>$1M	Local, PDM, HMGP	36	High
8	Install emergency generators at all future fire stations	Amend code to require emergency generators at all future fire stations. The VFD Station is in need of a generator.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G6	Y	Planning Department	$75,000	Local, PDM, HMGP	24	Medium
9	Wildfire Prevention Education	Develop a wildfire prevention program to inform citizens and visitors of what to do during incidents that threaten life and property. Educate on how to create a defensible space around homes and how to implement firewise sites principles at the neighborhood level that is tailored to specific community needs.	Drought, Extreme Heat, Wildfire		G1, G2, G3, G4	Y	Emergency Management, Fire Department	$50,000	Local, HMGP, Texas A&M Forest Service, ISD	24	High
10	Install a generator at the Middle School Shelter	Install a generator at the Middle School Shelter to provide backup power in the event of an emergency	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G6	Y	Public Works, Marble Fall ISD	$125,000	Local, PDM, HMGP, ISD	36	High
11	Develop new resident welcome packets that include how to stay informed in event of an emergency	Education campaign on signing up for emergency notifications and process to offer it to new residents. This would include infromation on warncentraltexas.org, city websites, and include LCRA flood operations notification for specific areas of town affected by lake floods.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G3, G5, G6	N	Emergency Management	$5,000	Local, PDM, HMGP, TWDB	48	Medium
12	Install computer-based flood warning system with remote flashers and remote automatic gates, where applicable	Locations: Broadway between Ave. N & Ave L, Commerce Street at Nature Heights, Main Street @ Broadway, Ave L @Broadway, Mission Hill, 2nd St @ Westside Park, 90 Ave N, 400 Blk Ave T, 700 Blk Ave U, 2000 Blk 7th St, Bluebonnet at Lantana, Lakeshore, Ave J in Johnson Park, and Nature Heights @ HWY 281. (LCRA hydromet added since last plan)	Hurricane, Flood, Dam Failure		G1, G3	N	Engineering, Public Works	$350,000	Local, PDM, HMGP, TWDB	60	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 Marble Falls											
13	Backup water and wasterwater service to southside of Lake Marble Falls	Study redundancy options considering whether to extend secondary water supply and wastewater lines across the lake or construct a water treatment plant and wastewater treatment plant on the southside of Lake Marble Falls. If the bridge is damaged, water and wastewater supply to the south areas is interrupted.	Hurricane, Flood, Dam Failure		G1, G2, G5, G6	Y	Engineering	$150,000	Local, PDM, HMGP, TWDB	60	Low
14	Build Bridge at Mission Hills Street Creek Crossing	Build bridge at Mission Hill's Street Creek Crossing to alleviate flash flooding that frequently causes road closure. It is a major east/west connection street.	Hurricane, Flood, Wildfire, Dam Failure		G1	N	Engineering, Public Works	$1.5M	Local, PDM, HMGP, TWDB	48	High
15	Buyout residential and commercial property	Propose a voluntary buyout using Floodplain ordinance, FEMA resources, etc. as each property is substantially damaged in 100-year flooplain if no flood improvement projects are planned or in progress for the area.	Hurricane, Flood, Dam Failure		G1, G2, G5, G6	N	City Manager	$500,000	Local, PDM, HMGP, TWDB	60	Medium
16	Update Emergency Preparedness website	Update Emergency Preparedness page on the city website to provide the latest information on best practices for hazard mitigation and preparation	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3, G4	Y	Emergency Management	$5,000	Local	24	Medium
17	Public education for homeowners on hazard mitigation	Educate homeowners about mitigating hazards for theirs homes and empower residents about the importance of having an emergency preparedness kit. Use ready.gov as a resource.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G2, G3	N	Emergency Management	$10,000	Local, PDM, HMGP	36	Medium
18	Update Community Wildfire Protection Plan to address new areas	Update Community Wildfire Protection Plan to address new areas of growth since the plan was developed.	Drought, Extreme Heat, Wildfire		G1, G2, G5	Y	Fire Department	$5,000	Local, HMGP, PDM, Texas Forest Service	36	Medium
19	AM Alert Emergency radio advisory system	City operated alert AM Emergency advisory radio station to inform citizens and visitors what to do during incidents that threaten life and property.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3	N	Emergency Management, Fire Department	$75,000	Local, HMGP	36	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 Marble Falls											
20	Support Burnet County CERT	Support the Burnet County CERT to enhance self sustainability of citizens	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3, G4, G6	N	Emergency Management	$1,000	Local	24	Low
21	Emergency generator for EMS Station	Install a generator at the EMS to provide backup power in the event of an emergency	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G6	Y	Public Works, Marble Falls Area EMS	$75,000	Local, PDM, HMGP	24	High
22	Relocate animal control facility out of floodplain	Relocate animal control facility out of floodplain to protect animals and facilty from flooding	Hurricane, Flood, Dam Failure		G1, G5	Y	Engineering, Public Works, Police	$2.5M	Local, PDM, HMGP	48	Low
23	Build a bridge at 2nd St at Westside Park	Build a bridge at 2nd St at Westside Park to remove low water crossing	Hurricane, Flood, Dam Failure		G1, G2, G5	Y	Engineering, Public Works	>$1M	Local, PDM, HMGP	60	Low
24	Mobile flood control devices used to protect lift stations from floodwaters	Mitigate flooding impacts to lift station at Pecan Valley, Westside, RV, 281 @ Flatrock Creek by implementing mobile flood control devices	Hurricane, Flood, Dam Failure		G1, G2, G5	Y	Engineering, Public Works	$500,00	Local, PDM, HMGP, TWDB	48	Medium
25	Create a city position for a full time public information officer	Create a city position for a public information officer to be in charge of disseminating information	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3	Y	City Council	$75,000	Local	36	Medium
26	Whitman Branch Bypass	Install a 50-foot wide by 5 foot deep bypass channel to the east along Oak Ridge Drive to increase the water capacity and minimize flooding. This action is identified in the drainage study performed by Halff.	Hurricane, Flood, Wildfire, Dam Failure		G1, G2, G5	N	Public Works and Engineering	$3.5M	Local, PDM, HMGP	24	High
27	Flood study for the southern part of the city	Study for the south part of the city to establish floodplains and for base flood elevations that are not complete	Hurricane, Flood, Dam Failure		G1, G3, G4	Y	Engineering	$350,000	Local, PDM, HMGP	36	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 Marble Falls											
28	Ensure stormwater retention and remediation is designed in all new developments	Amend Development code to require stormwater detention and retention requirements where necessary (Review recent code revisions to make sure isn't adopted already)	Hurricane, Flood, Dam Failure		G1, G2, G5	Y	Planning Department	$5,000	Local	24	Medium
29	Build a bridge at Broadway St between Ave N & Ave L (at Whitman Branch)	Build a bridge at Broadway St between Ave N to remove low water crossing	Hurricane, Flood, Dam Failure		G1, G2, G5	Y	Engineering, Public Works	>$1M	Local, PDM, HMGP	48	Medium
30	Plant drought tolerant trees along public sidewalks, parking lots, and streets	Xeriscaping is a type of landscaping that uses little water by only using plants that are native to the area. Trees along sidewalks and parking lots provide shade from the heat and sun while preserving potable water supplies for drinking and fire suppression. (Downtown Plan)	Drought, Extreme Heat, Wildfire		G1, G2, G5	Y	Parks, Planning, Public Works	$50,000	Local, HMGP, PDM, Texas Forest Service, TPRD	24	Low
31	Structural hardening of critical facilities	Analyze, prioritize and harden critical facilities to withstand impacts from hazard events such as earthquakes forces and movements, high winds, hailstorm and lightening strikes.	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G5, G6	Y	Public Works	$400,000	Local, PDM, HMGP	48	Medium
32	Create Creekwalk	Create Creekwalk trail system to create a linear network of parkland throughout the city that can absorb periodic heavy inundation to help mitigate the impacts from flooding (Flood Protection Plan)	Hurricane, Flood, Dam Failure		G1, G2, G3, G5, G6	Y	Engineering, Public Works, Parks	$3M	Local, PDM, HMGP	48	Medium
33	Amend City Code to include trail dedication requirements	Require dedication of riparian areas upon subdivision to reduce the impact of flooding to new development while creating a connected urban trail system. (Comp Plan)	Hurricane, Flood, Dam Failure		G1, G2, G5	Y	Planning Department	$10,000	Local, PDM, HMGP	24	Medium
34	Backbone Tributary Bypass	This project is constructing three 8 feet by 7 feet box culverts along the south side of FM 1431 from 800 feet west of Industrial to Backbone Creek to increase water capacity and minimize flooding. (Project scope may have changed)	Hurricane, Flood, Dam Failure		G1, G2, G5	N	Public Works and Engineering	$5M	Local, PDM, HMGP, TWDB	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
City of Marble Falls											
35	Generator to fully power City Hall	Install a generator at City Hall to provide backup power in the event of an emergency	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G6	Y	Public Works	$90,000	Local, PDM, HMGP	60	Low
36	Introduce wayfinding signage program	Strategically place wayfinding signage throughout the downtown area to help direct people and drivers during hazardous conditions (Downtown Plan)	Hurricane, Flood, Drought, Windstorms, Extreme Heat, Lightning, Tornado, Hailstorms, Wildfire, Severe Winter Storms, Earthquakes, Dam Failure		G1, G3	Y	Planning Department, Administrative	$80,000	Local, PDM, HMGP	36	Medium
37	Elevate Ave J Bridge at Johnson Park	Elevate Ave J Bridge at Johnson Park (Keep for now but deserves another look, only protects parkland and would require tree removal)	Hurricane, Flood, Dam Failure		G1, G2, G5	Y	Engineering, Public Works	$1.5M	Local, PDM, HMGP	36	Low

Legend:

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

Mitigation Action Plan

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

Each 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 exercise 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 20: PLAN MAINTENANCE

This section describes how Marble Falls 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 he department or title of personnel responsible for implementation of mitigation strategies and implementation procedures.

Table 20-1: Team Members Responsible for Plan Maintenance

Jurisdiction/Entity	Title
City of Marble Falls	Emergency Operations Coordinator
City of Marble Falls	Fire Chief

Incorporation

Following adoption and approval of the Plan, Marble Falls 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 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.

HMGP: The purpose of HMGP 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 PDM Program, authorized by Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, is designed to assist States, U.S. Territories, Federally-recognized tribes, and local communities in implementing a sustained pre-disaster natural hazard 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. PDM grants are funded annually by Congressional appropriations and are awarded on a nationally competitive basis.

Methods of Incorporation of the Plan

Once per year at a minimum, participating CORE team members will conduct periodic reviews 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. 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 City of Marble Fals will:

- Present specific mitigation actions to City Council by the responsible department. Upon approval by 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 becomes available. 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 in the budget process and will involve various departments and team members that participated in the planning process. Match requirements for grant funding 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	The City of Marble Falls has regulatory plans in place 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 the City. 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 Council 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 evaluating the Plan will prepare annual reports that will be used to keep the Plan updated. 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 the City and the amendment will be submitted to TDEM. To determine whether to recommend approval or denial of a Plan amendment request, the City 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 Marble Falls to keep the Hazard Mitigation Plan relevant based on the latest information, capabilities, needs and community input. This 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 also an 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 and to ensure eligibility. Oftentimes, the timelines for grant and planning cycles can be in excess of a year to apply and receive funding.

Much like the annual review, the 5-year Plan review provides the Planning Team an opportunity to evaluate mitigation actions that have been successful and those that may not have been successfully implemented or conceived. This is also a time to document any potential losses avoided due to the implementation of specific mitigation measures. The annual reports prepared by Core Planning Team members will be used in the review and factors will be considered that may affect the content of the Plan such as new development in identified hazard areas, increased exposure to hazards, disaster declarations, increase or decrease in capability to address hazards, and changes to federal or state legislation.

Upon completion of the review, any revisions deemed necessary by the Core Planning Team will be summarized and integrated into the existing plan based on the plan amendment process or reserved for the 5-year plan update. Upon completion of the review and amendment/update process, the revised or new Plan will be submitted to TDEM for final review and approval in coordination with FEMA.

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 Marble Falls 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 website, 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 Marble Falls Hazard Mitigation Plan Update.

APPENDIX A: CAPABILITY ASSESSMENTS

	Capabilities	City of Marble Falls
Planning and Regulatory	Comprehensive Plan	X
	Capital Improvement Program	X
	Economic Development Plan	X
	Transportation Plans	
	Emergency Operation Plans	X
	Continuity of Operations Plan	
	Stormwater Management Plan	X
	Erosion or Sediment Control Program	X
	Zoning ordinances	X
	Building Codes	X
	Subdivision Ordinance	X
	Floodplain Ordinance	X
Administrative and Technical	Engineers	X
	Planners	X
	GIS Analysts	X
	Building inspectors	2
	Emergency managers	X
	Grant writers	
	Chief Building Official	X
	Floodplain Administrator	X
Financial	CDBG	X
	Stormwater utility fees	
	Development impact fees	X
Education and Outreach	School programs	
	Firewise communities	
	Storm Ready communities	
	Hazard awareness campaigns	
	Public Information Officer	
	Community newsletter	

Planning and regulatory capabilities are identified as the most impactful to how a municipality or utility is able to plan and develop in a way that is disaster resilient. With Marble Falls having a firm grasp of fundamental items such as Capital Improvement Programs, subdivision ordinances, comprehensive plans, transportation plans and zoning codes, the capabilities are in place to continue to guide the city through this era of high growth and development. As is typical of small to mid-size 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 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. These capabilities are strengthened with the hiring of additional engineering, planning, GIS and building official personnel or developing these capabilities further with grants and other means. Marble Falls currently utilizes engineering and grant writing consultants that support meeting these capability needs and assessments will continue to be conducted to thoroughly identify gaps in capabilities and comparisons made with other communities of similar size and economy. Fiscal mechanisms to fund growth could also be explored throughout the Marble Falls planning area such as drainage utility fees. Lastly, educational programs and literature related to hazard mitigation will be strengthened in close coordination with Marble Falls ISD.

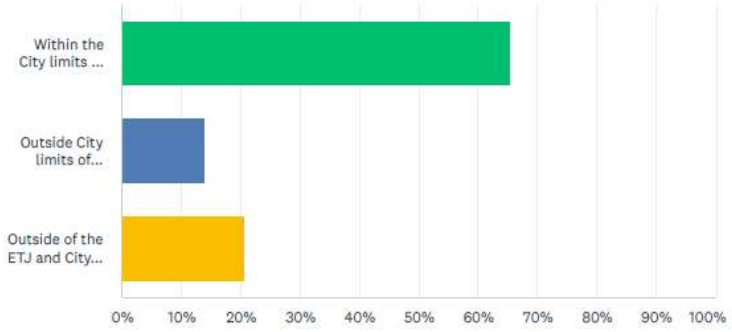
APPENDIX B: PUBLIC SURVEY

Q1

Customize Save as

Please tell us where you live

Answered: 58 Skipped: 0



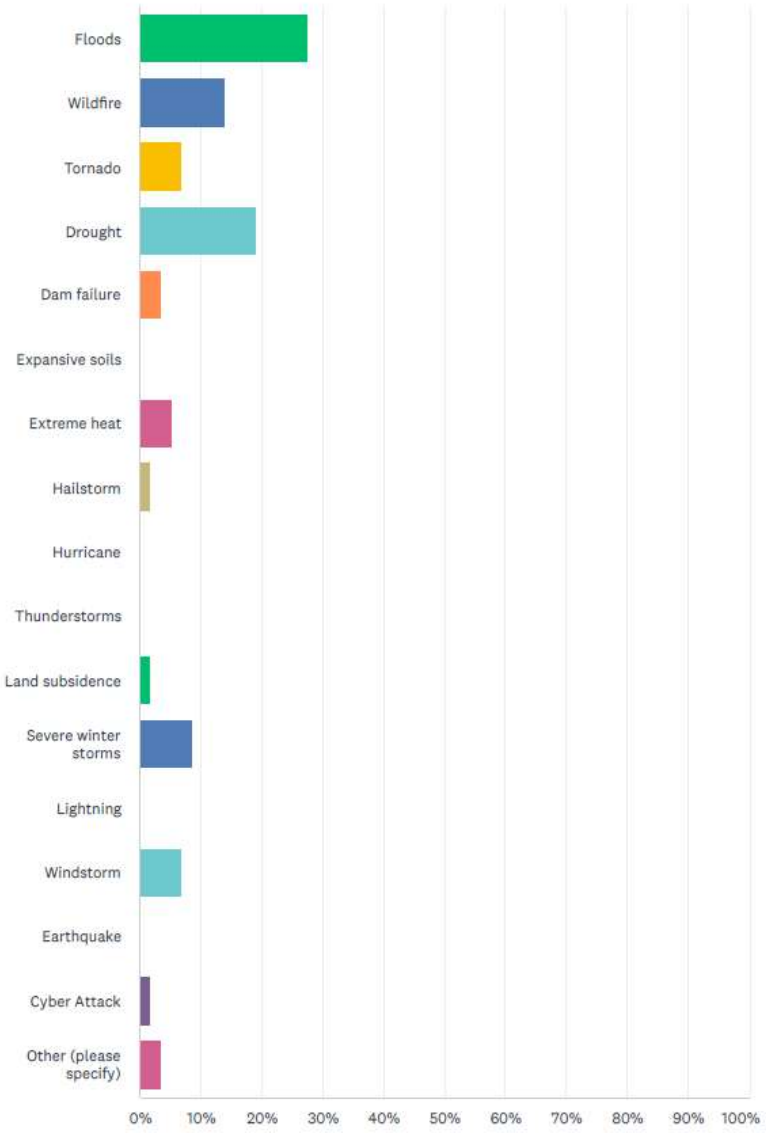
ANSWER CHOICES	RESPONSES	
Within the City limits of Marble Falls	65.52%	38
Outside City limits of Marble Falls but within the ETJ	13.79%	8
Outside of the ETJ and City limits of Marble Falls	20.69%	12
TOTAL		58

Comments (4)

Q2

Customize Save as

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



ANSWER CHOICES	RESPONSES	
Floods	27.59%	16
Wildfire	13.79%	8
Tornado	6.90%	4
Drought	18.97%	11
Dam failure	3.45%	2
Expansive soils	0.00%	0
Extreme heat	5.17%	3
Hailstorm	1.72%	1
Hurricane	0.00%	0
Thunderstorms	0.00%	0
Land subsidence	1.72%	1
Severe winter storms	8.62%	5
Lightning	0.00%	0
Windstorm	6.90%	4
TOTAL		58

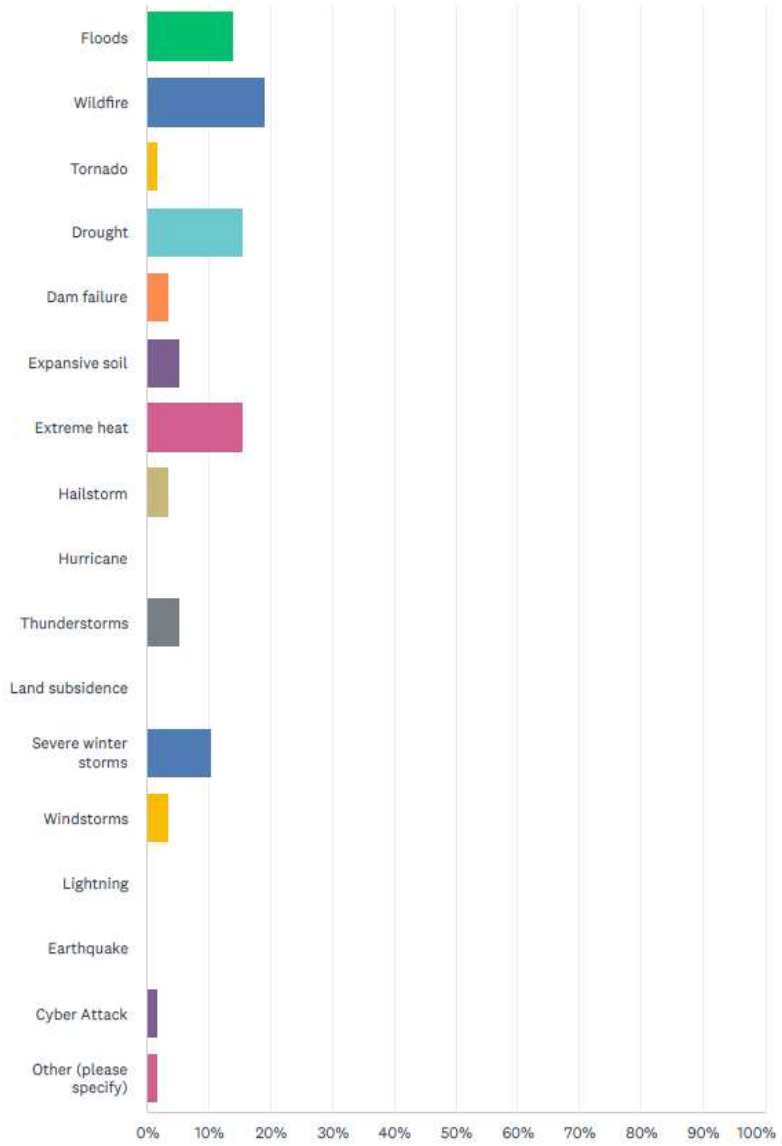
ANSWER CHOICES		RESPONSES	
Earthquake		0.00%	0
Cyber Attack		1.72%	1
Other (please specify)	Responses	3.45%	2
TOTAL			58

Q3

Customize Save as

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

Answered: 58 Skipped: 0



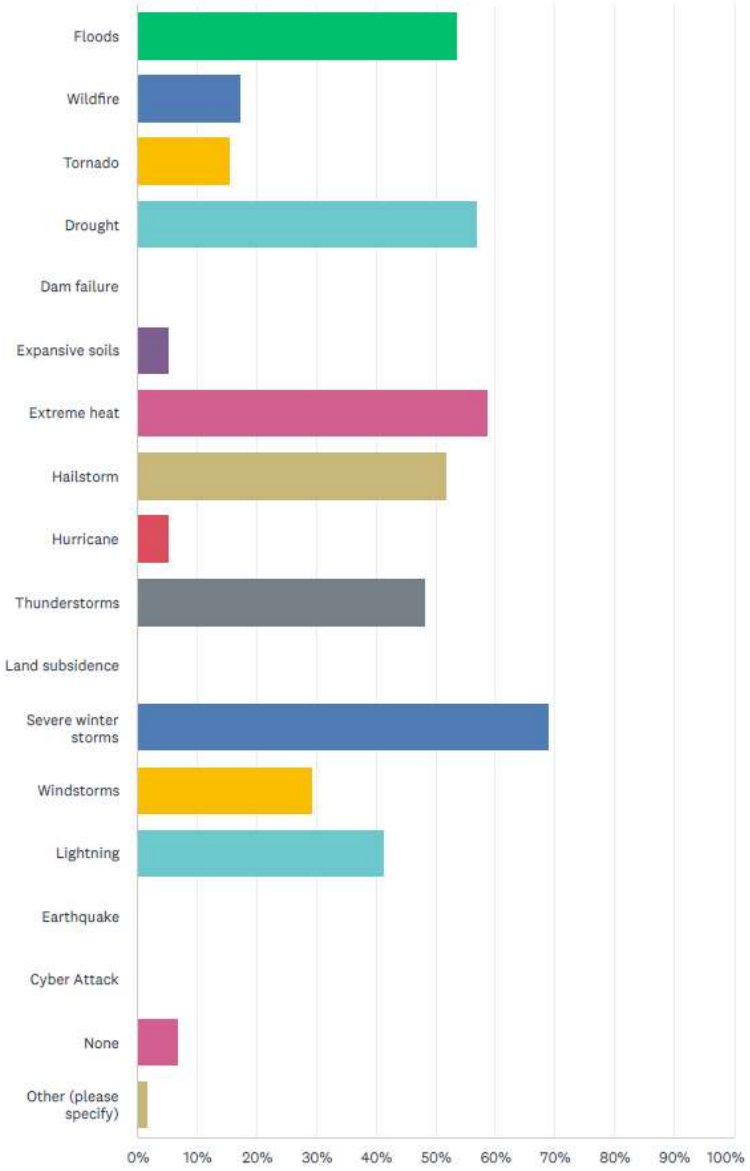
ANSWER CHOICES		RESPONSES	
Floods		13.79%	8
Wildfire		18.97%	11
Tornado		1.72%	1
Drought		15.52%	9
Dam failure		3.45%	2
Expansive soil		5.17%	3
Extreme heat		15.52%	9
Hailstorm		3.45%	2
Hurricane		0.00%	0
Thunderstorms		5.17%	3
Land subsidence		0.00%	0
Severe winter storms		10.34%	6
Windstorms		3.45%	2
Lightning		0.00%	0
Earthquake		0.00%	0
Cyber Attack		1.72%	1
Other (please specify)	Responses	1.72%	1
TOTAL			58

Q4

Customize Save as

While living here in Marble Falls, have you experienced a disaster? (please check all that apply)

Answered: 58 Skipped: 0



ANSWER CHOICES	RESPONSES	
Floods	53.45%	31
Wildfire	17.24%	10
Tornado	15.52%	9
Drought	56.90%	33
Dam failure	0.00%	0
Expansive soils	5.17%	3
Extreme heat	58.62%	34
Hailstorm	51.72%	30
Hurricane	5.17%	3
Thunderstorms	48.28%	28
Land subsidence	0.00%	0
Severe winter storms	68.97%	40

Total Respondents: 58

ANSWER CHOICES		RESPONSES	
Windstorms		29.31%	17
Lightning		41.38%	24
Earthquake		0.00%	0
Cyber Attack		0.00%	0
None		6.90%	4
Other (please specify)	Responses	1.72%	1

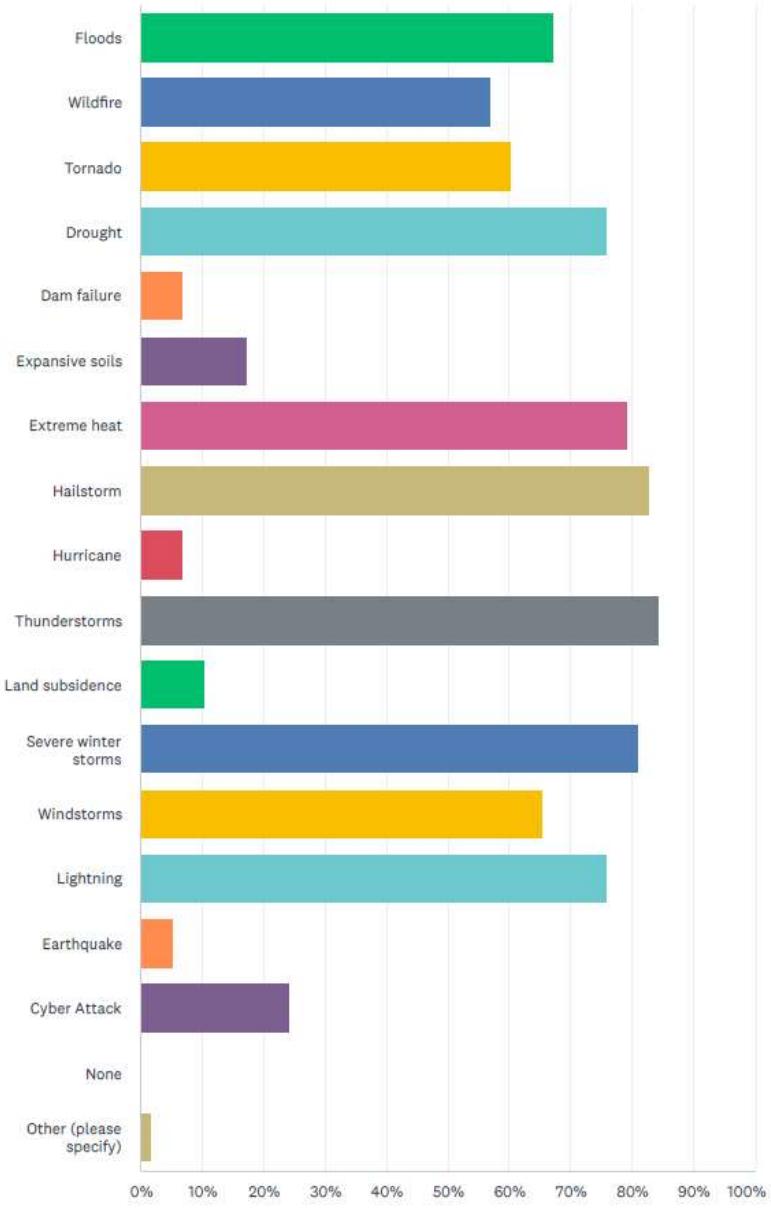
Total Respondents: 58

Q5

Customize Save as

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

Answered: 58 Skipped: 0



ANSWER CHOICES	RESPONSES	
Floods	67.24%	39
Wildfire	56.90%	33
Tornado	60.34%	35
Drought	75.86%	44
Dam failure	6.90%	4
Expansive soils	17.24%	10
Extreme heat	79.31%	46
Hailstorm	82.76%	48
Hurricane	6.90%	4
Thunderstorms	84.48%	49
Land subsidence	10.34%	6
Severe winter storms	81.03%	47

Total Respondents: 58

ANSWER CHOICES		RESPONSES	
Windstorms		65.52%	38
Lightning		75.86%	44
Earthquake		5.17%	3
Cyber Attack		24.14%	14
None		0.00%	0
Other (please specify)	Responses	1.72%	1

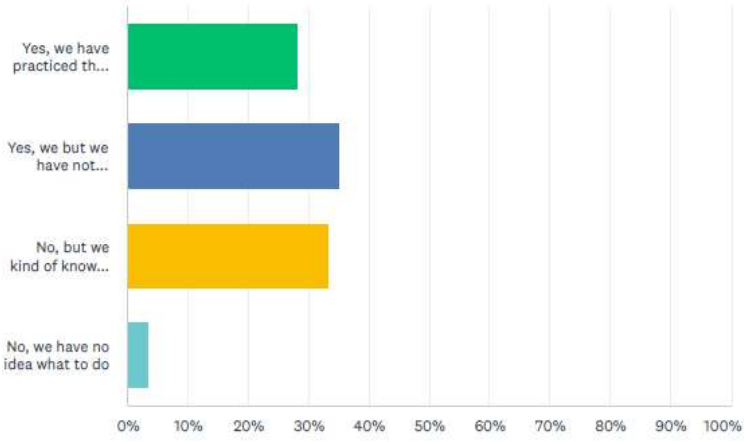
Total Respondents: 58

Q6

Customize Save as

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

Answered: 57 Skipped: 1



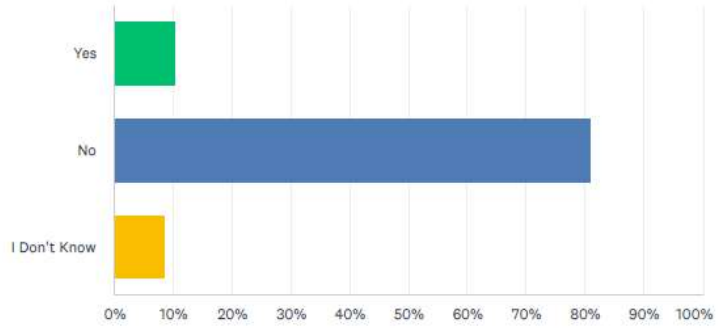
ANSWER CHOICES	RESPONSES	
Yes, we have practiced the plan	28.07%	16
Yes, we but we have not practiced the plan	35.09%	20
No, but we kind of know what to do	33.33%	19
No, we have no idea what to do	3.51%	2
TOTAL		**57**

Q7

Customize Save as

Is your home located in a floodplain?

Answered: 58 Skipped: 0



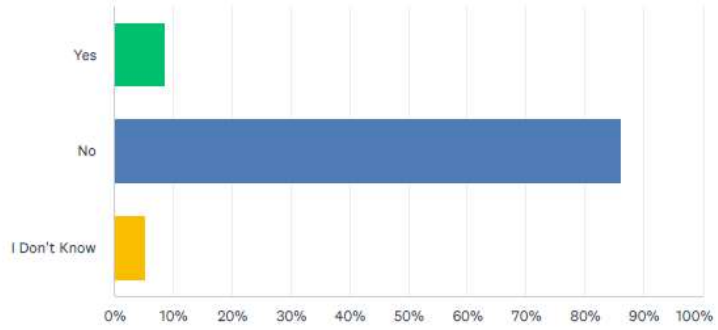
ANSWER CHOICES	RESPONSES	
Yes	10.34%	6
No	81.03%	47
I Don't Know	8.62%	5
TOTAL		58

Q8

Customize Save as

Do you have flood insurance?

Answered: 58 Skipped: 0



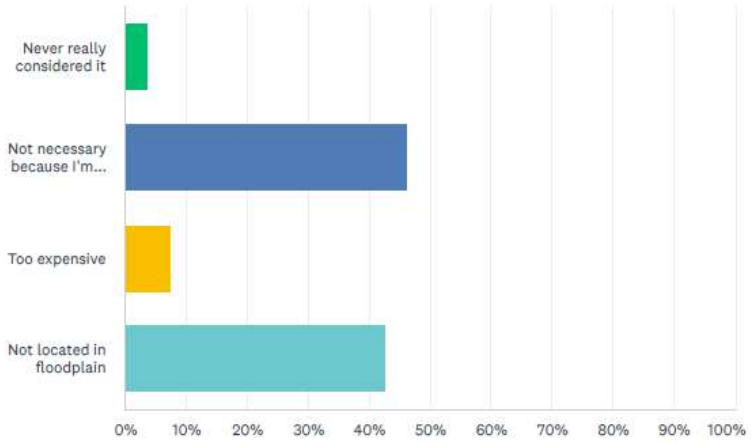
ANSWER CHOICES	RESPONSES	
Yes	8.62%	5
No	86.21%	50
I Don't Know	5.17%	3
TOTAL		58

Q9

Customize Save as

If you do not have flood insurance, why not?

Answered: 54 Skipped: 4



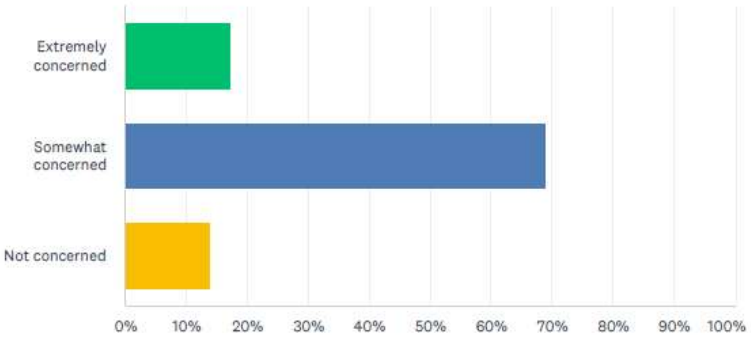
ANSWER CHOICES	RESPONSES	
Never really considered it	3.70%	2
Not necessary because I'm elevated or otherwise protected	46.30%	25
Too expensive	7.41%	4
Not located in floodplain	42.59%	23
TOTAL		54

Q10

Customize Save as

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

Answered: 58 Skipped: 0



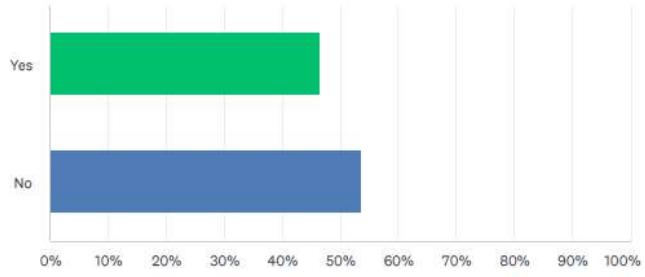
ANSWER CHOICES	RESPONSES	
Extremely concerned	17.24%	10
Somewhat concerned	68.97%	40
Not concerned	13.79%	8
TOTAL		58

Q11

Customize Save as

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

Answered: 56 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	46.43%	26
No	53.57%	30
TOTAL		56

Q12

Save as

If "Yes", please described the action you have taken:

Answered: 30 Skipped: 28

RESPONSES (30) WORD CLOUD TAGS (0) Sentiments: OFF

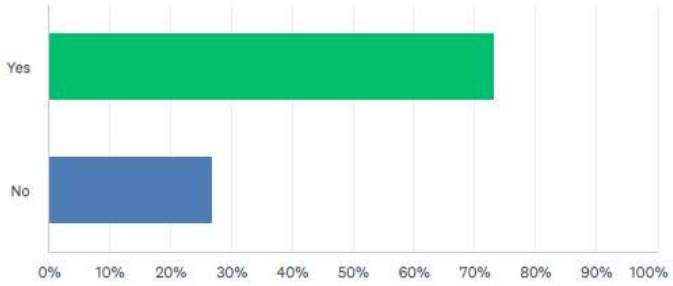
#	RESPONSES	DATE
1	research and making a plan.	7/1/2023 8:18 PM
2	Replaced exterior of house with concrete composite, upgraded metal roof, cut down certain trees close to house, installed rain water system for outdoor watering.	6/17/2023 1:30 PM
3	Cleared dead vegetation from a large area around all structures.	6/8/2023 6:47 PM
4	We have insulated our home from severe heat and cold.	6/1/2023 8:45 PM
5	n/a	5/30/2023 5:33 PM
6	We try to keep brush away from the house and water our property as much as we are allowed, to keep down drought and fire risks.	5/25/2023 7:21 PM
7	Winter proof home. Insulation	5/24/2023 7:33 PM
8	We have created "bug in" and "bug out" bins so we have light, water, food, clothing, tools and equipment in case a disaster strikes.	5/24/2023 3:11 PM
9	Keeping trees that threaten my structures trimmed as necessary	5/24/2023 3:10 PM
10	Im not take action	5/24/2023 2:45 PM
11	Cut high grass and limbs away from our property.	5/24/2023 1:35 PM
12	NA	5/24/2023 9:03 AM
13	Avery well constructed house. Good roof. And great insurance.	5/24/2023 8:18 AM
14	Maintain flood insurance,	5/24/2023 6:55 AM
15	Clear combustible material from around the house.	5/23/2023 11:23 PM
16	Brush cleared, personal training in CERT, staying informed of hazardous situations	5/23/2023 8:45 PM
17	1. Secured external structures, reduced internal obstacles & 'clutter,' monitor local weather forecasts & alerts, keep a 'bug-out' bag stocked and up-to-date.	5/23/2023 5:33 PM
18	Additional supplies on hand, clearing trees away from structures, acquired a 4-wheel drive vehicle.	5/23/2023 5:04 PM
19	Long-term food storage, solar panels, back up generator and the ability to purify water.	5/23/2023 4:39 PM
20	'safe room" reinforced in middle of house for storms and metal door.	5/23/2023 3:52 PM
21	Installed lightning rods and hurricane straps. Also have fire extinguishers available.	5/23/2023 3:00 PM
22	Removed flammable items (tree limbs, brush, etc.) from close to the house	5/23/2023 2:11 PM
23	Prepare for wildfire threat.	5/23/2023 12:33 PM
24	We have total solar in case of power outages and we have water storeage	5/23/2023 12:18 PM
25	keep trees trimmed, enhance drainage for high-rain events	5/23/2023 11:24 AM
26	NA	5/23/2023 10:01 AM
27	Metal roof after a major damaging hailstorm	5/23/2023 9:49 AM
28	Follwing fire-wise plan, cleared brush around house, keep trees trimmed, etc.	5/23/2023 9:48 AM
29	N/A	5/23/2023 9:29 AM
30	n/a	5/23/2023 8:31 AM

Q13

Customize Save as

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

Answered: 56 Skipped: 2



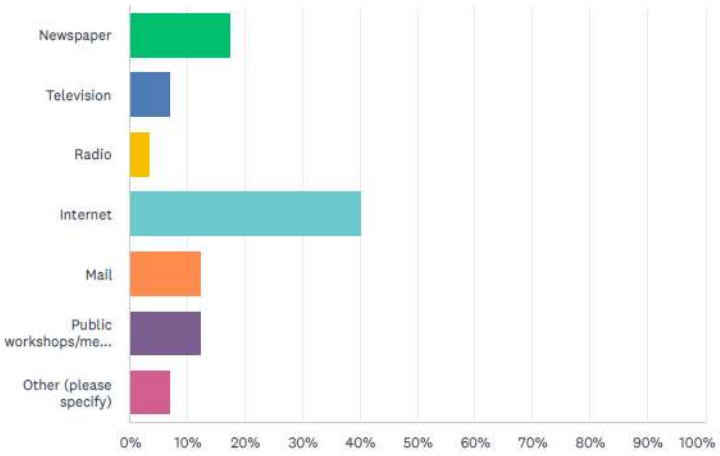
ANSWER CHOICES	RESPONSES	
Yes	73.21%	41
No	26.79%	15
TOTAL		56

Q14

Customize Save as

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: 57 Skipped: 1



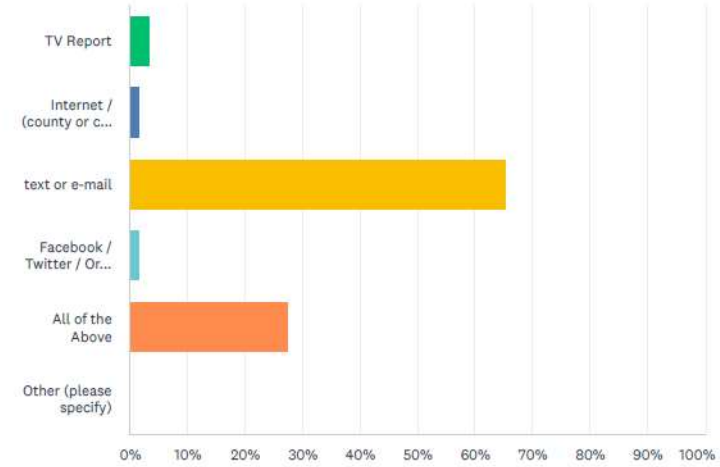
ANSWER CHOICES		RESPONSES	
Newspaper		17.54%	10
Television		7.02%	4
Radio		3.51%	2
Internet		40.35%	23
Mail		12.28%	7
Public workshops/meetings		12.28%	7
Other (please specify)	Responses	7.02%	4
TOTAL			57

Q15

Customize Save as

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

Answered: 58 Skipped: 0



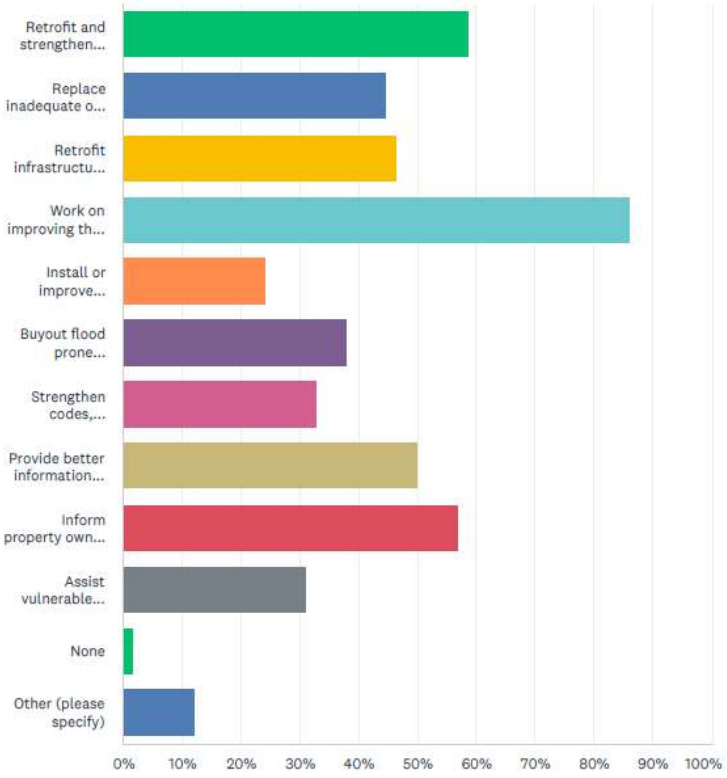
ANSWER CHOICES		RESPONSES	
TV Report		3.45%	2
Internet / (county or city website)		1.72%	1
text or e-mail		65.52%	38
Facebook / Twitter / Or other social media		1.72%	1
All of the Above		27.59%	16
Other (please specify)	Responses	0.00%	0
TOTAL			58

Q16

Customize Save as

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: 58 Skipped: 0



ANSWER CHOICES	RESPONSES	
Retrofit and strengthen essential facilities such as police, fire, emergency medical services, hospitals, schools, etc.	58.62%	34
Replace inadequate or vulnerable bridges and roads.	44.83%	26

Total Respondents: 58

ANSWER CHOICES		RESPONSES	
Retrofit infrastructure, such as elevating roadways and improving drainage systems.		46.55%	27
Work on improving the damage resistance of utilities (electricity, communications, water / wastewater facilities, etc.).		86.21%	50
Install or improve protective structures, such as floodwalls and levees or individual/community saferooms.		24.14%	14
Buyout flood prone properties and maintain as open-space.		37.93%	22
Strengthen codes, ordinances, and plans to require higher hazard risk management standards.		32.76%	19
Provide better information about hazard risk and high-hazard areas.		50.00%	29
Inform property owners of ways they can mitigate damage to their properties.		56.90%	33
Assist vulnerable property owners with securing funding to mitigate impacts to their property(s).		31.03%	18
None		1.72%	1
Other (please specify)	Responses	12.07%	7

Total Respondents: 58

Q17

Save as

Are there any other issues regarding the reduction of risk and loss associated with hazards or disasters in the community that you think are important?

Answered: 27 Skipped: 31

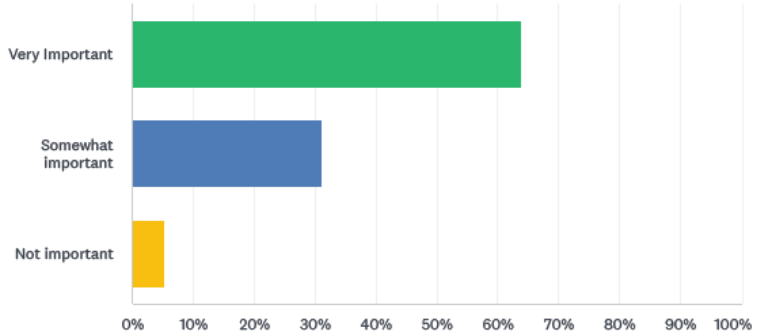
RESPONSES (27) WORD CLOUD TAGS (0) Sentiments: OFF

#	RESPONSES	DATE
1	don't raise taxes	7/1/2023 8:18 PM
2	Ins and outs for travel to or from the city in regards to traffic mobility.	6/8/2023 6:47 PM
3	Not at this time	6/1/2023 8:45 PM
4	n/a	5/30/2023 5:33 PM
5	Enforce various existing requirements such as floodplain limitations, wildfire hazards, drainage, water supply	5/30/2023 2:25 PM
6	No	5/26/2023 6:44 PM
7	The combination of explosive growth and housing developments, paired with climate change, is really putting the whole area at grave risk of 1) running out of water and 2) wildfires.	5/25/2023 7:21 PM
8	No	5/24/2023 9:44 PM
9	NO	5/24/2023 7:33 PM
10	Marble Falls needs a "bypass" to move heavy traffic off of US 281, and provide a "Hazardous Cargo" route to bypass the city	5/24/2023 3:10 PM
11	No	5/24/2023 2:45 PM
12	No	5/24/2023 1:35 PM
13	homes built under previous codes are not well suited for random sever cold IE pipes not properly insulated and not cutoff valve to vulnerable areas	5/24/2023 9:39 AM
14	I think we need a warming center for our homeless and people without power in the winter and a cooling center during extreme heat days. It's sad what the less fortunate have to live through and the lack of support from our city.	5/24/2023 9:03 AM
15	I think the city is in pretty good shape. I think this is a plan being used as an excuse to raise taxes which would probably not even be spent on "hazard" protection. We have already built new bridges(one of the things on your list. I think hazard protection is already in place. What is at stake is over regulation by power hungry politicians.	5/24/2023 8:18 AM
16	More citizen training, increase awareness of threats and responses	5/23/2023 8:45 PM
17	There are a number of civic organizations willing to help with manpower, material, logistics, etc. Identify 'volunteer' organizations and develop a combined disaster response plan to include their participation.	5/23/2023 5:33 PM
18	The continuity of information in a grid-down situation. For example, area local information centers such as schools, churches, or businesses willing to open their doors. These information centers should all be connected via radio transmitters, and receivers to the established command Information center.	5/23/2023 4:39 PM
19	Praises to the Highland Lakes Crisis center. Public areas need to be ready to assist when needed. Praises also to United Methodist and First Baptist churches for stepping up to help for any need.	5/23/2023 3:52 PM
20	Consider conducting drills involving the community.	5/23/2023 3:00 PM
21	Creating FireWise neighborhoods	5/23/2023 12:33 PM

22	flooding	5/23/2023 12:18 PM
23	NA	5/23/2023 10:01 AM
24	No	5/23/2023 9:49 AM
25	Not that I know of.	5/23/2023 9:48 AM
26	Drainage on old roadways worry me	5/23/2023 9:29 AM
27	n/a	5/23/2023 8:31 AM

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: 58 Skipped: 0



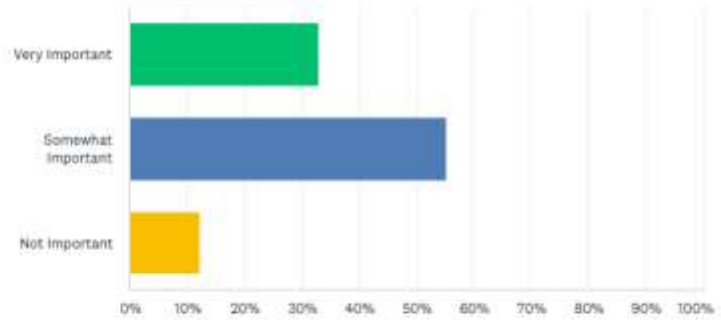
ANSWER CHOICES	RESPONSES	
Very Important	63.79%	37
Somewhat important	31.03%	18
Not important	5.17%	3
TOTAL		58

Q19

Customize Save as

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: 58 Skipped: 0



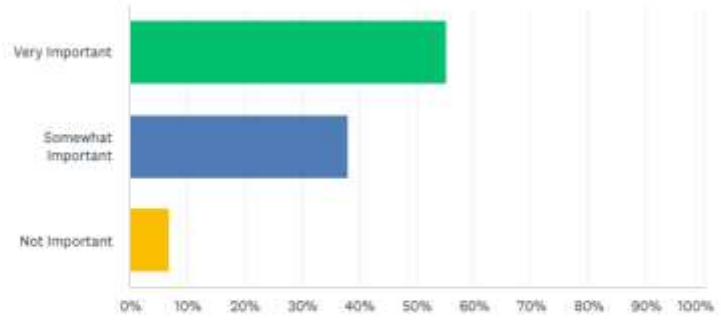
ANSWER CHOICES	RESPONSES	
Very Important	32.76%	19
Somewhat Important	55.17%	32
Not Important	12.07%	7
TOTAL		58

Q20

Customize Save as

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.

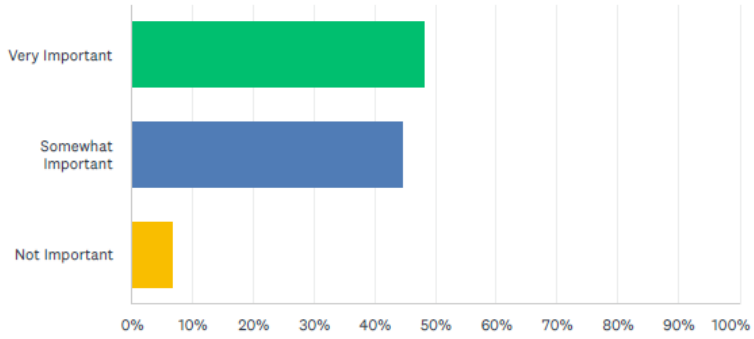
Answered: 58 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very Important	55.17%	32
Somewhat Important	37.93%	22
Not Important	6.90%	4
TOTAL		58

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: 58 Skipped: 0



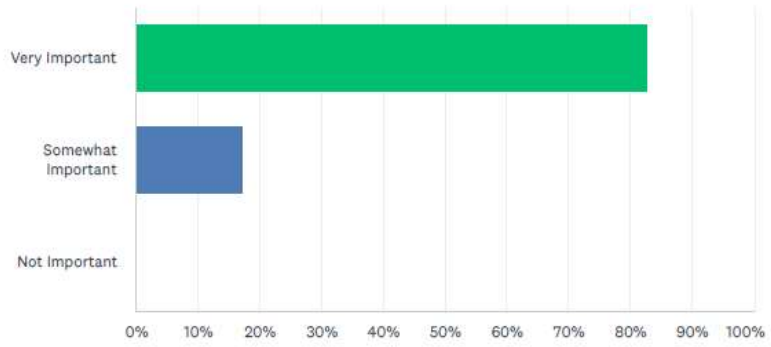
ANSWER CHOICES	RESPONSES	
Very Important	48.28%	28
Somewhat Important	44.83%	26
Not Important	6.90%	4
TOTAL		58

Q22

Customize Save as

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: 58 Skipped: 0



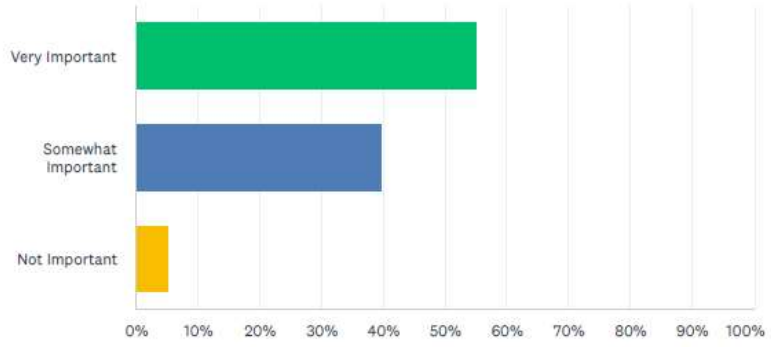
ANSWER CHOICES	RESPONSES	
Very Important	82.76%	48
Somewhat Important	17.24%	10
Not Important	0.00%	0
TOTAL		58

23

Customize Save as

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.

nswered: 58 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very Important	55.17%	32
Somewhat Important	39.66%	23
Not Important	5.17%	3
TOTAL		58

APPENDIX C: PRIORITY RANKING FORMS

City of Marble Falls

Marble Falls Hazard Mitigation Plan
Prioritization Exercise

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	Creek and crossing clearing projects	5	5	4	4	5	5	3			31	I	2
2	Public education for homeowners on hazard mitigation	5	3	2	3	5	3	5			26	S	17
3	Develop new resident relocation packets that include how to stay informed in event of an emergency	4	3	4	4	5	4	5			29	S	10
4	Backhoe Tributary Bypass	2	4	1	2	4	2	4			19	L	34
5	Whitman Branch Bypass	3	4	1	2	4	4	4			22	L	27
6	Old Alert Emergency radio advocacy system	4	3	2	2	4	4	5			24	S	19
7	Wildfire Prevention Education	5	4	3	4	5	4	5			30	S	8
8	Build bridge at Mission 13th Street Creek Crossing	4	5	1	4	5	4	4			27	L	14
9	Buyout residential and commercial property	4	4	3	4	4	4	4			27	L	15
10	Install computer-based flood warning system with sensor flashers and remote automatic gates, where applicable	5	4	4	4	5	3	4			29	S	11
11	Support Burnet County CLRT	2	2	3	3	4	2	5			21	I	20
12	Relocate Wastewater Treatment Plant out of Floodplain	4	5	5	5	5	5	4			33	I	12
13	Raise primary water intake system control and pumps out of floodplain	5	4	5	4	5	4	4			31	I	3
14	Raising of emergency water intake pumps	5	4	5	4	5	4	5			32	I	4
15	Relocate animal control facility out of floodplain	4	5	1	1	4	4	4			23	L	22
16	Build a bridge at 2nd St at Westside Park	4	4	1	1	5	4	4			23	L	23

Marble Falls Hazard Mitigation Plan
Prioritization Exercise

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	Build a bridge at Broadway St between Ave N & Ave L (at Whitman Branch)	4	4	1	1	4	3	4			21	L	30
18	Build a bridge at Ave N & Backhoe Creek	5	4	4	5	5	4	4			31	N	5
19	Build a bridge at Horace Heights & Whitman and Hwy 281	5	4	4	5	5	4	4			31	N	6
20	Install a generator at the Middle School Shelter	4	4	4	4	4	5	5			30	N	9
21	School District Pool Center Generator	4	5	4	5	4	5	5			32	N	1
22	Generator to fully power City Hall	3	3	1	1	5	3	3			19	L	35
23	Emergency generator for EMS Station	5	4	1	3	3	4	4			24	N	21
24	Backup water and wastewater service to southside of Lake Marble Falls	4	4	3	5	4	5	4			29	L	13
25	Mobile flood control devices used to protect lift stations from floodwaters	3	3	1	2	5	4	5			23	L	24
26	Install emergency generators to all Areas fire stations	5	5	4	4	5	4	4			31	S	7
27	Update Community Wildfire Protection Plan to address new areas	4	4	3	3	5	3	3			25	S	18
28	Flood study for the southern part of the city	3	3	3	3	4	3	3			22	L	28
29	Elevate Ave J Bridge at Johnson Park	2	3	1	1	4	3	3			17	L	37
30	Ensure stormwater retention and remediation is designed in all new developments	3	3	1	1	3	3	4			18	L	36
31	Plant drought tolerant trees along public sidewalks, parking lots, and streets	4	2	1	2	3	2	4			20	L	32
32	Structural hardening of critical facilities	3	4	1	2	5	4	4			23	L	25
33	Create Cooldown	4	3	1	2	4	3	3			20	L	33
34	Amend City Code to include tree dedication requirements	4	3	1	3	4	3	3			21	S	31

Marble Falls Hazard Mitigation Plan
Prioritization Exercise

#	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	
15	Interactive wayfinding signage program	4	3	3	3	4	1	1			22	5	29
16	Create a city position for a full time public information officer	3	3	2	3	4	3	5			23	5	28
17	Update Emergency Preparedness website	4	4	3	4	5	2	1			27	N	16

APPENDIX D: CRITICAL FACILITIES

The list and location of critical and vulnerable facilities will be kept and maintained by the Emergency Management Coordinators for Marble Falls. 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.

City of Marble Falls
5 Assisted Living Centers, 1 Church Shelter, 1 City Hall, 1 EMS, 4 Daycares, 1 Emergency Operations Center (EOC), 1 Fire Station, 1 Hospital, 12 Lift Stations, 3 Medical Care, 1 Post Office, 1 Police Headquarters, 1 Public Works, 1 Constables Office, 8 Schools, 1 MFISD Bus Storage, 1 VFD 1 Electric Substation, 1 Booster Station, 3 Grinder Pumps, 5 Water Pump Stations, 1 Raw Water Pump, 2 WW Raw Water Farms, 1 Water Treatment Plant, 1 Wastewater Treatment Plant, 7 Water Towers/Water Storage

APPENDIX E: MEETING DOCUMENTATION

Plan Kickoff Press Release:

Hazard Mitigation Plan Update for The City of Marble Falls

Mayor Westerman explained that the plan will offer practical actions that the City of Marble Falls can take to reduce long-term risk to the community from natural hazards and disasters.

According to FEMA, "Mitigation is an investment in the community's future safety and sustainability. Its critical importance includes protecting public safety and preventing loss of life, reduces harm to existing and future development and aids to prevent damage to a community's unique economic, culture and environmental assets." The possible effects of a natural disaster could become entwined in every aspect of the community with devastating consequences in its economic, social and environmental well-being.

Planning Consultant Gabe Rojas, Rojas Planning LLC, who will assist the city with development of the plan, said the hazard mitigation planning process will be conducted based on FEMA's standards and guidance. "The hazard mitigation focus for FEMA is looking at a broad set of threats and how those pair with community capabilities as well as vulnerabilities. We will be looking at everything from flood events to hurricanes and tropical storms, severe storms, tornados, hail, lightning, drought, wildfire, extreme heat and winter storms," Rojas said.

The plan includes a CORE Planning team composed of key City of Marble Falls staff and officials to develop specific mitigation strategies unique to the community. Once the Core team begins to meet, Rojas said that an on-line community survey would be conducted to understand top concerns, along with several public hearings. The survey will also be accessible in public facilities such as the library and city hall.

The CORE local planning team will be reviewing the community capabilities, conducting a risk assessment and identifying mitigation goals and actions, while gaining public input through public hearings. Once the plan is completed, a final public hearing will be held to present the completed plan and receive feedback. The plan will be submitted for FEMA's final approval and will then be adopted by the City of Marble Falls. Once adopted, the City is eligible for FEMA funds to help implement those action items within the plan.

Mayor Westermann says the city council's hope is that residents will become engaged, offer feedback about the plan and consider what their households would do in a wildfire, tornado or other emergency situation. This planning and public input process will help guide the city on what mitigate actions to take and how best to prioritize those actions before the next hazard.

"This is an opportunity for open and honest dialogue," Rojas said. "Maybe it's something that sparks a conversation within a household or within a neighborhood association or business area to work through what their response is to certain hazard events knowing that other actions are being taken by the city and the county."

Core Meeting #1 Sign-in sheet:

Please Sign In

Name	Representing	Email	Phone
Sarah Garcia	Engineering Dept.	sgarcia@marblefallstx.gov	512.755.9068
MIKE IVGALSBE	DSM. SERVICES	MIVGALSBE@MARBLEFALLSTX.GOV	830-798-0787
Thomas Cone	MFFR	tcone@marblefalls.tx.gov	512-693-4048
Russell Sander	MARBLE Falls Fire	rsander@marblefallstx.gov	830-669-7644
Chris Allen	MFISD	callen@mfisd.txed.net	512-365-2577
TESSA PATTIFF	MFPD	tpattiff@marblefallstx.gov	830-385-4595
GLENN HANSON	MFPD	ghanson@marblefallstx.gov	512-299-1276
Lynnette Courmey	City of MF - Emergency Mgmt	lcourmey@marblefallstx.gov	830-220-7344
Jay Everett	CMF Public Works	jeverett@marblefallstx.gov	512-755-9711
Johnny Campbell	Marble Falls Area EMS	jcampbell@mfems.org	830-613-8471
Starla McLaurin	Marble Falls Area EMS	smclaurin@mfems.org	325-217-6690
Lacey Dingman	City of MF - Parks & Rec	ldingman@marblefallstx.gov	830 613-8471
Mike Hodge	C.O. MF	mhodge@marblefallstx.gov	830 320-1594
Martin Feurt	Development Services	Mfeurt@marblefallstx.gov	830-798-7080

Core Meeting #1 Presentation:

CITY OF MARBLE FALLS HAZARD MITIGATION PLAN UPDATE

Kickoff Meeting

Fire Station, 700 Avenue N Marble Falls TX 78654
Thursday, October 20, 2022, 2:00pm -3:30pm

Today's Agenda

- Introductions
- Overview of the Hazard Mitigation Planning Process
- Review of goals and objectives from the prior plan
- Actions completed from the prior plan
- Hazards review from the prior plan
- Community Capabilities Survey
- Next Steps
- Adjourn

Overview of the Planning Process

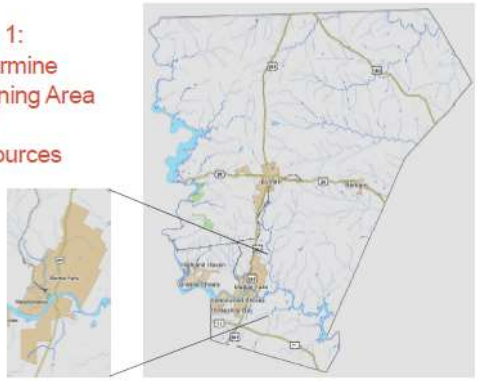
- What do we want to achieve?
  - Identify cost effective actions for risk reduction that are agreed upon by stakeholders and the public
  - Focus resources on the greatest risks and vulnerabilities
  - Build partnerships by involving people, organizations, and businesses
  - Increase education and awareness of hazards and risk
  - Communicate priorities to state and federal officials
  - Align risk reduction with other community objectives

Hazard mitigation plans are the blueprint for mitigation and resilience, and guide mitigation investments using a wide range of resources.

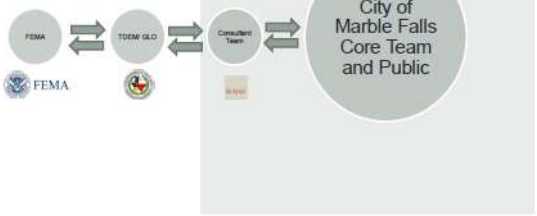
Mitigation Planning Process

Disasters don't care about political boundaries!

Step 1: Determine Planning Area and Resources



Step 2: Build the Planning Team



Roles and Responsibilities of the CORE Team

- Coordinate and facilitate local efforts.
- Attend meetings.
- Provide information and feedback.
- Involve the public and community stakeholders in the planning process.
- Assess mitigation alternatives.
- Select a course of action to be followed for their communities.
- Adopt the plan.
- Implement the plan and monitor its progress.

"If you don't actively attack your risks, your risks will actively attack you."

Guiding Principle

To reduce or eliminate the long-term risks to loss of life and property damage in the City of Marble Falls from the full range of natural disasters.

Hazard Mitigation: Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. (44 CFR §201.2)

Hazard Mitigation Planning: A coordinated process used by state, local, tribal and territorial governments to identify their risks and vulnerabilities associated with natural disasters and to develop and implement strategies to reduce or eliminate long-term risk.

Goals and Objectives

Goal 1: Protect public health and safety.
- **Objective 1.1:** Advise the public about health and safety precautions to guard against injury and loss of life from hazards.
- **Objective 1.2:** Maximize the utilization of the latest technology to provide adequate warning, communication, and mitigation of hazard events.
- **Objective 1.3:** Reduce the damage to, and enhance protection of, dangerous areas during hazard events.
- **Objective 1.4:** Protect critical facilities and services.

Goal 2: Protect existing and new properties.
- **Objective 2.1:** Reduce repetitive losses to the National Flood Insurance Program.
- **Objective 2.2:** Use the most cost-effective approaches to protect existing buildings and public infrastructure from hazards.
- **Objective 2.3:** Enact and enforce regulatory measures to ensure that development will not put people in harm's way or increase threats to existing properties.

Goal 3: Increase public understanding, support, and demand for hazard mitigation.
- **Objective 3.1:** Heighten public awareness of the full range of natural hazards they face.
- **Objective 3.2:** Educate the public on actions they can take to prevent or reduce the loss of life or property from natural hazards.
- **Objective 3.3:** Publicize and encourage the adoption of appropriate hazard mitigation measures.

Goals and Objectives Cont.

Goal 4: Build and support local capacity and commitment to continuously become less vulnerable to hazards.
- **Objective 4.1:** Build and support local partnerships to continuously become less vulnerable to hazards.
- **Objective 4.2:** Build hazard mitigation concerns into planning and budgeting processes.

Goal 5: Promote growth in a sustainable manner.
- **Objective 5.1:** Incorporate hazard mitigation into the long-range planning and development activities.
- **Objective 5.2:** Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities
- **Objective 5.3:** Utilize regulatory approaches to prevent creation of future hazards to life and property.

Goal 6: Maximize the resources for investment in hazard mitigation.
- **Objective 6.1:** Maximize the use of outside sources of funding.
- **Objective 6.2:** Maximize participation of property owners in protecting their properties.
- **Objective 6.3:** Prioritize mitigation projects, based on cost-effectiveness and starting with those sites facing the greatest threat to life, health, and property.

Mitigations Actions Review

TABLE 19-2.
RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in months	Benefit
[illegible]	Provide education for the subdivisions regarding flood/fire procedures and the Turn Around Don't Drown Program	Provide education for flood/fire evacuation procedures and the Turn Around Don't Drown Program.	[illegible]	EAP	G1, G3	Mayor	< $10,000	General Revenue	24	High
[illegible]	Promote purchasing flood insurance through NFIP	Provide education for NFIP presence at City Hall	[illegible]	EAP	[illegible]	Floodplain Coordinator	< $10,000	General Revenue	12	Medium
CITY OF MARBLE FALLS										
1	Creek and Drainage Clearing Project	This project will remove trees and other vegetation, along with any debris, along the floodway and culvert crossings to increase conveyance.	[illegible]	[illegible]	G1, G4	Public Works	>$100,000	Grants, City resources	[illegible]	High
2	Public education for homeowners to mitigate their homes from hazards and emergency preparedness kits.	Educate homeowners about mitigating [illegible] their homes and empower residents about the importance of having an emergency preparedness kit. Use the Ready.gov website as a resource.	[illegible]	EAP	G1	Emergency Management	< $10,000	City funds	60	Medium
3	Install hail resistant roofing and window coverings	Install hail resistant roofing and window coverings on existing city buildings.	[illegible]	SIP	G2	Building Department	>$100,000	[illegible] Insurance Companies	60	Low

Mitigation Actions Review

TABLE 19-2.
RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in months	Benefit
4	Backbone Tributary Bypass	This project is construction of [illegible] culverts along the south side of FM 1431 [illegible] to Backbone Creek to increase water capacity and minimize flooding.	[illegible]	SIP NSP	G1, G2, [illegible]	Public Works	>$100,000	Grants, City resources	36	High
5	Whitman Branch Bypass	This project is installing a 50-feet wide by 5-feet deep bypass channel to the east along Oak Ridge Drive Creek to increase water capacity and minimize flooding.	[illegible]	SIP NSP	G1, G2, G4	Public Works	>$100,000	Grants, City resources	36	High
6	Purchase NOAA All Hazard Radios	Purchase NOAA All Hazard Radios to distribute to residents.	12	SIP	G1	Emergency Management	< $10,000	City funds	[illegible]	Medium
7	Install an Alert AM Emergency Advisory Radio System	The city would operate Alert AM Emergency Advisory Radio Station to tell citizens and visitors what to do during incidents that threaten life and property.	8	LPR EAP	G1, G3	Fire Department	$10,000 to $100,000	Grants	24	Medium
8	Create defensible space	Create defensible space around structures and prevent fires from advancing and endangering homes and lives. Work through the five steps of Firewise recognition until complete.	[illegible]	LPR EAP	G1, G2, G3, G4	Fire Department	< $10,000	Grants, City resources	36	High
9	Build bridge at Mission Hills Street creek crossing	Build bridge at Mission Hill's Street creek crossing to alleviate the road being closed from flash flooding. It is a major east/west connection street.	[illegible]	SIP	G1	Engineering	>$100,000	Grants, City resources	36	Medium

Mitigation Actions Review

Hazards and Descriptions

Meeting Schedule

Communities Capabilities Assessment

- Review 2016 capabilities assessment from prior plan.
  - What has changed?
- Update current community capabilities.
  1. Planning and Regulatory - Planning and regulatory capabilities are based on the implementation of ordinances, policies, local laws and State statutes, and plans and programs that relate to guiding and managing growth and development.
  2. Administrative and Technical - This refers to staff, skills, and tools a community has. Provide staff numbers and any credentials or certificate trainings in reference to hazard mitigation.
  3. Financial - Resources that a jurisdiction has access to or is eligible to use to fund mitigation efforts.
  4. Education and Outreach - Programs and methods already in place that could be used to implement mitigation activities.

Next Steps…Risk Assessment

Basemap Review

- Critical Facilities
  - Critical Infrastructure (Utilities, Roads)
  - Police Station
  - Fire Station
  - EMS
- At-Risk Populations
  - Nursing Homes
  - Daycares
  - Schools
  - Hospitals
  - Prisons
- Assets
  - Public buildings central to continued governance
  - Major Employers
  - Veterinary clinics
  - Cultural and Historic Buildings and Sites

- Problem Areas
  - Low Water Crossings
  - Areas with high tornadic activity
  - Areas with high wildfire activity

Other Useful Information:
- GIS files of hazard events, problem areas, critical facilities
- NFIP information from floodplain administrator
- Code updates or other planning processes since the last hazard plan that seek to reduce the risk of hazards


Educates people about hazards and risk
Incorporates different perspectives
Improves plan quality
Ensures transparency and builds trust
Improves opportunities for implementation by building consensus
Strengthens community disaster resilience
Benefits of Public Involvement
Types of Stakeholders
Elected Officials and Planning Commission Members
Business Leaders and Large Employers
Regional, State, and Federal Agencies
Cultural Institutions
Schools and Universities
Non-Profit Organizations
Neighborhood Groups
Community events
Interviews
News media
Presentations to governing bodies
Questionnaires/ Surveys
Roundtable/ Forums
Outreach Methods


Outreach Strategy
"Must include opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as business, academia, and other private and non-profit interests."
Brainstorm outreach activities
How best to reach different groups of citizens and stakeholders (newspaper, radio, public media)
Determine objectives and schedule
Primarily geared toward stakeholders and the public
Determine the input needed and when it is needed. (mapping, capability review, risk assessment, mitigation strategy)
Identify appropriate outreach methods
Align with community values
Press release template sent out
Surveys - Stack of surveys (schools, churches, city hall), Newspaper, electric bill, Survey Monkey (Online)
Public and Sub-Jurisdictional Meetings


How to stay in touch
Rojas Planning
Gabe Rojas
(512) 468-4455
grcity@gmail.com
ROJAS

Survey Press Release:

Marble Falls seeks input on disasters, response

05/23/23 | DailyTrib.com (https://www.dailytrib.com/author/wendiw/)

Downtown Marble Falls after Winter Storm Uri in February 2021. The storm caused major electrical outages, frozen pipes, and other complications. The city of Marble Falls is seeking input through a survey on the impact of natural and manmade disasters. The collected information will be used to update its Hazard Mitigation Plan. Photo courtesy of Lee Ann Clark

Marble Falls residents have until July 11 to participate in an online survey (https://www.surveymonkey.com/r/mfhazard) regarding how the city should handle natural and manmade disasters. The city will use the information to update its Hazard Mitigation Plan later this year.

Paper copies of the survey are available at city offices and during meetings.

The survey takes about 5-10 minutes to complete and includes questions on how natural hazards impact residents' lives, property, and the community as a whole. The survey focuses on natural and manmade disasters that can or have happened in the city.

Among the hazards mentioned are thunderstorms, floods, tornados, extreme heat, drought, wildfires, winter storms, dam failure, and cyber attacks.

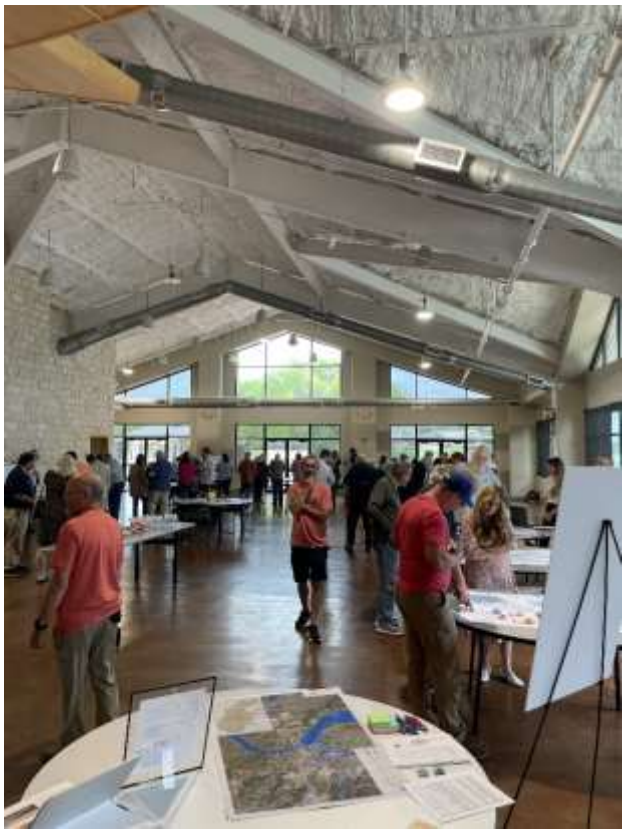
Survey data will be analyzed, summarized, and presented in the final plan, which should be posted to the city of Marble Falls website (https://marblefallstx.gov/) by late August 2023.

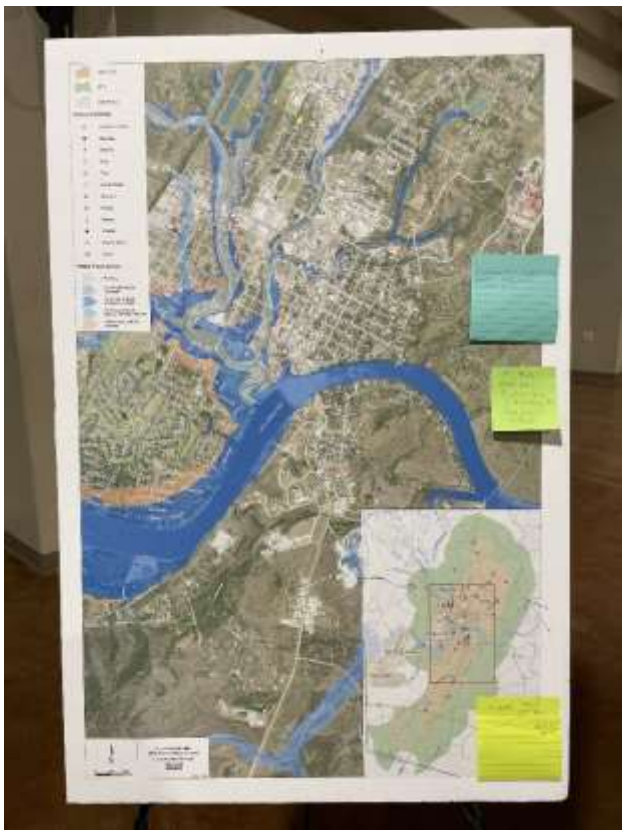
The voluntary and anonymous survey (https://www.surveymonkey.com/r/mfhazard) should be completed by an adult.

Residents wanting additional communications regarding the Hazard Mitigation Plan may opt in to email notifications at the end of the survey.

editor@thepicayune.com (mailto:editor@thepicayune.com)

Joint Comprehensive Plan/ HMP Open House: May 9, 202





Open House Flyer:

Core Meeting #2 Agenda: July 13, 2023

Marble Falls Hazard Mitigation Plan Update 2023
CORE Team Meeting #2
July 13, 2023
10:00am
Fire Department Training Room
700 Avenue N, Marble Falls, Texas 78654

PURPOSE: Provide shared experience, capability and problem discussion related to known hazards, natural and man-made, drawing from the broader community's expertise and observation, in order to develop appropriate hazard mitigation actions.

- Attendance Noted

- Review/Discuss Public Inolvement
  - Online citizen survey results
  - Public input from open house

- Hazard Risk Assessment
  - Review materials and risk assessments provided
  - Note data gaps – places where we need more information
  - Synthesis/Major oberservations

- Mitigation Actions
  - Review past mitigation actions and progress
  - Review mitigation actions goals
  - Discuss mitigation action worksheets/homework for next jurisdictional sub-team meeting

- Other items

APPENDIX F: ADOPTION RESOLUTION